ROOT CROP/OIL PALM FARMING SYSTEMS
A CASE STUDY FROM EASTERN NIGERIA

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1. Introduction

Technical, environmental, biological and socio-economic data related to farmers and farming systems in the humid tropics of Nigeria are scarce. This limited knowledge of the problems faced by farmers, facts related to their resource base, production relationships and constraints often result in research, policy and planning decisions being based on feelings rather than facts [Stopler, 1966]. Thus, IITA, like other institutions in Nigeria (notably the Ahmadu Bello University and the University of Ibadan) have been and continue to undertake detailed studies of farmers and farming systems in various ecological zones of the nation.

One such study undertaken by the Institute is the Root Crop/Oil Palm Farming Systems survey nearing completion in the East Central State. This particular area was chosen for study as its soils and climate are typical of large areas of the lowland humid tropics and has one of the highest population densities in rural, tropical Africa. The objective of the research was to quantify characteristics and where possible, changes in:

(a) farming systems, resource use and production;

(b) the productivity of land and labor;

(c) soil properties and plant climaxes, and

(d) social and institutional organisation

in response to increasing population pressure and intensity of use of agricultural

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land. The study is cooperative between the agronomy, economics and pedology Sub-Programs of the Farming Systems Program of IITA.

The purpose of this paper is to describe the environment and a typical farm operation in Umuokile ($5^{o}28'N$, $7^{o}11'E$) in Mbaise Division of East Central State. Of three villages studied, Umuokile was the village of "medium" population density.[1]

2. The Study Area

2.1 Climate

Weather records are not available for Umuokile or, for that matter, from other towns in Mbaise Division. The weather data reported in Figure 1 are those for Owerri some 15 km west and Umudike, some 30 km east of Umuokile. By interpolation, the mean annual rainfall in Umuokile was determined to be in the order of 2,300 mm with peaks in July and September with the so-called "August break" in between. Mean daily maximum temperatures determined in the same manner would be highest in January-February (33^{o} to 34^{o}) and lowest in July (28^{o}), and mean daily minimum temperatures would be lowest in January-February (20^{o} to 21^{o}) and highest in March-April (22^{o}). The relatively high maximum daily temperatures in January-February coupled with relatively low minimum daily temperatures in the same period result from the clear weather prevailing during the dry season when both day and night radiation are unhampered by cloud cover.

Estimated potential evapotranspiration figures for Umudike (based on the Thornthwaite method)[2] indicate that on the average, precipitation falls below potential evapotranspiration in the region early in November. Allowing a 10 cm buffer of soil moisture between field capacity and wilting point, results in moisture not normally limiting crop growth until late November to early December. Nevertheless, the low water holding capacity of the soils may cause drought stress

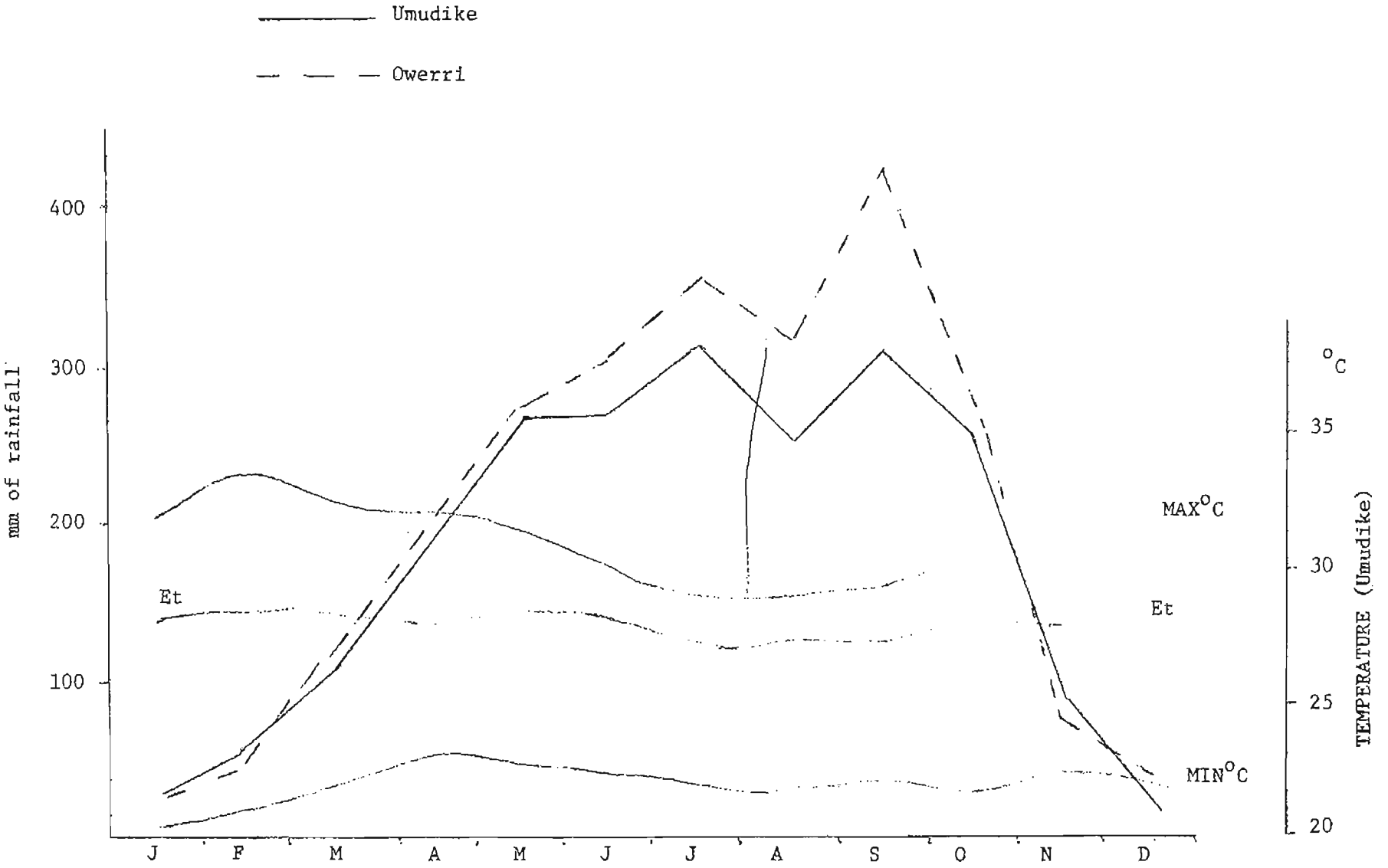


Fig. 1 Rainfall and temperature data for weather stations near Umuokile

and yield loss due to occasional rainless periods of 10 or more days, especially during the August period of lower rainfall. The dry season then lasts four to five months, with rainfall exceeding evapotranspiration again in April.

2.2 Soils

Soils in the Umuokile area are formed on deeply weathered areneceous sediments of Plio-Pleistocene age [Forbes, 1975, UITA, 1975]. These soils are remarkably homogeneous throughout the village both in relation to their physical and chemical characteristics and to their distribution in a very gently undulating plateau (terrace) landscape.

The soils are classified as Oxic Paleudults (USDA Soil Taxonomy) or as Dystric Nitosols (FAO/UNESCO legend of the World Soil map). The depth of the soil is more than two metres, and profiles may reach well over 10 metres in depth. Colors are uniformingly red below the surface soil. The textural profiles show a sandy loam surface soil and a gradual increase in clay content in the subsoil, which usually is a sandy clay loam and rarely a sandy clay (25 to 40 per cent clay). Structure is weak crumb in the surface layer and weak subangular blocky in the sub-soil. The surface structure is relatively stable, and the soils are not very erodeble. On bare land, not protected from heavy rains, the effect of heavy rains is moderate, with some separation of the clay-humus fraction from the sandy matrix under the impact of raindrops. Most lands in the area do not show appreciable erosion, but gullying takes place on field roads and in unprotected road ditches.

The soils, chemically speaking, are rather poor with a low subsoil pH, a low cation exchange capacity and low base saturation (Table 1). Most frequently, pH and base saturation are higher in the surface soil, although there is a rather strong variation in these values at the different sites. The higher pH and base saturation in the surface soil indicates circulation of bases, which are brought

to the surface layers by vegetation during fallow periods.

