THE APPLICATION OF ALLAN'S CRITICAL POPULATION DENSITY CONCEPT TO OWERRI PROVINCE, NIGERIA.

THE APPLICATION OF ALLAN'S CRITICAL POPULATION DENSITY CONCEPT TO THE INTENSIVELY-SETTLED PARTS OF OWERRI PROVINCE, EAST CENTRAL STATE, NIGERIA.

A Study of Farming Practice, Land Resources and Population Pressure.

By

MICHAEL NWAKWUOKE NWABUOGU, B.A.

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AUTHOR: Michael Nwakwuoke Nwabuogu, B.A. (University of Ibadan)

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SCOPE AND CONTENTS:

This thesis seeks to establish the levels of population densities, beyond which excessive pressure of population on land would occur in parts of Owerri Province, Nigeria. These Critical Population Densities are determined using Allan's Model.

The results of an original field survey and questionnaire provided the information for calculating land requirement per head of the population, and for estimating the carrying-capacity of land.

Certain normative hypotheses relating some variables in agricultural land use to elements of farm structure are tested. Other tests are also performed to determine the relative degree of importance of the variables associated with acreage per head cultivated in the province in 1971.

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TABLE OF CONTENTS

LIST OF MAPS

LIST OF PLATES

LIST OF TABLES

CHAPTER I

INTRODUCTION

1.1 Definition of the Problem

The purpose of this study is to assess the optimum population density of an indigenous agricultural land-use system, in parts of Owerri Province of East Central State, Nigeria, using Allan's model. In a purely traditional agricultural system, a quantitative estimate of the man/land relationship, which is based on the need for land per head of the population, is the most effective way of understanding the meaning of overpopulation. In this way, some of the main weaknesses inherent in the use of simple population density, as a criterion of overpopulation without reference to the environmental characteristics, will be avoided. The cultural and economic organisation of the society, as it affects the carrying capacity of the land, will also be mentioned.

It is widely known that the pressure of humans on available resources is serious in many parts of the world, especially in the developing countries with a poor resource base.[1] However, the assessment of this pressure on resources, as it relates to specific local conditions in different areas, has remained an unsolved problem. Widely applied measurement criteria of pressure on available resources, often referred to as 'overpopulation', are usually expressed in terms of (i) density of population, or in some cases, estimates of absolute numbers; and (ii)

deductions based on practical observation of worsening living standards.

The use of simple population density has three main weaknesses as a measure of overpopulation: (i) it is an average figure, while the spatial distribution of population is not uniform. Within such areas of underpopulation or overpopulation, there may well be small areas with high or low densities; (ii) the calculation is likewise based on total land area, which can be misleading, for the proportion of cultivable land may be very small; (iii) the most important weakness is that a mere statement of population density without reference to the population/ resource situation is almost meaningless. According to Ojo,[2] "... the notion of population density does not conjure up much more than the idea of so many people per square mile, or that of so many acres per head of population". His view presents the concept of population density as the relation of numbers of persons to the area effectively occupied by them, not to administrative or geographical areas.

In general, overpopulated areas are not synonymous with high population areas. An area that is densely populated may not at the same time be overpopulated when the resources available, and the organizational ability of its society, are examined. For example, two agricultural areas each with a population density of 300 to the square mile, will not necessarily have the same carrying capacity, if one is located on a nutrient deficient sandy ferallitic soil, and the other on a fertile, ferrisolic clay loam. Furthermore, the potential of both environments to support a given population, will become more difficult to establish when other factors are considered. These are: the physical characteristics

of climate, relief and soil, the systems of production, the tools employed, the level of investment, the type of crops grown, the organization of the society, the consumption levels and general standard of living of the people. In contrast, an area with a very low density could be overpopulated in terms of its resources. For example, some pastoral communities with a few persons per square mile, may be overpopulated in terms of the carrying capacity of livestock, due to low rainfall or poor pasture.

Density 'per se', therefore, does not necessarily imply overpopulation, nor does sparsity guarantee underpopulation. As Langdon White[3] has noted, "... if the degree and skill in the sparsely populated country be low, that country possibly is overpopulated; conversely, if the skill be high, and the natural resource base be strong, very high densities may occur without overpopulation."

From practical observations, a number of signs have been interpreted as indicators of a maladjustment between population and resources, and are most often seen in acknowledged intensively-settled rural communities, where most of the population lives by agriculture. Such signs include biological indications: malnutrition, hidden hunger and low calorie food intake, caused by recurrent famines and frequent food shortages; and social indications of overcrowding, housing problems and unemployment. Still other signs are agronomic or economic: small acreage of cultivated land per head, excessive fragmentation of holdings, increasing intensity of land use, over-cultivated or exhausted soils, declining yields of farm products due to lowering of fertility, and migration away from a geographic milie

All these indicators illustrate extreme cases of disruption of the population/land balance. The major drawback in using them as indicators of overpopulation is that they are purely qualitative, not easily amenable to quantitative treatment and, cannot readily be compared therefore.

The concept of overpopulation can be understood by examining a related, though theoretical concept - that of 'optimum' or 'ideal' population. Robbins[4] has described the optimum population as a "point at which population is neither too great or too small, but is such as to secure a maximum return per head under given conditions of production". By deduction, overpopulation is that population which is too great to achieve a maximum return per head; conversely, underpopulation would be too small to attain maximum return per head under the given conditions of production.

Carr-Saunders[5] has listed factors which determine optimum population as: (a) the natural resources available and the possibilities for exploiting them;

(b) the skill, endowment, knowledge and habits of the population;

(c) opportunities for trade and economic activity.

Given these factors, there would be an appropriate population to maximize income per head. As this is difficult to assess in practical terms, the concept remains a "rather vague and theoretical objective"[6] As many variables are involved, the term defies precise statistical

definition.[7] Furthermore, various levels of optimum population exist such as income optimum, employment and land optimum. Since these three optima may hardly coincide, the approach remains at best an "indicator of welfare".[8]

The above concepts for testing population in relation to available resources, according to Steel,[9] are of doubtful validity and raise many difficulties of definition. The necessity arises to search for a simple more meaningful and easily quantifiable model to describe human population in relation to exploitable resources.

Three models, the Economic Density Population Model, the Physiographic Density Model, and the Comparative Density Model, have been applied in Nigeria, but were found to give unsatisfactory results by shifting the main centres of population pressure away from critical areas.[10] Because of these anomalies, Duru[11] has called for the "perfection of the notion of Critical Population Density popularized by Allan", while Steel[12] described it as "... a field of research awaiting much more investigation by geographers than it has so far been given". It is thought that Allan's model in a much more refined form, is more likely to further the estimation of population/resource relationship, by pinpointing the stage of overpopulation at which critical resources, especially land, are likely to be exploited.

1.2 Scope of previous work in Nigeria, and summary of objectives

The case for overpopulation on land in most parts of Eastern Nigeria has frequently been made.

In 1938, Stamp[13] estimated the optimum population that the most densely settled parts of Eastern Nigeria would be able to support to be 134 persons per square mile. Grove,[14] outlined the three congested areas with densities of more than 300 per square mile in Owerri and Onitsha Provinces, and concluded that the "... overall population is probably close to the maximum, which can continue to be supported by the existing population", thus implying that the carrying capacity of these provinces was 300 persons per square mile.

Buchanan and Pugh[15] described the "... southeastern or Ibo nucleus as an area of high concentration of population, representing one of the most critical areas in West Africa". They further argued that the traditional system of shifting cultivation had become untenable as a result of population pressure, and consequent shortening of the fallow period, especially in Owerri and Calabar provinces, where population densities exceeded 400 persons per square mile. In this they seemed to suggest that the optimum population density of these areas was about 400 to the square mile.