Table 1. Typical values of some properties of soil samples from cultivated plots in Umuokile, 1974.

Soil Properties	Depth	
	0-25 cm	25-45 cm
Texture	Sandy loam	Sandy loam
pH	5.0	4.7
Organic Matter, %	1.30	0.65
Exch. Ca, me/100g	1.63	0.35
Exch. Mg, me/100g	0.74	0.12
Exch. K me/100g	0.06	0.04
CEC, me/100g	3.30	2.67
Base Saturation, %	74	43
Available P (Bray 1), ppm	9.6	3.1

The chemical composition of surface soils in compound and distant fields[3] are listed in Table 2. For the 25 farms sampled, there was no significant difference in the level of organic carbon between compound and distant fields. The loss of organic matter -- which would be anticipated with continuous farming of the compound -- is offset by mulching and deposition of household refuse. Similarly the pH of the compound soils had not deteriorated when compared to distant fields (after a period of fallow), indeed it had slightly increased due to the import of alkaline materials (shells, bones, ash etc.). The level of Ca+Mg, K and P were significantly higher in the compound than in the distant fields due to the import of plant nutrients from non-compound fields and from beyond the farm, and a concentration of these plant nutrients in the area around the farmer's house. In summary, soils of the compound farms were found to be in a better condition than those of the distant fields, even after these soils had been rested for four years under bush fallow.

Table 2. Average values of the chemical composition of surface soils in compound and outer fields, Umuokile, 1974.

	Average values of				
	Org. C	pH	Ca + Mg	K	PP
Compound	2.06	5.06	4.93	0.30	37.26
Distant	1.95	4.75	1.66	0.05	8.10
t*	0.11	3.07	4.04	5.38	4.68

*Student t test for comparison between levels of elements within farms between compound and outer fields. For n=24, t=2.06 for P=.05

2.3 Vegetation

The natural vegetation in the study area according to Keay 1965 , falls within the Lowland Rain Forest Zone in the Moist Forest at Low Medium Altitude Zone. In this vegetation zone, the larger trees are deciduous for an appreciable period of the year while others which are mostly under-storey plants are evergreen. The forest when undisturbed attains a stratified structure consisting of three strata. The topmost structure consists of a few tree species usually over 36m in height, such as Iroko (Chlorophora excelsa) and Obeche (Triplochyton scleroxylon) which are located at widespread intervals with the crowns isolated. They are often designated as 'emergents'. The middle structure consists of a great variety of species varying in height from 16 to 36m with small laterally spreading crowns in contact with each other thus forming the upper canopy of the mature forest. The third or lowest stratum often designated as under-story consists of trees usually less than 16m in height with spreading crowns frequently bound together by lianas such as Landolphia spp. and Combretum spp. which with the many shrubs form a dense canopy.

There are few oil palms in the dense forest and where they exist are often in the form of forest outliners or are occupying gaps in the forest canopy.

Under these conditions, the climax vegetation consists of the following families:

(a) Leguminosae e.g. Cylicodiscus spp. and Cosswellerodendron spp.;

(b) Meliaceae - Khaya ivorensis and Entandrophragma spp.;

(c) Sterculaceae - e.g. Cola spp., Triplochyton spp. and Sterculia spp.;

(d) Moraceae - Fig family e.g. Chlorophora sp., Ficus spp. Treculia spp.; a

(e) Ulmaceae - Celtis spp. and Heloptelea spp.

Farming, bush clearing, firing and other human activities have reduced the forest to mainly oil palm bush with few isolated patches of woodland and secondary forest. The large trees consist of specially preserved or protected plants such as Chlorophora excelsa and Triplochyton scleroxylon. There are numerous medium-sized trees such as African breadfruit (Treculia africana) the oil bean (Pentaclethra macrophylla), the native pear (Dacryodes edulis), African star-apple (Chrysophyllum spp.), and Kolas (Cola spp.). Under prolonged periods of cultivation, the oil palms persist and attain prominence, with some woodland developing in areas of fallow made up of shrubs and small trees such as Dialum guineensis and Phyllanthus discoides which are sometimes entangled with several combretaceous and other climbers. Some shrubs which grow from stumps remaining after the clearing of the forest in fallows include: Newbouldia laevis, Berlinia spp. etc.

Acioa bateris and Anthonotha macrophylla may be purposely planted in fallows while Ficus, Dialum guineensis and other shrubs are mainly grown or protected as browse plants. In some areas, prolonged periods of cultivation with very short fallows result in soils being invaded by certain grasses such as Pennisetum purpureum, Adropogon spp. and Panicum maximum while in extremely poor soils, the spear grass (Imperata cylindricum) is common. Recently, the noxious Eupatorium odoratum constitutes the major climax vegetation in fallows

on constantly cropped land. Around compound farms where perennial crops grow in mixtures with annual crops, perennial weeds such as Icacina spp. with underground rootstocks gradually attain dominance over annual weeds and may be the only weeds found during the dry season.

2.4 Transport and Marketing

Umuokile is situated some two km south of the main Umuahia-Owerri road, 40 km from Umuahia and 20 km from Owerri. Taxis and lorries regularly ply this route, the fare to Owerri is ₦.30 and to Umuahia ₦.70; the cost of load carried by a person is extra.

The principal market used by the villagers is at Enyiogugu on the Umuahia-Owerri road, reached by a dirt road from Umuokile. Enyiogugu is the central market for 24 small villages, so called "council wards". These 24 villages comprise the Enyiogugu clan. The most common form of transport in the village is by bicycle, for those who don't own bicycles, the fare for a bicycle taxi service is ₦.10 from Umuokile to Enyiogugu.

The main Enyiogugu market is an eight day market, with a smaller market on the fourth day between markets.[4] Figure 2 shows the prices prevailing in this market for the 12 months June 1974 to July 1975 for four important food crops. Food prices rose more than seasonally in late 1974 and early 1975 due to the general inflation experienced in Nigeria and also, as the region is an importer of foodstuffs (particularly cassava and maize) transport charges were further inflated due to the chronic shortage of petrol in the area.

3. A Typical Smallholder

3.1 The Farm Family

The farm family reported in this paper consists of nine persons as listed in

Table 3. The older children, while they are no longer at school remain at home due to their inability to find employment in the region or elsewhere in the State. However, the farmer does not regard these members of his family as a component of his farm labor force. In consequence, while the farmer is responsible for feeding in the order of 6.8 consumption units, the labor equivalents available for farm work is in the order of 2.1 units.

Table 3. Composition of the "typical" farmer's household.

Person	Age	No. of years of schooling	Consumption Units	Labor equivalents
Farmer	52	9	1.0	1.0
Wife	26	0	.9	.8
Son	18	9	1.0	-
Son	16	9	1,0	-
Son	4	0	.4	-
Son	2	0	.4	-
Daughter	16	8	.9	-
Daughter	13	5	.8	-
Daughter	6	0	.4	.3
Total			6.8	2.1

3.2 Land

In 1974 the farmer cultivated .46 ha of land made up of a compound field, a near field and a larger distant field. In addition, he owned .36 ha of "old" cassava (i.e. cassava on land cultivated the previous year) and 2.13 ha of land under bush fallow. The farmer is the senior member of his family and shares portion of the land with his junior brother who also lives in Umuckile.

The spatial location of the eight plots controlled by the farmer are shon in Figure 2. The area of the compound farm is 400 square metres and has a

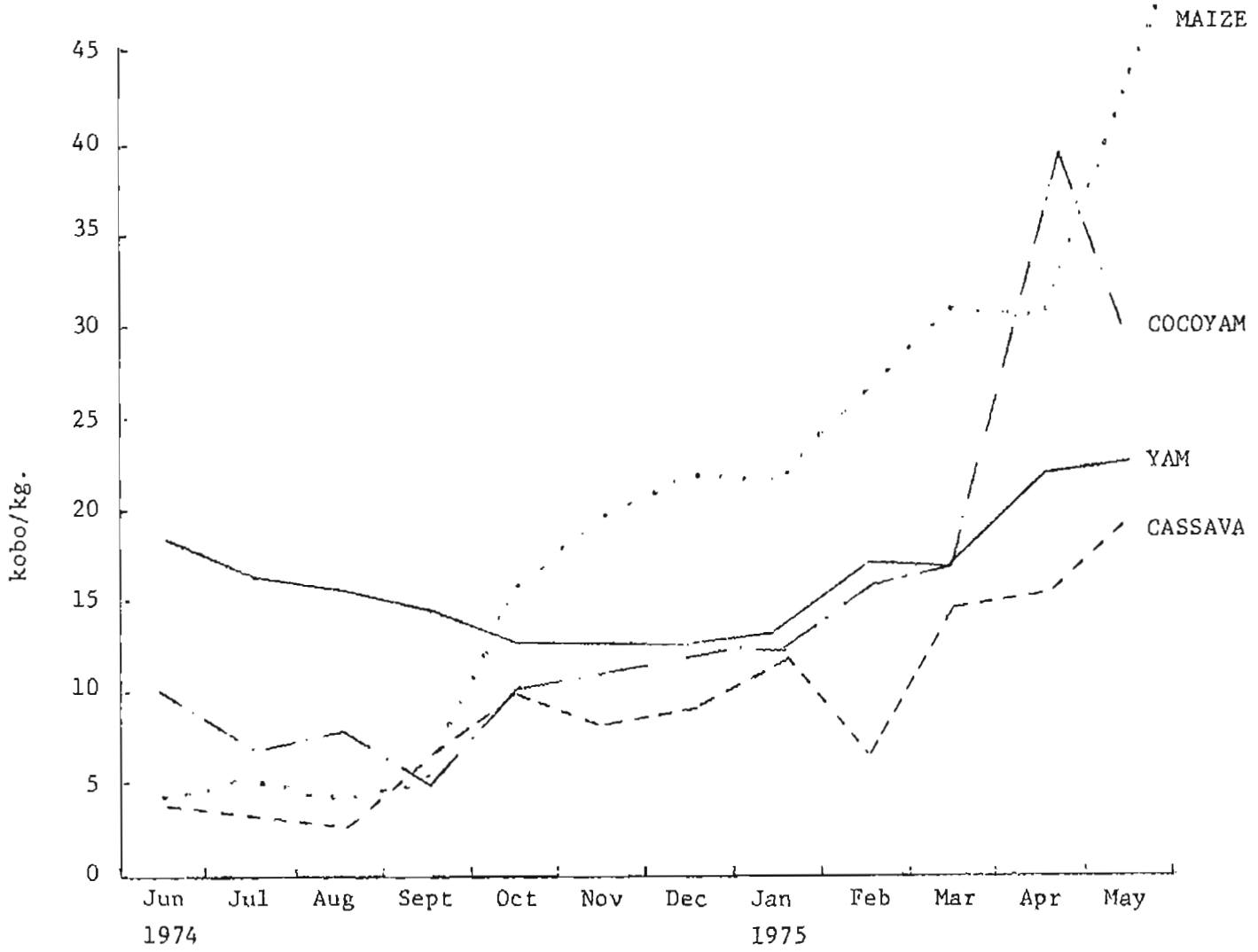


Fig. 2 Variation of major food crop prices in Umuokile over 1974/1975, kobo/kg.

high density of trees, shrubs and crops which have particular economic or cultural value. The compound farm is farmed intensively and continuously, with household and farm refuse being used to augment soil fertility. The near field is 600 square metres in area and close to the compound. The dominant tree species in this field are oil palm and oil bean; it is farmed for 1 to 2 years before reverting to bush for two to three years. Finally, the distant field is the largest field at .36 ha over 10 minutes walk from the compound. This plot has a low density of trees (mostly wild oil palm), and produces the bulk of the starchy foods, and, after one to two years of cropping reverts to bush for 3 to 4 years.

While land is regarded as scarce in the area (as exemplified by the decreasing number of years plots remain in bush fallow) this particular farmer indicated that he could obtain land from friends if he were forced to increase his production of food crops. However, given his normal supply of labor he would find it difficult to farm more land than he does at present. His present cultivated land/man ratio is in the order of .22 ha/man (.54 acres/man) which is somewhat less than the .4 ha per man ratio often quoted as approaching the physiological maximum for this type of environment.

3.3 Livestock

The prevalence of tse-tse fly in the area does not allow the farmer to rear cattle or other draft animals; he also claims that cattle would damage his crops too much. Table 4 lists his livestock inventory as of July 1974. The goats are reared in a small stable in the compound where they receive daily fresh leaves and branches, their main dietary source are oil palm fronds and to a lesser extent various browse plants and some kitchen refuse, eg. yam, cassava

Plot sizes, in hectares, of the smallholders farm

	Plots under cultivation			Plots in bush fallow	
C	compound	.04	F1	fallow	.72
N1	near field	.06	F2	"	.36
D1	distant field	.36	F3	"	.18
OC1	old cassava	.15	F4	"	.36
OC2	"	.05	F5	"	.09
OC3	"	.04	F6	"	.24
OC4	"	.03	F7	"	.09
OC5	"	.09	F8	"	.09

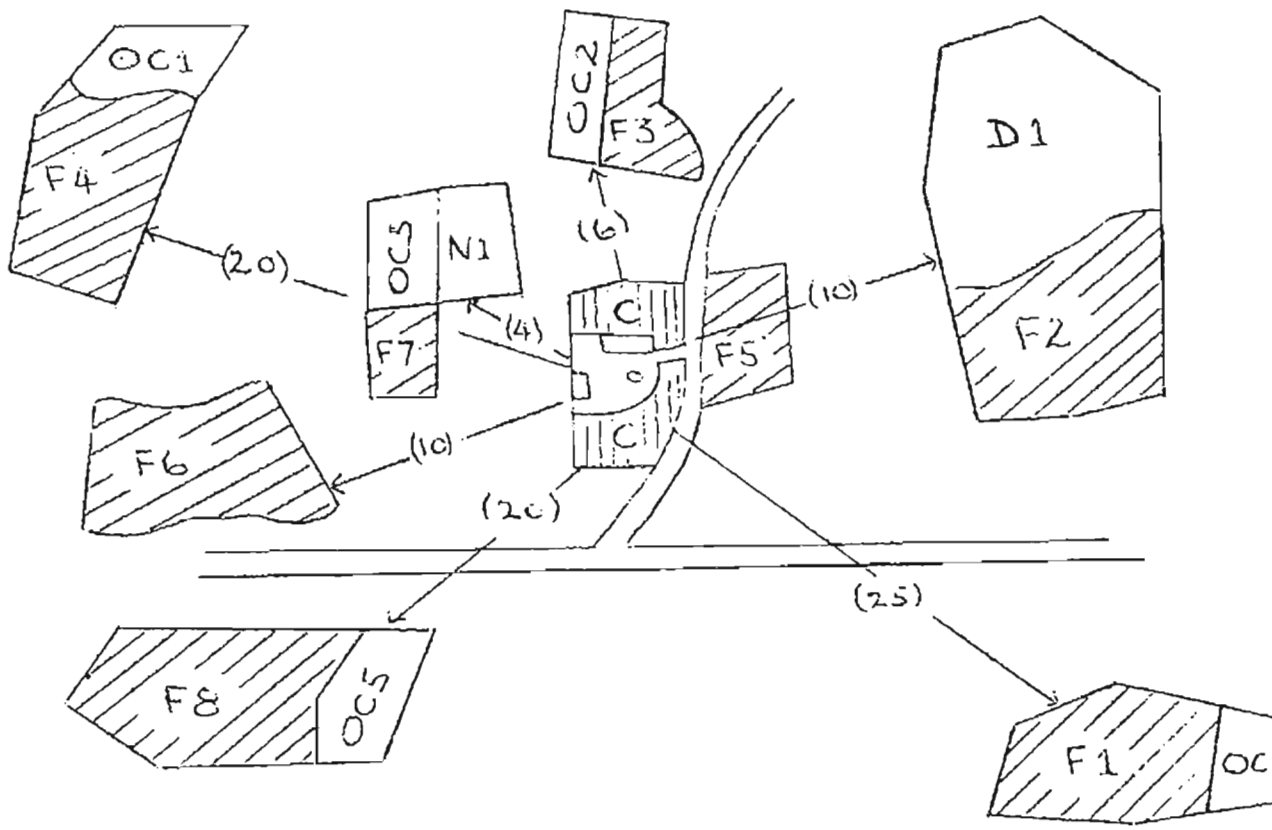


Fig. 3 Layout of the smallholders farm (plots are not drawn to scale). Bracketed figures are the time taken, in minutes, to walk from

and banana peelings. From November to January, when there are few food crops on the farms that may be damaged by livestock, the goats are allowed to range free and forage for themselves. During this period when the goats are on free range they cause extensive damage to the cassava (the main green pick available). Farmers attempt to overcome this problem by pruning the leaves and fencing the cassava. No particular care is taken of the chickens which are always on free range, nor do the eggs produced seem to be consumed by the household.