Other comments on the population problem are more generalized statements on overpopulation. Church[16] has commented that "... there is severe population pressure causing periodic emigration... in the greatest cluster of population in Nigeria, east of the Lower Niger in Onitsha and Owerri provinces", and Jesufu[17] wrote that the population density in parts of Eastern Nigeria is "bordering on overpopulation". Dema[18] blames the poor nutrition in parts of Eastern Nigeria to overpopulation, claiming that the most crowded farmlands are in Eastern Nigeria, where

most families cultivated between 0.12 and 0.15 acres per person. Ojo[19] ascribes overpopulation in Eastern Nigeria to "land tenure, traditional methods of land use, the introduction of a cash crop economy, and rapid population growth consequent on improved health and a lowering of death rates". Other previous works on overpopulation in Eastern Nigeria, were based on social, biological, agronomic and economic indicators. Where attempts were made to establish a ceiling on optimum population densities, no clues were given as to how such a figure was derived.

This thesis sets out, therefore, to revalue the ideas of over-population in quantitative terms. It tries to apply Allan's Critical Population Density in Owerri Province, by establishing the human carrying-capacity of these areas in relation to their land-use system. A limit to population density will be established, expressed in persons per square mile, which parts of Owerri Province are capable of supporting. The assumption is made that the present methods of agriculture and land available remain unchanged. The study is not aimed at strictly 'copying' or extending Allan's ideas in a different part of Africa, but to determine the degree of its applicability, subject to certain amendments or modifications, in a part of West Africa.

It is not possible fully to consider all the variables - physical, social and economic - which affect the C.P.D. For instance, land is not the only means of support in Owerri Province. All of the 205 households sampled are known to engage in other income-earning activities, although the degree of engagement in non-farm activities varies, depending on land availability and the relative rewards of agriculture and other

income-earning activities. Any C.P.D. based on land alone would be an oversimplification, and would underestimate the carrying-capacity in terms of total resources.

The procedure adopted in this study is to exclude other income-earning activities and calculate C.P.D. on the basis of land alone; and second, to use a small sub-sample of 20 households based on total identifiable economic pursuits, to show the carrying-capacity of the area in terms of total resources.

1.3 An Outline and Evaluation of Allan's Critical Population Density Model

(a) Meaning and Definition

The term "Critical Population Density", was used by Allan in his book, "The African Husbandman", to describe the "human-carrying capacity of an area in relation to a given land-use system, expressed in terms of population per square mile ...", and was defined "... as the maximum population density the system is capable of supporting in that environment without damage to the land".[20] It is the level of density of population "... beyond which degeneration, leading to ultimate collapse, is bound to set in".[21] Max Gluckman, in a forward to Allan's book, described the C.P.D. for the different systems, as "a point beyond which the land would begin to deteriorate".[22]

The C.P.D. can be described as the marginal point of population density at which diminishing returns set in, either when population is increasing, or land quality is declining. It refers to optimum population density beyond which support derived from the land would gradually

fall off. It is a function of the population; its distribution, quality and rate of change, influenced by the systems of land use, and of environmental factors such as climate and soil. Moreover, opportunities for outside trade, seasonal migration and remittances from abroad also affect a realistic assessment of the C.P.D.

(b) Requirements for Estimating the Carrying-Capacity of Land

Allan lists the essential data required to formulate an estimate of the carrying-capacity of a traditional system of land use as:[23]

(i) a soil or land map based on a suitable form of land classification (V-S)

(ii) an estimate, for each of the land classes employed, of the proportion of the land which is practicable for cultivation under the prevailing system of agriculture; (P)

(iii) a survey of the customary land-usage of the people concerned with particular reference to the duration of cultivation and subsequent fallow of the soils of each land class; (L.U) and

(iv) an average for the acreage under cultivation per head of population at any one time. (C)

The formula for assessing Land Requirement per head of population is given as:

$$100 \text{ L.U X } \frac{C}{P}$$

when L.U is the Land-Use Factor,

C is the Cultivation Factor, and

P is the Cultivable Percentage of Land.[24]

(c) Assessment of Allan's Critical Population Density Model

Allan's concept has been described as a "theoretical analysis of high practical importance".[25] The study aids our understanding of over-population, by showing at what level of population density a situation turns critical. The C.P.D. Model is more specific than ideas of 'over-population' or 'pressure', and tends, if other things remain equal, to indicate critical levels of man/land relationship.

His formula for calculating land requirement per head of the population is original andingenious, and his derivation of the Land-Use Factor is a useful criterion for differentiating shifting cultivation from the more common agricultural practices of long-fallow, semi-permanent and permanent cultivation. Allan's work is a "Land Potential Model"[26] based exclusively on man/land relationship, a quantitative model devised for measuring the carrying-capacity of subsistence agriculture.

The concept of Critical Population Density has a number of weaknesses, however. It relates more to a simple, traditional society dependent more or less on land alone, and it is difficult to imagine such a society deriving all of its livelihood only from the land.

It was pointed out by Allan that in the estimation of the C.P.D. of traditional land-use systems in Africa south of the Sahara, the most intractable of the problems involved, is the assessment of the Cultivable Percentage of land, which is more likely to be based on "... observation and conjecture".[27] For instance, a repeat of the estimates of the Cultivable percentage of the Ndola Resettlement Area made by Wood[28] sixteen

years later, gave a general figure of 36, compared with Allan's 22.

It is difficult to evaluate the relative contributions of cultivable and uncultivable land. The uncultivable land could be used for grazing, timber production, collection of wild fruits, vegetables and oil seeds, gathering of firewood and ropes, tapping of wine, and hunting of game. It is possible that in an area of predominantly poor soils or hoe culture, or one where the cultivable percentage of land is very low, the cash contributions from uncultivable land, may exceed those from agriculture, especially if the materials produced - wine, timber, meat - are highly priced. In such circumstances, a C.P.D. based only on the proceeds from cultivable land, would be greatly underestimated. Another important criticism of Allan's work is that it lays claim to some permanency, and Duru[29] has remarked that this is the greatest single weakness militating against its use in the Eastern States of Nigeria. He argues that in a rapidly changing society such as that found in Eastern Nigeria, no maximum figure of C.P.D. could be expected to remain valid for more than one farming season.

The accurate derivation of the C.P.D. rests upon the stability of factors which are essentially dynamic variables. Allan's Concept of C.P.D., like other theories on population pressure, is volatile and acceptable only at a given point in time.

CHAPTER II

DATA AND METHODOLOGY

2.1 Data Problems in Agricultural Geography Research

In developing countries, agriculture accounts for nearly two-thirds of the National Income, and employs about four-fifths of the population.[30] In Nigeria, it is the most important sector of the economy, and continues to be the largest contributor to the National Income. With forestry and fisheries, it accounts for over 60% of the National Accounts, provides over 80% of Domestic Exports, and employs nearly 80% of the working population.[31] In Owerri Province, 82.2% of the labour force (34.3%, men and 47.9%, women), were engaged in agriculture alone in 1952-53.[32] In 1965, agriculture in Eastern Nigeria, accounted for 70 to 80% of all visible employment of the active population, and contributed 55.4% of the Region's estimated Gross Domestic Product of £N545.6 million.[33] (£1 Nig.=$Can.3.05).