Table 4. Number and value in Naira of livestock owned by typical farmer in Umuokile, 1974.

	Goats		Fowl		Total Value
	No.	Value	No.	Value	
Under 1 year	2	4	6	3	
Over 1 year	4	24	18	12	
Total	6	28	24	15	43

The livestock kept by the farmer are not necessarily expected to constitute a normal diet item. They are kept as a financial reserve -- particularly to be sold in times of a cash emergency or when the animals are ill or dying. Goats are often slaughtered for feasts, chickens are often sacrificed in various ceremonies. In addition, the livestock act as scavengers, converting non-marketable wastes into a saleable product and providing manure which is applied to the compound farm or garden.

3.4 Capital Equipment

In addition to the farm house (made from cement blocks) -- it cost him ₦300 for materials when he built it in 1972 -- a kitchen hut, obi "parlor" both made from local materials; the current replacement value of capital items used in

farming is in the order of ₦68. The farm implements owned by the farmer are listed in Appendix A. The farmer also owns a bicycle which is frequently used by him and his wife to transport goods to and from the market.

4. Cropping Patterns and Husbandry Practices

4.1 The Compound Farm

Numerous trees shrubs and food crops are grown on the compound farm. For example on this farmer s 400 square metre plot there was one oil palm, 15 raffia palms two coconut palms three kolanut trees as well as 13 other trees and shrubs of various species. In addition to 566 shrubby to herbaceous vegetable type plants. This range of plants in complex mixtures of high density, approximates in the view of Okigbo [1974], the bush or forest condition resulting in stable agro-ecosystem

The various food and tree crops grown in the compound farm have numerous uses. For example they provide

a supply of beverages various fruits edible leaves and food crops over the year

handles for hoes wood for mortars etc.

a supply of materials for building thatching ropes and containers

a supply of livestock feed

materials for social and festive occasions

a means of demarcating boundaries live fencing etc.

The dense leaf canopy also protects the house and work areas from the weather, reduces erosion by absorbing the impact of rainwater shading the land and so reducing soil temperature and providing a leaf litter for nutrient recycling, maintaining reasonable levels of organic-matter and conserving soil moisture

during dry periods.

The compound plot is cultivated continuously. Vegetables such as fluted pumpkin (Telfaria occidentalis), vegetable jute (Corchorus olatcrus), ofe (Solanum spp.), pepper and garden egg are grown all the year round. This is possible as the soil is kept moist during the dry season with waste water from the household. During the peak of the dry season the vegetables are also watered if necessary by the women and children carrying water from the local tap and pond water points.

Before the intensive cultivation period begins following the opening rains in March, Nwanyaghara, (a local variety of yam which yields tubers up to 30 to 40 kg weight) is pregerminated in the yam barn. All trees except raffia are pruned or heavily trimmed, so that only a few branches on the very top of the trees remain. This enables more light to reach the ground and facilitates the growth of sunloving crops. The branches that have been lopped off are used for yamsticks, building material and firewood while the small twigs and leaves are used as mulching material. Yams are planted in roughly straight lines at distances varying from 1 to 1.5 metres. Usually a hole is dug 50 to 60 cms. deep by the farmer using a long handled hoe specifically designed for digging yam holes. The yam setts, weighing on the average from .5 to .8 kg are placed in the holes over which mounds 20 to 25 cms high are built. In this part of southeastern Nigeria large mounds are not used as the sandy soils are subject to shifting resulting in large mounds being washed away during heavy rainstorms.

Maize is the next crop planted. This is usually done on the flat between the mounds. The maize is followed by cassava and cocoyam which are planted on

smaller mounds between the yam heaps. Vegetables are usually planted on the sides of all the heaps. After planting, the mounds are covered with palm and fronds and twigs of other plants.

The fertility of the soil, as previously mentioned, is maintained by applying household refuse and crop residues. The application of refuse and compost while more elaborately done during the first part of the season, is continuous throughout the year. In the compound gardens and farms, weed growth is not vigorous due to the high population of trees and other crops whose canopies provide, such an effective shade that very little light reaches the ground.

4.1.1 Crops harvested from the compound farm

While some of the leaf vegetables tend to be available throughout the year, the majority of crops have reasonably well defined harvest periods. For example, maize is the first of the major crops harvested which effectively ends the "hungry season" from late June onwards. The majority of the maize is consumed as green or fresh corn on the cob, only a small amount is dried and stored unhusked over the fireplace.

The method and time of harvest differs among the various varieties of yams. For example, while some early planted and early maturing varieties (e.g., the white yam, D. rotundata) may be harvested in July-August, other late maturing species such as the yellow yam (D. cayenensis) are usually harvested later even if planted at the same time with the early maturing types. The July-August harvest, called "milking", is followed by a second harvest which takes place in November to December when the yam heads that were buried after the first harvest have developed small tubers and the main vines die. These smaller tubers are stored as seedyams for the following cropping season. Other varieties of yams such as the three-leafed yam (D. dumetorum) are harvested once from

November to December.

The last of the food crops to be harvested (other than cassava) are cocoyam (Xanthasoma ad Colocasia spp.), in January and February, after which the plot is prepared for the new cropping season. In most compound farms cocoyams usually precede yams in the rotation.

4.2 Near and Distant Fields

Two cropping mixtures were dominant on the near and distant fields:

(a) near field -- cassava-yam-maize
(b) distant field -- cassava-groundnut-maize. The spatial location of plants within the intercrops are shown in Figure 4.

There is a far lower density of trees in the near and distant fields than is the case in the compound farms. The reasons given by the farmer for following different cropping patterns in his compound, near and distant fields were:

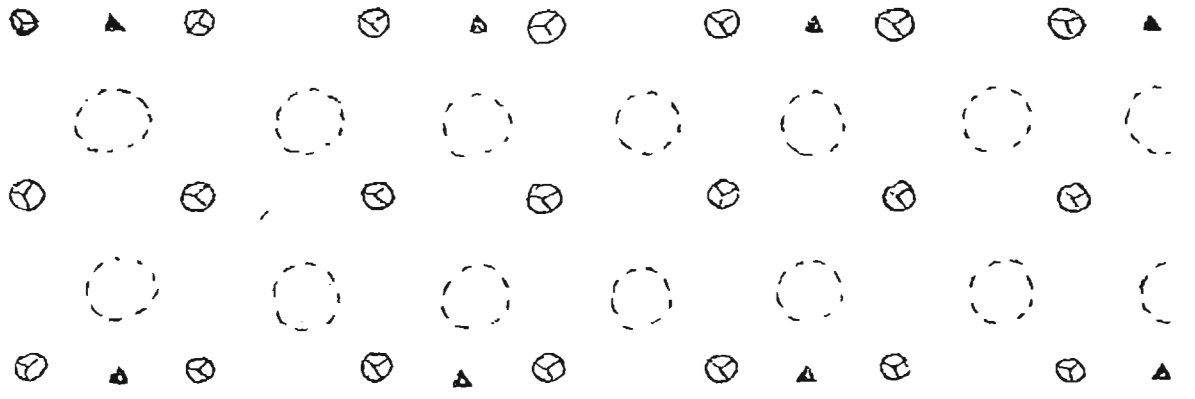
(a) many of the crops he grows -- particularly vegetables -- only grow on fertile soil maintained by mulching the compound farm;

(b) intensive farming on the compound plot is only possible on a small area because of the high labor input;

(c) because of the distance to near and distant fields, daily harvest would require too much walking;

(d) crops such as pepper, okro, fluted pumpkin, yams are easily stolen or damaged by goats.

Cultivation of the inner and outer fields starts in the first 2 to 3 months of the year with clearing of the bush and trimming of most of the trees. When the bush regrowth is 'insufficient' or involves sparce growth of a few shrubs and trees the farmer introduces palm frond and twigs from adjacent plots in order to get more ashes from the burn.



100 cms.

Fig. 4.1 cassava-maize-groundnuts

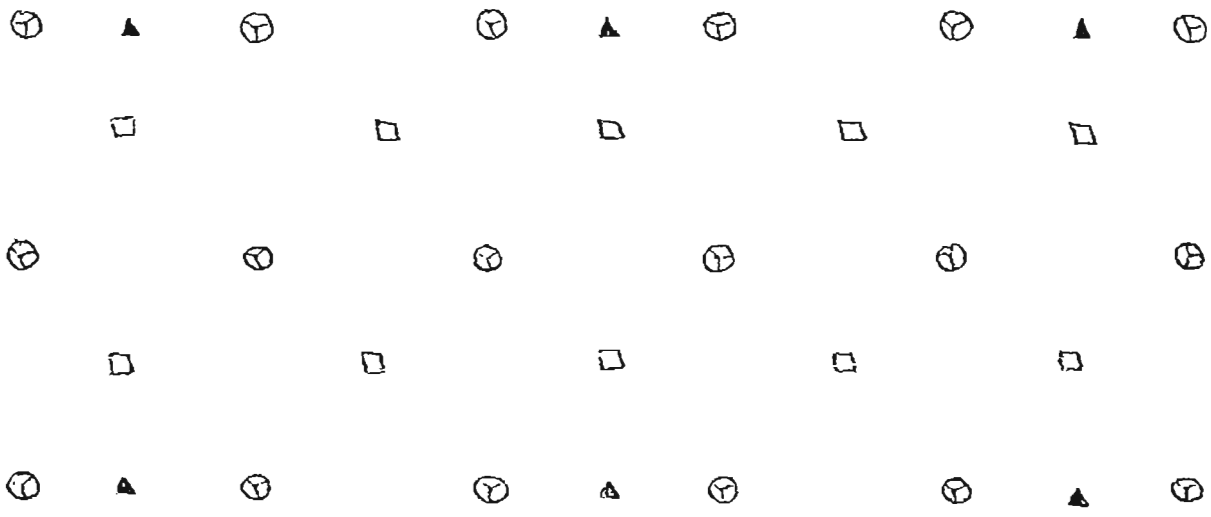


Fig. 4.2 cassava-maize-yams

100 cms.

cassava

maize

yams

groundnut (grown in circle diameter approx. 40 cms., seeds 5 to 10 cms. apart; these plants rapidly cover soil surface)

Fig. 4 Proximate spatial arrangement of two intercropping systems.

Maize is the first crop to be planted (on the flat) immediately after the early rains. Yam (grown on small mounds) is planted in situations where the farmer thinks soil fertility is best. The yam setts used in the near and distant fields varies in size, depending on the variety, the quantity of yam available and whether the setts are expected to produce were yams or setts for planting. In general, on near and distant fields the yam setts are smaller than those planted in the compound area.

Cassava and groundnuts are planted after the maize and yam. They are often grown on slightly raised heaps or on the flat. When planting cassava, the farmer digs small holes with a hoe of diameter of about 40 cm, 5 to 10 cm deep. Three and sometimes two cassava cuttings are laid flat in the hole and covered so that several shoots sprout from the nodes on each cutting. Where the cuttings are planted at an angle (which tends to be the case when cassava is planted as a late relay crop), few shoots per cutting result.

Mulching and manuring is not a common practise in the inner and outer fields, except for yams. For this, the farmer cuts dry grass and palm fronds from the surrounding bush and "caps" the yam mounds to protect the tender shoots against the heat of the sun and to conserve moisture in the mound. A disadvantage of this practice (of which the farmer is aware) is that termites, which are prevalent in the area, are attracted to the plot. Indeed, termites are probably the major pre-harvest insect pest in the area.

On average, the farmer weeds his near and distant fields twice a year. The difference in weeding practice between compound and outer fields was, according to the farmer, due to a lack of labor. This reason is probably only one of several. Other reasons may be:

(a) the farmer adheres to the traditional practice, i.e., he weeds as

often as his forefathers did, when the fallow period was longer and subsequently the weed growth was much less than now;

(b) the farmer may regard weeds (in the younger stage) more as a cover crop than as weeds competing with his food crops; and

(c) the use of creeping crops (groundnut, egusi) also acts as a form of weed control.

The harvest of cassava, the main staple, is done by the wife or daughters normally twice a week. All the cassava is processed by hand. After a growth of 10 to 14 months -- depending on the scarcity of food and sometimes variety they start uprooting cassava from the new plots as well as from the old cassava plots. The harvest of this crop takes place in varying quantities throughout the year -- according to the food and cash needs of the family.

4.3 The Value of Traditional Plant Species in the Diet

The time sequence through which the major food crops are harvested are shown in Figure 5. These crops, harvested from the compound, near and distant plots tend to provide a continuous supply of food for the farm family over the year. It is apparent that in addition to the usually mentioned food crops (e.g. yam, cassava, cocoyam, maize, groundnut), semi-wild protected plants and wild plants are also important sources of food, particularly in supplementing diets during periods of food deficits. Home grown food is most scarce in March, April and May, the so-called "hunwu" or hungry season which occurs after the yam barns have been emptied and major staples planted but before these crops are harvested.

A nutritional analysis of a number of the more important traditional foodstuffs consumed by farm families in the region are listed in Appendix B. Many of these foodstuffs are higher in protein and essential amino acids than