Despite its dominant position, research in agricultural geography in Nigeria, is at an early stage of development. This in Coppock's view,[34] stems largely from the nature of available data. The Agricultural Census of Nigeria (1950-51 and 1957-60), produced agricultural statistics of doubtful quality and a haphazard system of land-use classification.[35]

The problem of data in carrying out worthwhile and meaningful exercises in agricultural research has been stressed in the case of Ghana, where H.P. White[36] has noted that the "... study of economic geography in Tropical Africa is, except for external exchange, constantly hampered by lack of statistical material". Valid data on farm practices as crop yields, labour input, farm sizes and detailed local soil surveys, are often not available. This presents awesome tasks for the geographer for, as Grigg[37] has remarked, "the problem for the geographer, as distinct from the historian, is that he needs comprehensive data for either a consideration of distributions, or analysis of regional variations".

2.2 Data Sources and Techniques

This research was based exclusively on field survey and enquiry. Secondary sources available, (e.g. The Census of Agriculture, 1950-51 and 1957-60) were greatly limited in scope, and were used only where it was not possible to carry out field enquiry or checks due to limited time. Both large- and small-scale investigations were carried out with the active co-operation of local guides.

Sampling

At the outset, three of the four Divisions in Owerri Province most pertinent to the study were chosen - namely, Mbaise, Mbaitolu-Ikeduru and Owerri. The sampling design adopted was stratified and random. Three hundred questionnaires were distributed and 209 completed and returned, giving a response of roughly 70 per cent.

Soil and Land-Use Surveys

Eleven soil pits were dug and their profiles studied. These pits were distributed throughout the province, the choice for the site of pits depending on such factors as:

(i) relief and its accompanying drainage effects; (profiles I, II, 111).

(ii) semi-permanent to permanent-cultivated land; (profile VI).

(iii) farmland of long fallow duration; (profiles VIJ).

(iv) overfarmed or exhausted land (profile 1V).

These conditions for profile pit selection were met in order to explain variations or differences in soil fertility. Twenty-two soil samples from different horizons were taken. Field equipment consisted of a spade, an iron rod in place of a soil auger, a knife for clearing sites, and a field tape and compass.

Field notes included site characteristics, such as topography, drainage, vegetation and land use; and profile descriptions such as soil colour, texture, structure, organic matter content, consistence, root development and horizon boundary.

A full description of the soil profiles is given in Appendix 1.

Questionnaires

Two sets of questionnaires were prepared. The first was designed for use by agricultural officers in charge of the divisions, and was meant to show what existing data or knowledge on farm practices, soils and land use already existed in the province. Unfortunately, it

produced no useful result, as soil and land-use surveys had never been carried out, and the scanty records on farm statistics were claimed to have been lost during the Civil War.

The second set of questionnaires tested among farmers produced very useful results. Vital statistical information relating to acreage of land owned, amount cultivated in 1971, implements and farm expenditure, family labour input on the farm, crops grown and crop yields, and details of non-farm engagements were returned. Farmers were also expected to indicate if their area was overpopulated or not, to give reasons why they thought this was the case or not, and to suggest what they thought would amount to an acceptable solution.

Teachers and top-class high school students were trained to complete the farmers' questionnaires each, in respect of one family/household. All the questions were reviewed during the training, and the field workers were briefed on what to look for. The best approach to enlisting farmers' cooperation was widely discussed, and each worker was given 6 to 8 weeks to complete and return the questionnaires.

With regard to the questionnaire, a copy of which is reproduced as Appendix 2, the following explanatory comments should be made:

Family size or household in most cases, comprised more than one family, and was based on common ownership of land.

Farm sizes were obtained by planimeter measurements using chain and compass. Some field workers used 'stepping' or long, erect bamboo sticks to measure distances. The general practice was to divide the farmland into measurable rectangles, squares, triangle or other convenient figure,

and to calculate the area in acres.

Fallow periods and the number of years of cultivation were assessed during interviews.

Land Requirements per head for the family were estimated on the basis of the present performance of available land, using Allan's formula.

Family Labour Input in man-days was based on monthly checks. Questions such as when the farmer leaves for work each day and returns home, and days on which he abstained from farmwork due to illness, holidays and local feasts, helped the questioner to estimate the hours per day and the days per month put into farmwork. Comparison of time spent on the farm by different families led to the establishment of seven man-hours as one man-day. The work ability of men and women was taken as equal, while differences between the age groups were considered. Men and women 21 to 45 years old were assigned a labour unit of 1; children between 7 and 14 years 0.25, age groups 15-20, 0.5, adults 46-55, 0.75 and those 56-65, 0.5. Children less than 6 years of age, and adults over 65 were excluded.

Crop Yields. Data on these was obtained from the number of baskets of a particular crop type harvested, usually an acre. The average weight of one basket of each type of crop, was calculated from the weighted mean of at least ten different such baskets, using a spring balance.

Family Need for Foodstuffs was worked out on an annual basis, estimated on the weekly family consumption of food.

Market Surveys were carried out to establish the prices of the different food crops based on the weight of one standard basket.

The whole aim of the exercise was to lead the farmer through questions,

suggestions, memory 'tuning', comparison, evaluation, frequent visits and small tips, to supply reliable answers, which could be used by the field-worker to complete the questionnaires.

Cultivable Percentage of Land. This was based on the Nigerian Census of Agriculture (1951-53 and 1957-60), which gave the cultivable area of Owerri Province as 96.5%. This means that the remaining 3.5% would be accounted for by roads, houses,village and public squares, markets, and uncultivated forests, swampland, and fetish groves. This figure was found to be acceptable, and was used.

Population Density Figures. The population density for the entire province was taken from the Nigerian Census figures of 1963, and the 1962 Mid-Year estimates of the Population Studies Centre at Ibadan University. The population density figures for the divisions were not available. However, facts on these were gleaned from the population density figures of the other heavily populated areas in Orlu, Awka, and Uyo Divisions, which exist in the same population 'problem area' as Owerri, and from the general literature on population. Estimates of the agricultural population density were also made from the sample population survey.

References on census-taking in Nigeria by Okonjo[38], Udo[39], Duru[40], and Oluwasanmi[41], suggest serious limitations of the reliability of census figures, particularly as a basis for planning. The 1952-53 census is prejudiced by facts of undercounting and omission of large areas. The 1962 census was not published owing to irregularities, while the 1963 figures hardly received countrywide or outside recognition. The 1963 figures which are the only officially recognised, up-to-date figures for

the country and which are widely quoted, were used.

2.3 Data Storage, Transfer and Processing

The completed questionnaires were transferred to punched cards to facilitate analysis. Data processing for the study was carried out on the I.B.M. 7040 computers at the McMaster University Data Processing Centre.

Statistical Analysis. Linear and Multiple Correlations were used to test the degree of association between farm variables. The Spearman Rank-Order Correlation was used to evaluate the relative incomes from agriculture and other non-farm activities.

Soil Analysis. The following soil tests were performed:

(i) percentage air-dry moisture was determined by oven-dried sample at 105°C and 110°C.

(ii) loss on ignition % was determined on a sieved fine-earth sample less than 2 mm), oven dried at 550°C and 850°C.

(iii) % coarse, medium and fine sand was carried out by dry seiving, while silt and clay fraction were determined by the pipette method.

(iv) pH was determined by using glass electrode in soil paste (5 gm soil to 25 ml H_2O).

(v) organic carbon was determined by the Walkey and Black Method.