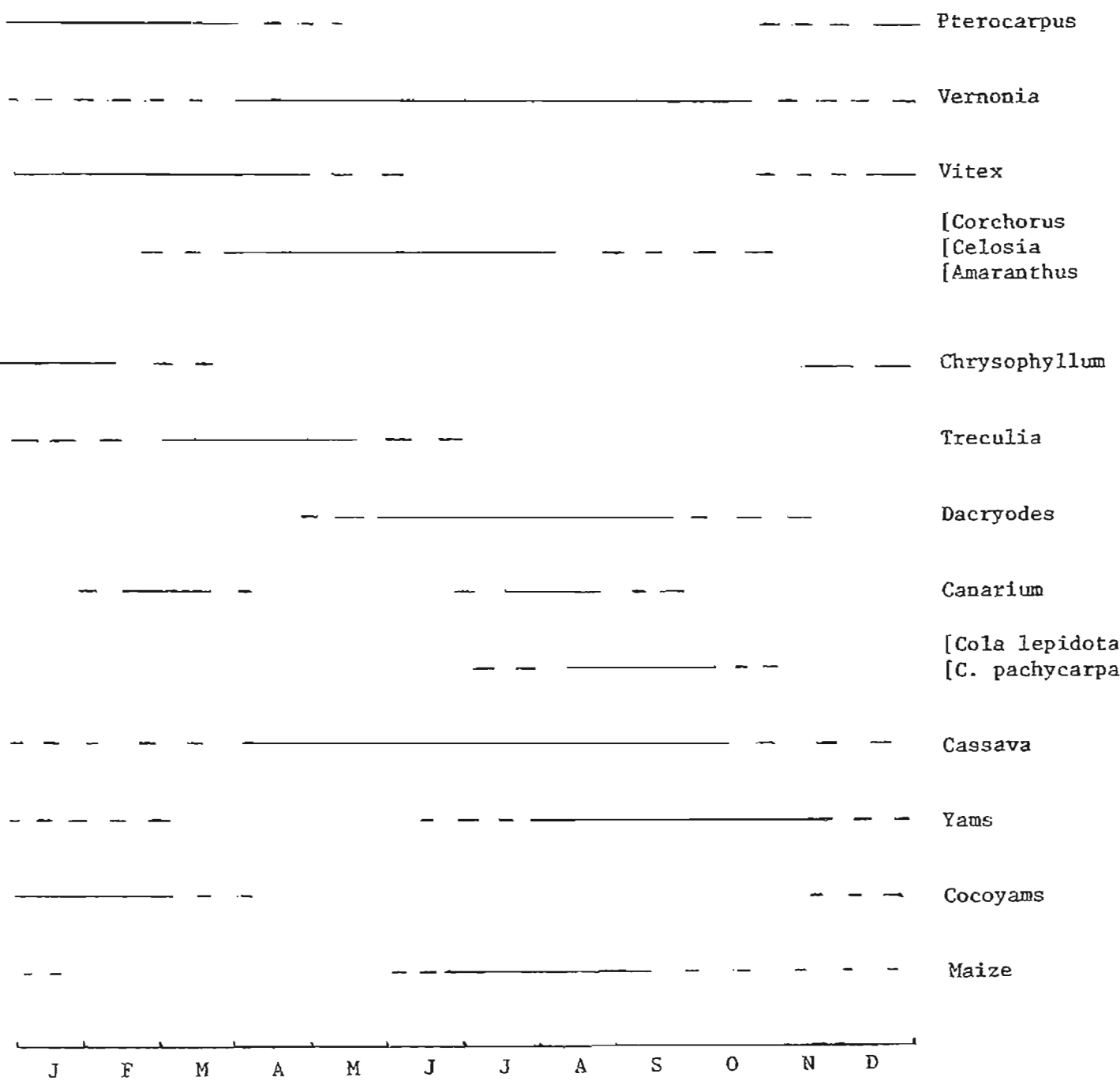


Fig. 5 Time sequence of harvest and availability of major annual staples and leaf vegetables as compared to fruit and leaf vegetables perennials found in compound farms in South-eastern Nigeria.

the "basic" foodstuffs which government tends to promote. In consequence, the traditional foodstuffs, in addition to providing sustenance during food deficit periods of the year are extremely important sources of protein, essential amino acids, vitamins and minerals in the diet.[5]

5. Labor Use

To collect accurate labor data for a smallholder where many activities are of short duration requires data collection by participant observation or at least asking the farmer and his family to recall their activities on a daily basis. Also, the data collected in any one year is rather specific to that year, being related to the weather, the health of the farmer, etc. In consequence, such data collected within one year should be used with caution since it may be subject to high variability between years.

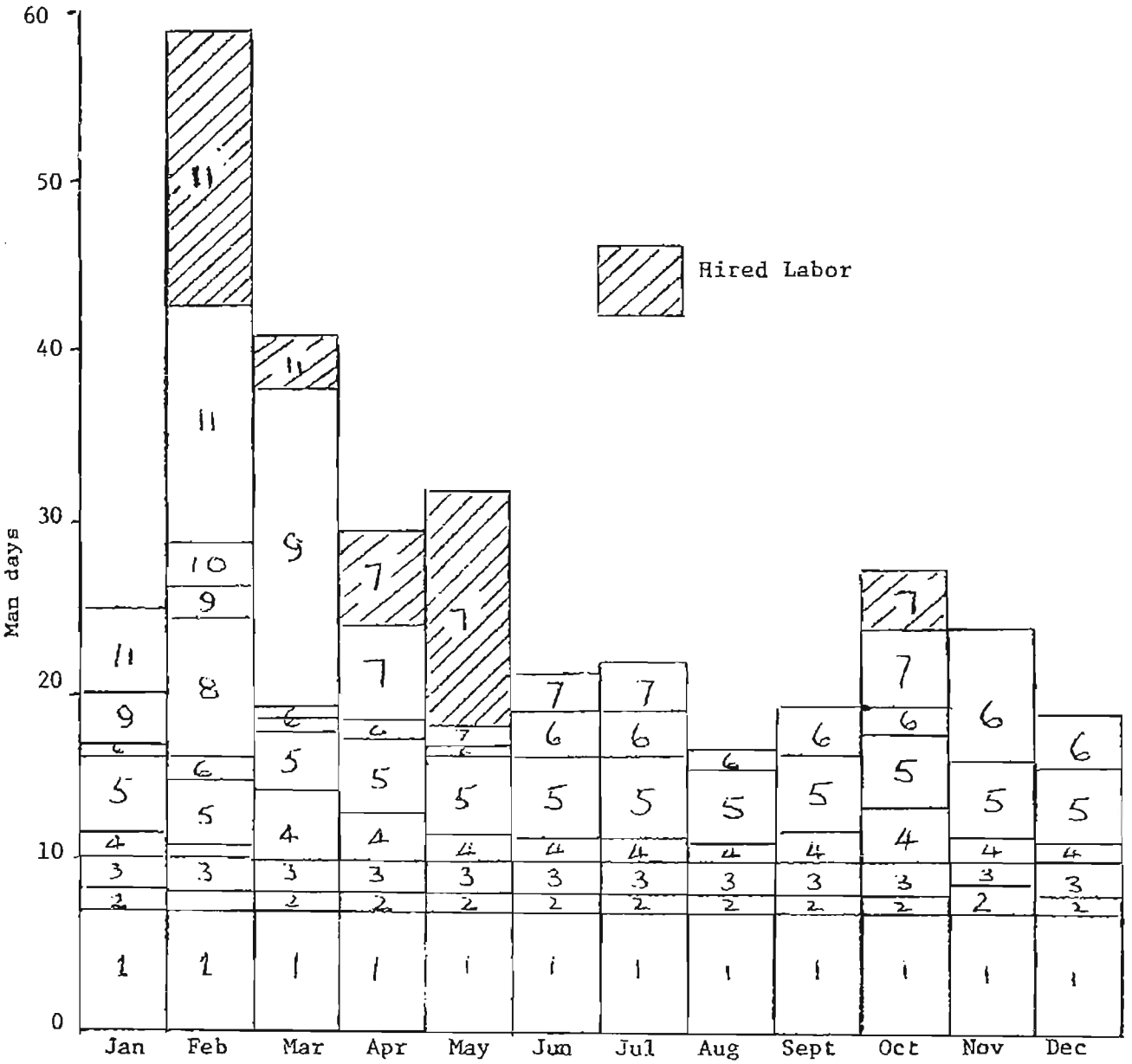
In this survey we adopted an alternative approach.[6] After each major farming activity (e.g. clearing, planting, weeding, harvest etc.), each farmer was questioned as to how long it would take to complete a specified task and who would normally carry out the task. The labor use figures for the farmer shown in Figure 6 were collected using this method.

The seasonal distribution of labor employment on the farm shows that:

(a) the peak demand for labor is from February to March when land clearing, cultivation and planting are the main activities;

(b) hired labor is used almost exclusively for clearing and weeding;

(c) the modal labor input of the farm family is in the order of 20 mandays per month, during the period of peak labor activity, the family works significantly more days per month in addition to hiring labor;



1 - Marketing
2 - Collection of firewood
3 - Collection of livestock feed
4 - Oil palm processing
5 - Cassava processing
6 - Harvesting of food crops
7 - Weeding
8 - Staking
9 - Planting
10 - Burning
11 - Clearing

Fig. 6. Distribution of farm activities over the year

(d) the amount of labor allocated to marketing, collecting firewood, feed for the goats and the processing of cassava did not fluctuate markedly throughout the year. These activities (mainly performed by the wife and children) occupied the bulk of their time, except during the periods of land preparation and planting.

The time allocated to household and social functions are not recorded in Figure 6, nor is the time taken to carry crops from the outer field to the compound. Most of the carrying was done by the women (an average headload weighed 25 to 30 kg). when returning from the plots at mid-day and again in the evening.

6. Output and Inputs to the Farming System

6.1 Food Crops

6.1.1 Compound farm

The output from the compound farm in both physical and value terms are shown in Table 5. In value terms, yam, fluted pumpkin and cocoyam were the most important food crops produced in this plot. The total value of production was ₦144, produced on 400 square metres of land, which if extrapolated to a per hectare basis would be in the order of ₦3,600/ha.

Table 5. Yields and value of food crops produced on the compound farm of a smallholder in Umuokile, 1974-1975.

Crop	Yield (kg.)	Value (₦)
Cassava	40.0	4.96
Yam	674.2	84.39
Cocoyam	102.0	15.81
Maize	20.0	1.06
Telfaria leaves	62B	3.10
Vegetables	21B	1.05
Pepper	8.0	1.64
Melon	0.3	0.20
Okro	2.2	0.66
Fluted pumpkin	278.0	30.56
Tomato	0.4	0.20
Pumpkin	11.0	0.20
Total crops*	1136.1	143.83

B = Bundles with a value of 5 kobo each
* excluding the weight of Telfaria leaves and vegetables

6.1.2 Near and distant fields

The production of foodcrops from the non-compound plots are shown in Table 6. In value terms, cassava was the most important crop produced in these fields.

Table 6. Yields and value of food crops produced on the near and distant fields of a smallholder in Umuokile, 1974-1975.

Crop		Yield (kg.)	Gross Value (₦)
A.	near field, 0.06 ha.		
	Cassava	133.5	10.68
	Groundnut	37.5	5.98
	Maize	18.6	0.93
Total			17.59
B.	distant field, 0.36 ha.		
	Cassava	848.7	67.90
	Yam	184.0	29.80
	Maize	55.9	2.70
Total		100	100.40

It is obvious that the value of production on the compound farm was significantly higher than from all the non-compound fields. Indeed, the farmer produced 55 per cent of his food crops on less than 10 per cent of the area he cultivated.

6.2 Tree crops

The values and quantities of produce harvested from the different trees are listed in Table 7,(the yield and value of edible leaves and materials used for building purposes, are not included in the Table). The gross value of tree products harvested was ₦117.76, which is 45 per cent of the value of the food crops produced. It is worth noting that the fallow fields, while not immediately contributing to the output of food crops, continue to contribute to the total

value of output of the farming system through the harvest of trees.

Table 7. Production and value of production of trees harvested.

	Compound		Non-Compound		Fallow Plots		Total	
	Kg	₦	Kg.	₦	Kg.	₦	Kg.	₦
Oil palm	42	2.31	647	19.25	817	25.02	1506	46.58
Raffia palm	452	15.08	-	-	280	22.40	732	37.48
Pear	-	-	-	-	30	4.09	30	4.09
Citrus	25	1.75	-	-	-	-	25	1.75
Breadfruit	-	-	-	-	30	1.50	30	1.50
Cocoa	71	1.60	-	-	-	-	71	1.60
Banana	13	0.92	-	-	-	-	13	0.92
Plantain	27	2.24	-	-	-	-	27	2.24
Oil bean	-	-	15	3.60	-	-	15	3.60
Firewood	-	-	-	-	-	18.00	-	18.00
Total		23.90		22.85		71.01		117.76

6.3 Livestock

The closing livestock inventory of the farmer did not change from the opening inventory. Livestock sales were ₦36.94 and (estimated) home consumption of livestock ₦18. Thus, the total value of livestock produced was ₦54.94.

6.4 Gross Agricultural Production

The gross value of agricultural production over the year's study was, as summarised in Table 8, ₦434.53.

Table 8 Gross value of agricultural production of smallholder in study year, 1974/

Source	Value	% of total value
Food crops	261.82	60
Tree crops	117.76	27
Livestock	54.94	13
Total value of output	434.53	100

As shown in Figure 7, over 50 per cent of gross income was derived from root crops, 25 per cent from tree crops, the remainder being livestock and other food crops. It must be stressed that the gross returns are based on the prevailing prices in the local market. As the region is a food deficit region, market prices in the area tend to be higher than in the nearest food surplus areas.

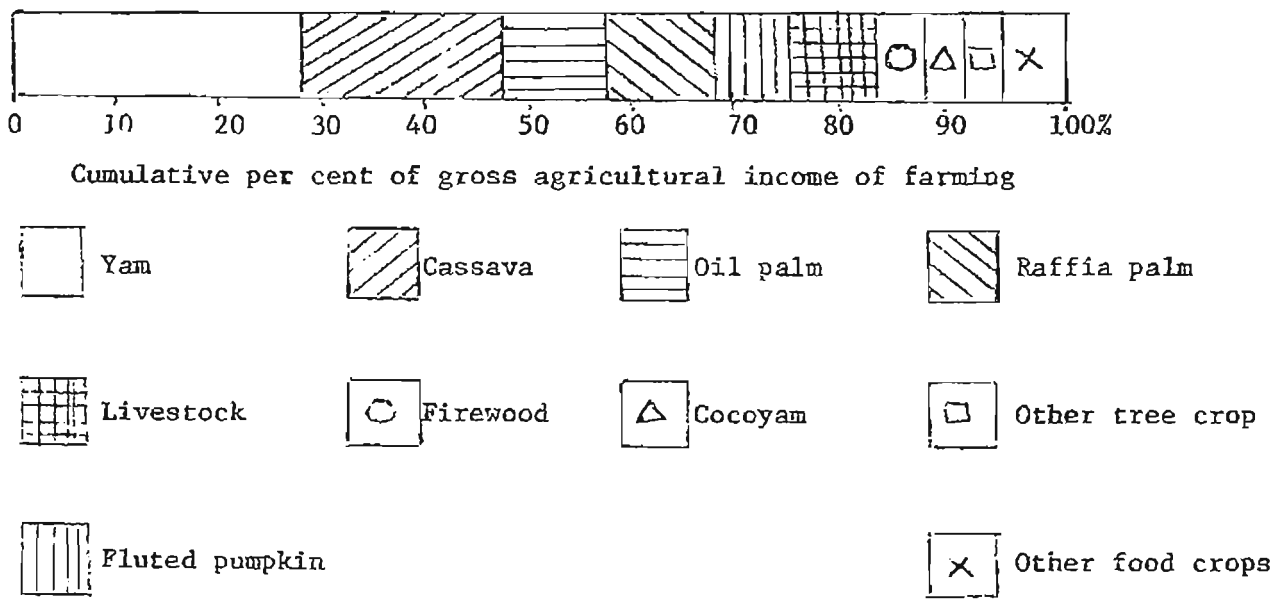


Fig. 7 Sources of gross income of the smallholder

7. Income and Expenditure

7.1 Cash Farm Income

The figures for farm income quoted in Section 6 represent the total value of agricultural production from the farm. Like most smallholders the farmer consumes a considerable portion of his produce. Thus the farmer's marketed surplus -- the difference between total production less consumption, less gifts, less inventory changes -- represents the cash farm income of the smallholder. In this study we recorded total production and farm sales, so consumption plus gifts of farm products (after allowing for inventory changes) were estimated as the residual of total output less sales.

The magnitudes and sources of cash farm income for the farmer over the year's study period are listed in Table 9. Recorded total farm sales were just over ₦170, representing 39 per cent of the total value of agricultural production. The sale of products derived from trees (oil palm bunches, raffia palm wine, etc.) yielded two thirds of the total cash farm income. It is interesting to note that while the majority of tree crop products are sold (this figure is suspiciously high), very little of the food crops produced by the farmer were sold. The reliance of tree crops as a source of income is obvious, the minimal sale of food crops reinforces the contention that farmers in the region do not attempt, or cannot produce enough food to feed themselves and their families.

Table 9. Sources of cash farm income, and sales as percentage of total production, small farmer in Umuokile, 1974/1975.

Commodity	Sales Value (₦)	%	Sales as % total production
Food crops	22.69	13	9
Tree crops	113.84	67	96
Livestock	34.60	20	63
Total	171.13	100	39

7.2 Total Family Cash Income

In addition to his cash income from farming, the farmer had non-farm sources of income (petty trading, gifts, laboring, pension, etc.) as well as access to credit through traditional channels. This particular farmer had been a civil servant, his pension and other non-farm sources of income totalled ₦357.44. Also as shown in Table 10 the farmer claimed to have received a loan of ₦250 from his "Isusu"[7], ₦23.70 from friends and contributed ₦64.80 to the Isusu. Thus, the cash resource available to the farmer was ₦737 during the year's survey.