(vi) exchangeable bases (C.E.C.) were determined in 1N ammonium acetate at pH 7

CHAPTER III

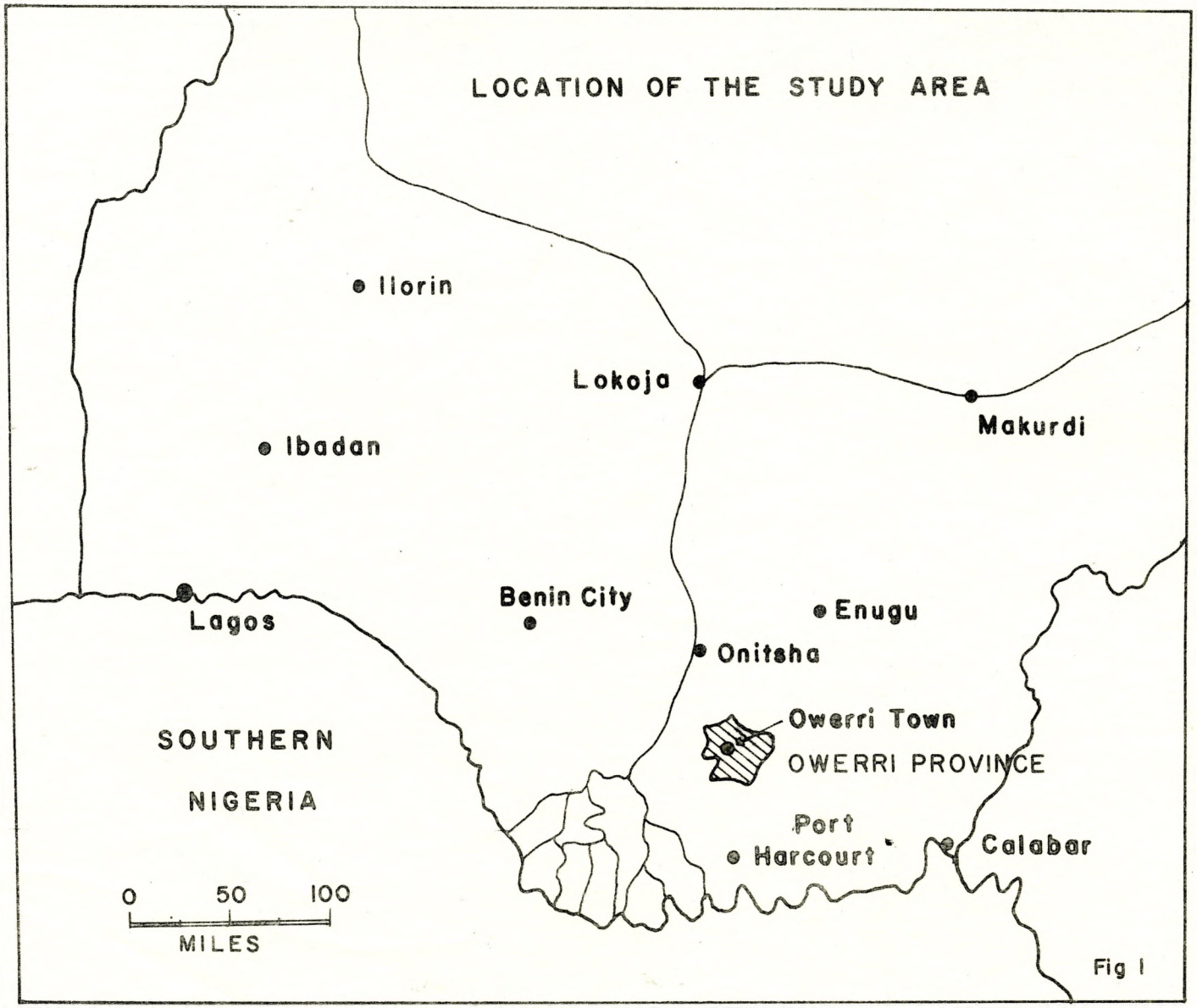
NATURE OF THE STUDY AREA AND THE ENVIRONMENT

3.1 Location and Area

Owerri Province, including Oguta Division, covers an area of 1,085 sq. miles (2813 sq.km). Its geographic position is defined by 6°65', 7°23' East Longitude, and 5°25', 5°38' North Latitude.[42] The eastern boundary is the Imo River, separating it from parts of Umuahia and Aba Provinces. It shares its southern boundary with Etche and Elele Divisions in Port-Harcourt Province, while its Western Division of Oguta terminates at the banks of the Niger. The northern outskirts of Owerri, and Mbaitolu-Ikeduru Divisions, adjoin the southern parts of Orlu and Onitsha Provinces. The area surveyed for the purpose of the present study, is less than that originally defined for the province, covering only about 700 sq. miles in extent.

3.2. Geology

The entire area of Coastal Plain Sands overlies consolidated Young Sedimentary Rocks of Lower Cretaceous to Tertiary origin[43] Sedimentation began in Cretaceous Time when the sea transgressed widely over the land, and most of the superficial deposits were laid down. These in turn, were overlain by Eocene and Pliocene Sands, the most recent being the Unconsolidated Sands of Pleistocene Age. Usually, these sands


LOCATION OF THE STUDY AREA
Ilorin
Lokoja
Makurdi
Ibadan
Lagos
Benin City
Enugu
Onitsha
Owerri Town
OWERRI PROVINCE
SOUTHERN
NIGERIA
Port
Harcourt
Calabar
0 50 100
MILES
Fig 1

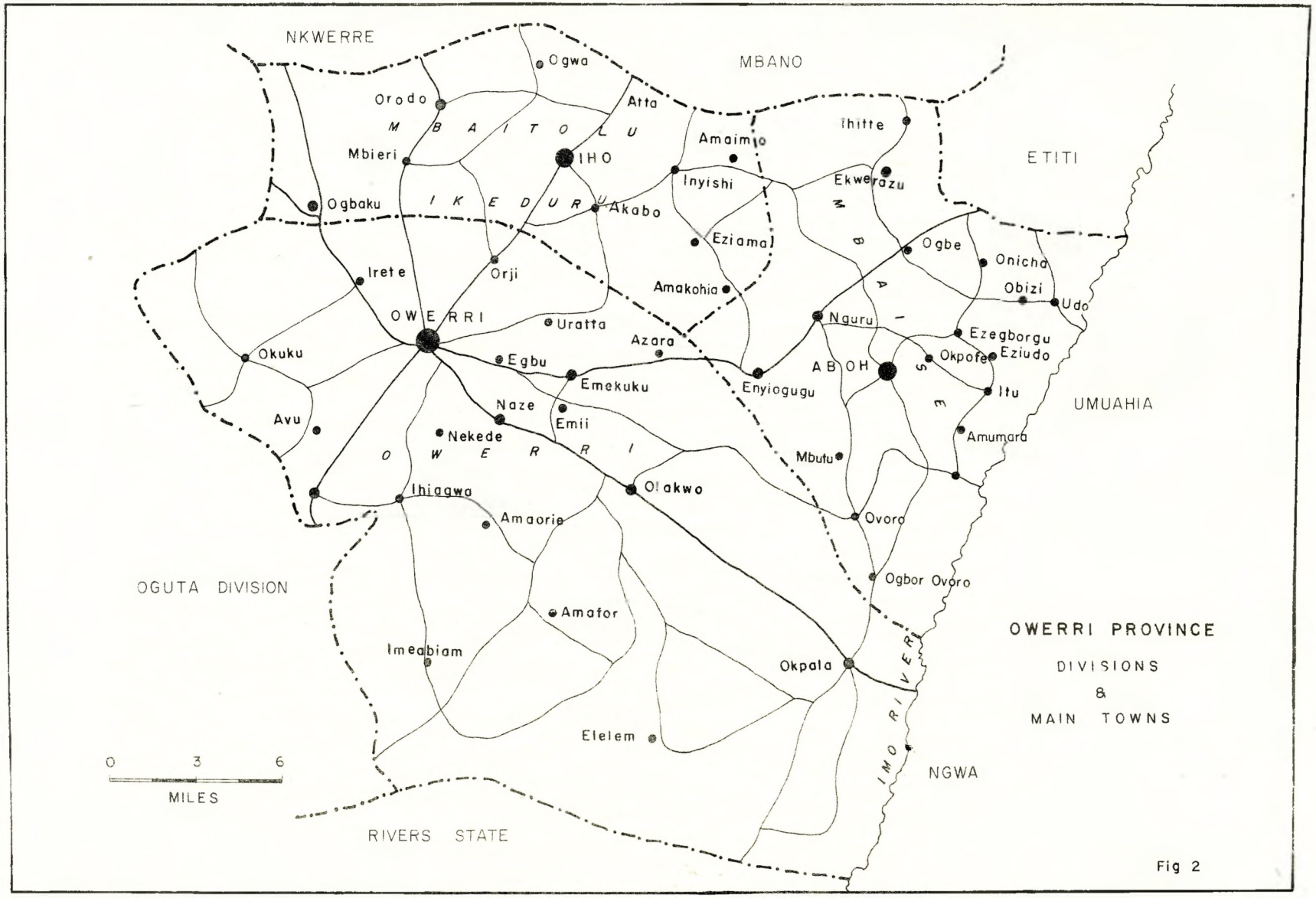

NKWERRE
MBANO
ETITI
UMUAHIA
OGUTA DIVISION
RIVERS STATE
NGWA
Ogwa
Orodo
Atta
MBAITOLU
Mbieri
IHO
Amaimo
Ihitte
Inyishi
Ekwerazu
Ogbaku
IKEDURU
Akabo
Eziama
NBAA-ISE
Ogbe
Onicha
Irete
Orji
Amakohia
Obizi
Udo
OWERRI
Uratta
Nguru
Azara
Ezegborgu
Okuku
Egbu
Okpofe
Eziudo
ABOH
Emekuku
Enyiogugu
Itu
Naze
Emii
Avu
Nekede
Amumara
OWERRI
Mbutu
Ihiagwa
Olakwo
Amaorie
Ovoro
Ogbor Ovoro
Amafor
Imeabiam
Okpala
IMO RIVER
Elelem
0 3 6
MILES
OWERRI PROVINCE
DIVISIONS
&
MAIN TOWNS

Fig 2

are masked by a Red Earth, which may be 40-60 ft. thick, but which is considerably shallower on valley slopes.[44] Reyment[45] groups these Unconsolidated Sands, known variously as the Benin Sands (Parkison, 1907), the Coastal Plain Sands (Tattam 1944, Simpson, 1955, Reyment and Barber, 1956) collectively as the Benin Formation.

3.3. Relief

Owerri Province forms part of the great lowland plain between the Niger and the Cross Rivers - an area of low relief generally below 1,000 ft. Elevation varies between 200 ft. in the south and south-east of the province, to about 600 ft. in the north and north-east.[46] The greater part of the province lies between 200 and 400 ft. Excepting the relatively small areas of strongly undulating relief in the northern vicinities of Ikeduru and Owerri divisions, which form the southern extension of the Enugu-Okigwi cuesta, the land surface is gently to very gently undulating. The general trend of descent, is in the direction of the Imo River Basin. On the whole, the province is easily traversed by road, but suffers from a dearth of rivers and streams.

3.4. Climate

The annual means of daily maximum and minimum temperatures in Owerri are 87.8°F and 70.7°F respectively. (Table I), and the annual mean of average daily temperature is 79.4°F. The deviation between the annual average maximum and minimum mean is relatively small, which indicates small variation of temperature throughout the year.

Owerri Province has two main seasons - the wet and dry, located within a high rainfall region. It receives 97.1 ins annually (Table I). The average monthly mean is 8.09 ins, and there is no month without rain. The rainly period lasts from April to October, with early showers in March. Rainfall durations of 8 to 10 hours are faily common during the heavy rainfall season. There are two rainfall maxima occurring in July and September, with the usual 'little dry season' occurring in August.

The data in Table I is rainfall averages over a period of years, and does not reflect fluctuations from year to year. Yearly fluctuations are not as significant agriculturally, as the variation of onset of the rains. Although figures are lacking, farmers have noticed intermittent delays in the onset of early rains for a period of eight years, up to and including 1971.[47] Late rains result in appreciable losses in seed-crops, and could affect yields, especially of yams, very adversely.

Seasonal variation of humidity is slight, but short periods of low humidity can occur in January or February. The mean relative humidity varies from about 90% to 95% at dawn, and from 60% to 65% in the early afternoons.

An extrapolation of the potential evapotranspiration for Moor Plantation, Ibadan, would show that a period of 'water deficit' exists in Owerri between December and May, and a period of 'water surplus' from July to October.[48] The early rains of March and April would be used for soil moisture recharge. The question of water shortage from December to March, is emphasized by lower atmospheric humidity, higher temperatures, and greater windspeeds of the dry harmattan.

TABLE I

TEMPERATURE AND RAINFALL STATISTICS FOR OWERRI PROVINCE

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Monthly Mean Maximum	91	92	93	91	89	86	82	81	83	87	88	90	87.8
Monthly Mean Minimum	69	72	73	72	72	71	70	69	70	70	71	69	70.7
Rainfall in ins.	0.9	1.7	4.6	8.9	10.8	12.1	14.1	13.0	16.2	11.1	2.8	0.9	97.1

SOURCE: (a) Temperature Figures - Holy Ghost College, Owerri, Weather Records 1965-1967.

(b) Rainfall Figures - T.A. Phillips "An Agricultural Handbook' (Longmans) p.208.

One important feature for agriculture, is that during the dry season months of December to February, the upper 8-10 ins of the soil profile dries up and becomes hard, while during the heavy rains, especially from July to October, the soil is saturated with moisture resulting in heavy leaching of soil nutrients downwards beyond the reach of crops. These two extreme conditions of water deficit and water surplus, significantly limit both the time of cultivation, and the performance of crops.

3.5. Vegetation

Under the prevailing climatic conditions, the climax natural vegetation in Owerri is considered to be the Tropical Rain Forest. A typical Rain Forest vegetation would be a three-storey forest (P.W. Richards[49], Keay[50], Lawson[51]) in which there is a dense forest with deep-rooting vegetation, producing much organic matter which is rapidly mineralized.

However, in all parts of Owerri, a heavy biotic pressure due to human occupation, has been superimposed on the vegetation-soil pattern. Under the influence of a high agricultural population, practising a rotational bush-fallow system, very little forest remains, except relics of forest reserves and sacred groves. Even these relic forests are known to have been farmed some 50 to 80 years ago.[52]

The most extensive vegetation type observed during the survey was the Oil Palm Bush. It is a poor to rich secondary bush, 10 to 30 feet high, dominated by numerous tall oil palms (Elaeis guineensis), and a few other economic trees, interspersed with the vegetation. Near to the

homes, the oil palm bush changes to oil palm groves, with a high density of palms per acre. (Plate 15).

Secondary forests of tree growth 15 to 50 feet high, with occasional oil palms and scattered emergent tall trees, 70 to 80 feet high below which there is a lower stratum of thicket growth, are rare and are found only in Umukabia, Imeabiam, Amafor, Nekede and Ohaji, which have large areas in fallow for 8 to 15 years. Secondary bush regrowth characterizes areas with less than 8 years of fallow; consisting of thick woody small trees up to 15 feet high. A typical floristic composition of a 5- to 8-year fallow land is Acioa barteri, Dialum guineensis, Parinari speciosa, Sida spp. and Alcornea cordefolia. The mature trees of these species are a good indication for judging the maturity of fallow land.

Broken forest exists in a belt 23 to 50 yards along both sides of the banks of the Imo River, and numerous swamplands, carrying mainly Raphia and other palms, have been exploited for wine and thatch.