Table 10. Sources of funds for farm family, Umuokile, 1974/1975

Source	Amount (₦)
Agricultural sales	171.13
Pension, non-farm income	357.44
Borrowed from Isusu	250.00
Borrowed from friends	23.70
Paid to Isusu	- 64.80
Total cash "Income"	737.47

7.3 Disposal of Income

The cash balance sheet for the family's activities over the year are listed in Table 11. Eight per cent of total expenditure was for agricultural production. Half of this farm expenditure was for hired labor, the bulk of the remainder was to purchase yam setts. Expenditure on foodstuffs accounted for 40 per cent of family non-farm expenditure. The dominant food items were fish (₦72.54), meat (₦35.19), cassava and yams. The more important "other" food items were rice, beverages, and various condiments. The total value of food and drink consumed by the farm family was thus ₦557, the sume of purchased food

and drink (₦293.71) and farm products consumed by the family (₦263.40); i.e. the family produced 47 per cent of the value of the food and drink they consumed on the farm.

Just over half of family expenditure was for non-food and non-farm items. School fees and medical expenses accounted for over half of this category of expences. School fees could be regarded as an investment rather than consumption, as it is a normal practice for the child, once he is educated and earning an income to repatriate a portion of his earnings to his parents. Incidentally, if the proposed Universal Primary Education becomes a reality, it would release a substantial portion of the farmer's cash income for other uses. This particular farmer thinks that if he did not have to pay school fees he would use the majority of this released cash to buy goods for petty trading, his next priority would be to buy more food.

Over the year it appears that the farmer emerged with a small cash surplus (₦16). However, his liquidity position did not improve over the year as the farmer borrowed, ₦208.90, a portion of which presumably must be repaid. While one must treat reported income and expenditure figures with caution, it does appear that this farmer, like many of his colleagues, generated minimal, if any, savings.

Table 11. Recorded Income, Expenditure and Savings of smallholder in Umuokile, 1974/1975.

Item			₦	₦
A.	Income:			
	Total cash resources (see Table 10)		737.47	737.47
B.	Expenditure:			
	i.	Agriculture		
		Wages for hired labor	29.40	
		Other	28.82	
		Total Agriculture	58.22	
	ii.	Food purchased		
		Fish and meat	107.73	
		Cassava products	52.07	
		Yam	30.08	
		Other	103.83	
		Total Food	293.71	
	iii.	Non-Farm or Food Expenses		
		School Fees	130.30	
		Medical	75.19	
		Clothes	53.11	
		Other*	110.63	
		Total Non-Farm or Food	369.23	
	Total Expenditure		721.16	721.16
	Surplus of Receipts over Expenses			16.31

*Major items: Costs of transport, entertainment, gifts, contribution to a water pipe being laid in the village.

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Footnotes

1. Other information related to the study are found in Flinn and Lagemann [1974 a,b], IITA [1975] Williams et al [1975] and Lagemann [1975]. Other reports related to the study are in preparation.

2. We appreciate that the Ture estimate has proven more useful than the Thornthwaite method of estimating Et. Potential evapotranspiration figures will be reviewed during further analysis of the data.

3. The plots are differentiated with respect to their spartial location from the house and intensity of land use.

   'Compound Plots' are small farms close to the hut or house which are cropped annually or at most with only one year of bush fallow. Soil fertility is maintained through mulching application of household refuse and animal waste. In most cases they are fenced to protect the crops against rodents, goats sheep, etc.

   'Near Plots' are fields close to compound plots or if there are no compound areas close to the house. A farmer can reach them within five minutes walk. The fallow periods are in general a little bit longer than on 'compound plots'.

   Distant Plots' cannot be reached within five minutes walk. The fallow period is longer than on the 'near plots'.

4. Hodder and Ukwu [1969] describe the typical market setting in Iboland.

5. In many socalled development programs the cultivation of traditional foodstuffs is de emphasised, it is "modern" to concentrate on the exotic species. Thus it is possible that farm families end up with a worse diet than historically was the case.

6. For a subset of the farmers interviewed daily records were taken of labor use. The particular farmer used as the example in this paper was not one of the farmers for whom daily labor records were recorded.

7. We suspect that a large proportion of this loan came from a relative living outside Iboland.

ppendix A

arming equipment owned by the smallfarmer in Umuokile.

Item	No.	Replacement Value (₦)	Total Value (₦)	Years of useful life
hoe (ube)	1	.40	.40	5
hoes	6	.40	2.40	4
cutlass	5	1.50	7.50	4
rake	1	1.00	1.00	4
shovel	1	2.50	2.50	2
files	2	.50	1.00	1/3
climbing ropes	3	2.00	6.00	½
calabash	3	.40	1.20	1
jars	3	1.50	4.50	10
tapping knives	2	.50	1.00	2
baskets	5	.75	3.75	1
buckets	4	2.50	10.00	4
mortars (oil)	2	2.00	4.00	10
mortar (pepper)	1	.60	.60	10
Total replacement value			68.35	

Appendix B1

Table 2 Analysis of some edible nuts seeds and mushrooms consumed by farm families in Umuokile 1974/1975*

Description	Protein (Nx6.25)	Lysine g/100g	Tryptophane g/100g	Oil %	Starch %
Pleurites sp. (mushroom)	9.5	1.9	1.0	0.3	22.2
Detarium microcarpum (seed)	12.0	0.7	0.2	12.0	35.4
Colocynthis vulgaris (egusi) seed	22.0	3.5	1.7	45.0	6.3
Irvingia gabonensis (agbono) seed	24.0	2.3	1.0	38.0	28.5
Pentaclethra macrophyllum (oil bean)	20.8	5.0	1.2	45.9	19.0
Mucuna urens (shelled)	22.4	5.0	0.9	14.4	40.3
Treculia africana (shelled) seed	19.0	3.7	1.3	15.8	40.3
Dacryodes edulis (native pear) fruit	10.0	0.37	0.10	16	3.38
Cola lepidota (aril)	8.75	0.28	0.18	1.14	2.26

* Materials analysed by IITA Analytical Services Laboratory

Appendix B2

Table 3 Analysis of edible oil seeds and star apple consumed by farm families in Umuokile, 1974/1975

Sample	Protein %	Oil %	Total Sugar%	Starch %	Ca %	Mg %	K %	Mn ppm	Fe ppm	P %	S %	Zn %
Egusi (melon) black edges	32.6	55.2	5.80	6.4	0.15	0.45	0.70	40	231	0.83	0.50	70
Calabash seeds	35.4	47.9	6.04	9.4	0.10	0.54	0.70	60	250	1.05	0.45	78
White melon seeds	36.3	50.4	6.64	7.6	0.10	0.54	0.70	40	250	1.10	0.36	72
Egusi brown coated	33.8	53.1	6.00	7.1	0.15	0.44	0.65	140	200	0.95	0.38	58
Star apple (Udara)	8.8	17.1	20.9*	11.0*	0.55	0.17	2.00	20	200	0.13	0.35	60

* The starch of the Udara must have been converted to sugar during ripening

Materials analysed by IITA Analytical Services Laboratory

Appendix B3

Table 4 Analysis of leaf vegetables consumed by farm families in Umuokile, 1974/1975.

	PLANT TISSUE ANALYSIS								
Species	Total N%	Protein %	Total P%	Ca %	Mg %	K %	Mn ppm	Fe ppm	S %
Leaf Vegetables Ocimum viridis	4.67	29.2	0.41	2.05	0.53	3.40	100	480	0.22
Telfaira occideatalis	5.96	37.3	0.62	0.40	0.50	4.00	180	680	0.22
Pterocarpus soyauxii	5.14	32.1	0.40	0.50	0.30	2.50	80	100	0.23
Gnetum spp ("Okazi")	2.75	17.2	0.21	1.15	0.41	1.00	700	380	0.19
Pennisetum purpureum	2.45	15.3	0.60	0.45	0.30	10.50	80	320	0.21
Editan E*	2.88	18.00	0.11	1.50	0.45	3.30		350	
Heinsia crinata	2.21	13.81	0.20	1.40	0.50	2.20		590	
Piper guineense	2.74	17.13	0.23	1.25	0.56	3.85		300	
Gnetum sp.	2.84	17.75	0.11	1.13	0.48	1.15		320	

E* = Efik

Materials analysed by IITA Analytical Services Laboratory