Dominantly grass with shrub vegetation, is found throughout the province in areas of very short fallows of 1 to 3 years duration and evidence of recent cultivation is apparent in the form of cassava stalks, old yam stakes and mound remnants.

3.6. Soil Characteristics

Eleven soil profiles were studied. These exclude profiles on road-cuts and excavation pits, which were examined without taking field notes. The mechanical and chemical analyses of 8 soil samples taken at a depth of 0-6 ins, which illustrate the essential characteristics of

soils in Owerri Province is set out in Table 2. Almost all the soils studied were found to possess very similar diagnostic characteristics of physical, and to a lesser extent, of chemical properties.

(a) Physical Characteristics

Soil horizon boundaries are not properly differentiated, especially in the lower horizons. Clear boundaries exist only between the upper 0-10 ins, and the lower horizons, due to organic matter colouring.

Texture. All the soils analysed, with the exception of profile III, contain more than 80% sand, and less than 15% of silt and clay. They are essentially friable, porous sands. Profile III is a loamy sand, with 74.9% sand, and 25.1% silt plus clay. An important feature in the composition of sand, is the preponderance of fine and medium sand, and very little coarse material.

Soil colour ranges from the dark-reddish black and dark-reddish brown of the up-slope wooded soils, to the dark-reddish brown, reddish-brown, or dark brown soils of adjacent valley areas and frequently-cultivated areas. Differences in colour are due mainly to organic matter content and drainage conditions. A common characteristic of all the soils studied, is the increasing redness of the soil with depth.

Soil structure is weakly developed, ranging from loose, structureless sands (Profiles I, IV, VIII), to weakly friable, or friable soils (Profiles II, V, VI). Profile VII and the lower part of Profile V, have fine to medium weak crumb structure. This is probably due to the binding effect of organic matter, and the action of soil bacteria, resulting from a longer period of fallow. Medium to strong crumb in the upper horizons,

and large granular structure in the lower horizons are defined especially for Profile III, which is due to higher silt and clay content.

Field Moisture Percentage for all the soils, except profile IV, is above 10%. Higher figures of 21.3% obtained for Uvuru soil, may be due to a higher content of organic matter, while the still higher figure of 34.4% for profile III, is due to the higher content of clay (13.5%), and silt (11.6%). The comparatively lower field moisture content of 13.3% in the Ohaji soil, with the highest content of organic matter, may be due to the wealth of forest cover, and the litter covering the soil surface.

(b) Chemical Characteristics

The chemical analyses performed, reflect the importance placed on those soil characteristics which determine, especially, the agricultural value of the soil.

Organic carbon content is concentrated mainly in the upper 1-5 ins of the profile, and has a value of between 1 and 4%. The low organic carbon content of 0.88% for profile IV, reflects the impoverished exposed nature of Ekwerazu soil in Mbaise. The high figure of 4.29% for Ohaji soil reflects the long years of fallow, and non-cultivation, for many years.

Soil Acidity. pH values were between 4.3 and 5.5, and represent moderate to strongly-acid soils. The lowest figure of 4.3 for the Ekwerazu soil, could be explained by the extreme porous nature of the organic matter-deficient sands, which promotes excessive percolation of surface water, and enhances the lack of bases in the organic matter.

Exchangeable bases are low for most of the soils, being in general, less

TABLE 2

SOIL ANALYSES OF SURFACE HORIZONS : OWERRI PROVINCE

Profile 0-6"	I	II	III	IV	V	VI	VII	VIII
Location	Ezi-East	Amakam Ezi-East	Amakam Ezi-East	OPI Ekwerazu	Uvuru Ezi-West	Agric.Farm Owerri	Ohaji Farm Settlement	Iho Ikeduru
%Field Moisture	10.4	17.9	34.4	6.0	21.3	15.5	13.3	12.6
Loss on Ignition	3.2	4.1	7.3	2.2	4.4	6.9	11.4	6.1
Coarse Sand	8.3	5.1	6.5	3.1	5.7	4.4	4.3	5.6
Medium Sand	34.8	38.3	28.7	43.3	37.0	38.5	36.3	38.6
Fine Sand	45.3	43.0	39.7	49.2	42.6	43.3	50.6	48.7
Total Sand	88.5	86.4	74.9	95.6	85.3	86.2	91.2	92.9
Silt Pct.	6.8	7.8	11.6	2.1	8.5	7.7	5.1	3.3
Clay Pct.	4.7	5.8	13.5	2.3	6.2	6.1	3.7	3.8
pH	4.9	4.7	5.2	4.3	4.6	5.5	5.2	4.8
Organic C	1.02	2.01	2.34	0.88	2.47	1.99	4.29	1.26
C.E.C.	6.8	9.4	13.9	5.6	15.5	9.7	20.68	7.1

PLATE 1. Amakam Ezinihitte, Owerri. Cross section of Soil Profile I. Observe the eroded irregular bare surface and the underneath charcoal layer.

PLATE 2. Ekeogba Road, Ohaji, Owerri. View of Soil Profile VII. Notice the lack of horizon differentiation, and the largely preserved upper leaf structure. Contrast the soft loose to weak friable upper 1 - 23 ins. with the slightly hard to hard 24 - 60 ins.+

PLATE 3. Farm Implements, Owerri Province. From right to left are the hoe, long basket, machete and axe. Depth of hoeing is about 5 - 6 ins. and the irregularly-shaped mounds are made for cocoyams.

PLATE 4. Oparanadim-Nwafor, Ekwerazu, Owerri. Site characteristics of Profile IV with poor Guinea grass, numerous weeds and open, bare soil surface. Abundant shrubs and oil palm bush in the background.

than 21 meq/100 gm. The low cation exchange capacity, is in keeping with the low percentages of clay and organic matter. Higher C.E.C. figures of 13.9, for the loamy sand of the Imo Banks, Ezinihitte, is probably the result of a higher clay content, while C.E.C. values of 15.5 and 20.68 meq/gm recorded for Uvuru and Ohaji soils respectively, are probably due to their higher organic matter content.

(c) Implications of the results of the soil analyses for soil fertility in Owerri Province

A fertile soil has been defined as one that has sufficient nutrients to produce the plant growth that may be required, without additions of one or more nutrients.[53] Soil fertility depends on the physical and chemical properties of the soil, and on the system of soil management.

The soils in most parts of Owerri are chemically poor, but physically very good. The sandy texture, loose consistence and weak, friable crumb structure, permit easy root penetration and allow free surface and good internal drainage. This makes for balanced aeration, but it also causes poor moisture retention, especially during the dry season. In the dry season, the clayey sands become very hard and cracks develop. In the rainy season such are poorly drained, and present problems of workability under the present system of hoe-culture. (Appendix I).

The main reason for the poverty of the soils, is their low content of clay and organic matter. Clay and organic colloids hold essential plant nutrients on their surfaces, and by exchange processes, release

them for absorption by plant roots. The low content of clay, in almost all the soils studied, is due to the nature of the parent material from which the soils are derived - the Coastal Plain Sands overlying sedimentary rocks. The low content of organic matter is due to the slow rate of organic matter accumulation, following the gradual disappearance of the forest cover, and the reduction in the length of fallow. The rapid deterioration of the humid forest soils under cultivation, because of leaching and oxidation of organic matter, necessitates long fallowing to maintain soil fertility. Vine[54], Nye and Greenland[55] and Laudelout[56] have shown that the organic matter build-up and restoration in the soil, is faster under forest-covered soils, than under grass-covered soils. With increasing shortage of fallow, and the continuous cropping of the land, shrubs and grass fallows have replaced the forest in most parts of Owerri. Fertility reserves have been depleted in the absence of any artificial means of restoring them.

In most parts of the Province, the crucial problem of soil fertility has been complicated by increasing population growth, with its resultant small acreage per head. The direct consequence is over-cultivation of available land, further soil degeneration, and a gradual decrease in crop yields.

(d) General considerations

It would be worthwhile, to conclude this section on soils, by attempting to relate the soils of Owerri to other Nigerian soils, and to their place in the World classification.

In Vine's comprehensive classification of Nigerian soils (1954),[57] the soils of Owerri Province, would be found mostly in the "... predominantly reddish, friable, porous sands developed over sedimentary rocks ... on well drained and fairly well drained soils", which are "moderately to strongly leached", and of "low to medium humus". His class of "yellowish brown porous sands to sandy clays", on well drained to poorly-drained soils, would compare with the soils found on both sides of the Imo River banks.

Identical, dominantly red or yellowish-brown ferallitics, on loose sediments derived from coarse-grained sandstones, on very gently undulating plains, have been studied by Tomlinson,[58] and are known to occur extensively in N.W.Sokoto, the area between Gombe and Bauchi, and the western parts of the trough containing the Niger and Benue Rivers.

Smith and Montgomery, in "Soils and Land Use in Central Western Nigeria", (1956),[59] have also delimited ferallitics on unconsolidated sediments, with dominant red and yellowish-brown colours.

Following Bramao and Dudal[60](1957), soils in the study area would be classed as "Red-Yellow latosols", with a dominant red to yellow colour, formed on acid sediments in an undulating topography.

In D'Hoores' Soil Map of Africa, produced by the Inter-African Pedological Service (S.P.I.),[61] soils classed as Ferallitics on loose sandy sediments, or clayey sands, with dominant red or yellowish brown colour, would correspond to those studied in Owerri Province.

In the classification of the Seventh Approximation by the USDA, (1960, 1967),[62] most of the soils studied in Owerri would be placed in

the Order of Oxisols, characterized by an oxic horizon, and very low C.E.C. values. A few footslope soils and especially those close to the Imo River would be in the Order of Ultisols, characterized by clay accumulation, poor exchangeable cations, and no oxic horizon. There are also Inceptisols, following annual flood water debris accumulation.

To sum up, Owerri soils are typical red or yellowish-brown feralitics, developed on loose sandy parent material. They are poor in mineral nutrients, possess a low pH values, and have a loose to friable consistency. Organic matter content is low, except where land has been under fallow for many years. To maintain their stability, and conserve them for food production in the absence of mixed farming and use of fertilizer, a lengthy period of fallow is necessary. The land acreage per head of the farming population, which will ensure adequate fallowing and good soil management under the present system, will be the subject of investigation in the next three chapters.

CHAPTER IV

LAND USE AND AGRICULTURE

In Chapter III, the environmental characteristics of Owerri Province were described, with a view to providing a background understanding of those factors, which affect soil fertility in particular, and the systems of agricultural production in general. In this chapter, the main features of land use and agriculture in the Province, will be discussed, concentrating on the main issues; the essential characteristics of the bush-fallow system, the problem of land availability, the nature of land tenure and fragmentation, the techniques of land preparation and crop production and the crop types and cropping systems.

4.1 Type of Agricultural Practice

Basically, all available land is devoted to food crops, cash crops being interspersed among the food crops, on both garden (compound) and farmland. Agricultural practices and enterprises are essentially the same throughout the province. The system of agriculture practised makes use of fallows to restore, or improve, the fertility of the soil. After one to four years of cultivation, farmers must needs abandon the cultivated land to secondary grass, shrub, bush or forest fallow, for a period ranging from one to fifteen years, depending on land availability. After this rest period, the land is cleared and burnt again for a new cropping cycle.

Five fallow types, based on the number of years for which land is rested, are identified for this survey:

(a) Semi-permanent to permanent cultivation: based on farmyard manure and grass fallow, sometimes with or without fertilizer. Usually, one to four years of cultivation, followed by only one to two years of fallow is the rule, and the Land-Use Factor (L.U.) is less than two.

(b) Rotational grass or bush fallow of short duration in which one to three years of cultivation are followed by one to three years of fallow. There is no application of farmyard manure or fertilizer, and the L.U. is less than two.

(c) Rotational-bush fallow system with short to medium fallows. Crop/fallow time ratio is 1-3/2-5 years. L.U. is between two and three.

(d) Rotational-bush fallow with medium to long fallow, with one to three years of cultivation, followed by five to seven years of fallow. L.U. varies between three and five.

(e) Rotational-bush fallow system, with long to very long fallows. Usually 1-3 years of cultivation are succeeded by 10-15 years of fallow. L.U. most often varies between 5 and 8, and is invariably less than ten.

The term, 'permanent cultivation', does not always have the meaning of permanency of tenure. Around homesteads, where cultivation is carried on with the aid of dung from domestic animals and other household refuse, permanency of cultivation depends on maintaining adequate soil fertility. In areas of land shortage - especially on farmlands, where no manure is used - repeated cultivation of the same piece of land may go on, in spite of the poor fertility status of the soil. Permanent

cultivation land, as used in this literature, therefore, has a double connotation. It refers both to good and poor quality land, intensively cultivated on a permanent basis.

'Short', 'medium' and 'long; fallow, as used in this text are relative terms, based on what the farmers themselves considered to be the appropriate fallow periods in their own case. Short to medium fallows were more prevalent in Mbaise and Mbaitolu-Ikeduru Divisions, and in those parts of Owerri Division which experience land shortage problems. The Land-Use Factor for all parts of Owerri Province, calculated from crop-fallow time ratios, ranges from 1.1 to 6.2. From available evidence, no part of the province is likely to have a L.U. of 10 (Table 3), suggesting that "shifting cultivation" is not practised.[63]

For a long time, there has been some confusion in the use of the term "shifting cultivation", much of which turns on the point whether it is only the cultivators' fields, or the homes as well as the fields, which shift. A UNESCO Commission on World Land-Use Survey (1952),[64] recommended that "land rotation" and "shifting cultivation", should be used significantly for the two types of practice. Vine[65] has suggested that "shifting agriculture", refer to the growing of short-term crops on land dependent on natural regenerative processes, during definite or indefinite fallow periods for raising fertility to adequate levels. It is often pointed out that rotational bush-fallowing developed out of shifting cultivation, as a result of a trend towards fixed settlement.[66]

Rotational bush fallowing has often been criticized as being wasteful of land, and capable only of supporting a low population density,

TABLE 3

DISTRIBUTION OF LAND-USE FACTOR (L.U.) BY FAMILIES/HOUSEHOLD IN OWERRI PROVINCE

L.U.	Mbaise Division		Mbaitolu-Ikeduru Division		Owerri Division		Total Province	
	No. of Garden Families	Pct.	No. of Garden Families	Pct.	No. of Garden Families	Pct.	No. of Garden Families	Pct.
<2	68	70.8	34	68.0	21	35.6	123	60.0
2 - 3	28	29.2	16	32.0	13	22.0	57	27.8
3 - 4	-	-	-	-	16	27.1	16	7.8
4 - 5	-	-	-	-	5	8.5	5	2.4
5 - 6	-	-	-	-	3	5.1	3	1.5
6 - 7	-	-	-	-	1	1.7	1	0.5
Over 7	-	-	-	-	-	-	-	-
TOTAL	96	100	50	100	59	100	205	100

requiring a far greater acreage of land than cultivation, for fallow must be available for each year's cultivation. Other criticisms are that a system which depends on fallowing the land as a means of maintaining soil fertility is incapable of "raising food production per head in agriculture".[67] Nye and Greenland[68] argue that in the forests the system is the best that could have been devised, while in the savanna, there is far less to be said in favour of it.

Pelzer[69] thinks that the least imaginative approach to the problem of shifting cultivation in development, is that of outlawing the practice, without showing the cultivators an alternative, more intensive, type of land use,and without making certain that shifting cultivation is not sound in the social and environmental conditions, under which the cultivators live.

The critical factor in the assessment of the unsuitability or otherwise of the system, therefore, seems to be the density of population, or the amount of cultivable land available per capita. Once the density of population reaches a point at which adequate fallowing is impossible, then the system breaks down, and must be replaced by one in which the same amount of food must be produced from a smaller area of land continuously cropped. Abundant evidence exists to show that the system has broken down in most parts of the study area, and that increased pressure on the land has led farmers to shorten the fallow period and prolong the cropping period, thus reducing the fertility of the soil, and the vigour of the forest regrowth.

For the present study, Rotational-Bush Fallowing, after W.B.

PLATE 5. Umumme Uvuru, Mbaise. A Two-Year fallow on good soil. Observe the preponderance of, and healthy appearance of the grasses, herbs and shrubs, and the general absence of trees.

PLATE 6. View of Cultivated 8-Year fallow, Amafor, Owerri. Healthy appearance of cassava in foreground. Trees (with branches lopped off) are left for firewood, or provide support for climbing plants.

PLATE 7. Ekeogba Road, Ohaji Farm Settlement, Owerri. Mature Relic forest (80 yrs.), closely typical of the Tropical Rain Forest. The three-storey structure are apparent from the photograph.

PLATE 8. Preserved Relic forest on superstitious groves, Inyishi, Mbaitolu-Ikeduru. Observe the climber tangle and hanging lianes and a two-year fallow on foreground.

Morgan,[70] is used to describe the type of agriculture practised in Owerri Province. It is the system of agriculture, which is characterized by a rotation of fields rather than crops, by clearing and burning of bush, and by short to long periods of cropping, alternating with short-, medium-, or long-fallows.

Maintenance of fertility is achieved mainly by natural regeneration of secondary forest, bush, shrub or grass regrowth, aided by kitchen refuse or animal manure. Occasionally, fertilizer where available, or justified by experience, is used.

Draught animals and tractors are absent. The chief tool is the hoe, and human labour is often inefficiently used. Farm expenditures are low, and the farmer's economic position hardly improves from year to year.

A subsistence yam-cassava-maize-cocoyam culture is the rule, but it is difficult to draw a clear distinction between subsistence and cash-farming, since the agricultural type is devoted mainly to food production for local consumption, but also includes a varying proportion of cash cropping.

Livestock is kept, but are not well integrated into the farming system. Cattle are rare; sheep, goats and fowls contributing a significant proportion of the farmer's income. Sheep and goats browse on rough grasses, shrubs and trees in the uncultivated bush after harvest time. Throughout the growing season, they are tethered in the compounds and are fed on crop residues and fresh grass and branches cut from the bush. With the exception of a few literate farmers who rear fowls under

PLATE 9. Well-managed fallow land, Eziagbogu, Mbaise. Rows of Acia bateri planted to improve fertility, and provide stakes for yams. Compare the original vegetation of an unplanted section in the foreground.

PLATE 10. St. Mary's School, Atta, Ikeduru. Compost heap (5 ft. high; base 20 ft.) prepared for the school farm. The more decomposed material already in use is to the left of the photograph.

PLATE 11. Government Farm, Nekede, Owerri. Luxuriant second maize crop produced with fertilizer. This practice is now only possible in Colleges, government farms or large cooperatives.

PLATE 12. Eziudo, Ezinihitte, Mbaise. Productive, well-managed garden land. Observe the big crop of yam (carried), the tall erect staking, and the properly-spaced interplanted crops.

modern methods and make use of poultry feed, the majority of farmers house the birds in pens only at nights, setting them free during the day to fend for themselves.

4.2 Crop Types and Crop Acreage

The major crops grown are yams (Dioscorea spp.), cassava, (Manihot utilissima), cocoyams (Xanthosoma sagittifolia and Colocasia esculenta), and maize (Zea mays). Interplanted crops are okro (Hibiscus esculentus), yam beans (Sphenostylis stenocarpus), groundnuts (Acachis hypogea), melon (Citrullus vulgaris), and fluted pumpkins (Telfairia spp.)

Usually freshly-cleared fallow land is opened with yams, interplanted with maize and a variety of vegetables, with or without cassava at a later stage. These are then followed by cassava in the next farming season, or left to fallow.

Yams follow freshly cleared medium to long fallow (except on garden land) in the cycle, because of the high soil nutrient demand by yams, especially nitrogen. Cassava is planted in any order, being a hardier crop, and is more tolerant of exhausted soils. It can thrive on land that has been cultivated for several years. Yam, on the other hand, is a luxury crop, and is the first choice on better soils because a large proportion of the harvest has to be preserved for the next year's planting. It is also a demanding crop to cultivate because of the labour required in hoeing, seed bed preparation, staking, digging, washing, curing and stacking. Because of the reduced soil fertility in the heavily-populated areas due to over-cultivation, yams are no longer

PLATE 13. Azaraegbelu, Emekuku, Owerri. Cassava thriving on over-cultivated soil. Contrast the healthier crops on the receiving lower slope (foreground) with the poorer cassava on the eroded upslope. Scattered maize plants.

PLATE 14. Umudim, Ezinihitte, Mbaise. A typical crowded mixed-cropping. There are at least ten different crops - maize (harvested), yams (bottom right), cassava (predominant), fluited pumkin (top centre), groundnuts (centre right), melon (round balls), okro (foreground), three-leaved yam, yam beans and cocoyams.

PLATE 15. Umuezue Ekewerazu, Mbaise. Land devoted to cash crops but planted to cassava because of land shortage. Observe the tall, smooth trunks of the iroko tree (Chlorophora excelsia) and the rough sturdy appearance of the oil palms. Shut out from sunlight, the undergrowth of cassava is feeble and elongated.

PLATE 16. Sawyers at work, Inyiogugu, Mbaise. Timber production, an important non-farm activity in Owerri Province, constitutes an expensive investment in human energy.

sufficiently productive to satisfy food requirements. For these reasons the acreage under yams has declined (Table 4), and in all divisions, cassava has replaced yams as the dominant crop, occupying more than 50% of the mean cropped area of 5.7 acres per family/household of 60 sample households in the province in 1971. (Table 4). The demand for cassava in the more congested areas of Mbaise and Ikeduru, has also caused the cassava acreage in the less densely-populated parts of Owerri, to increase. W.B. Morgan,[71] in a study of agriculture in Southern Nigeria, observed that manioc production has expanded at the expense of yams because it "is generally more productive on land with short fallows". The Department of Agriculture has also noted in Western Nigeria that a "tendency toward declining acreage (for yams) is reported from some areas of relatively dense population, with a compensating expansion in the planting of cassava".[72]

Many more crops are now grown together on one farm, than was formerly the case. The writer saw as many as ten crops in one farm at Umudim, Ezinihitte (Plate 14). Usually, yams are interplanted with vegetables and maize, and any of the other major crops in any combination. Maize often goes with cassava, melon and groundnuts, while cocoyams, which in the past used to be planted alone, are now intercropped with cassava, pepper, and vegetables. There is no longer any clear-cut system of mixed cropping, as any combination of crops may be tried. One common practice adopted to intensify the use of space, is to line up the boundaries of individual farms with beans, or other climbing crops.

TABLE 4

MEAN PERCENTAGE ACREAGES OCCUPIED BY 4 MAJOR FOOD-CROPS IN SELECTED VILLAGES OF OWERRI PROVINCE, 1971

(Average per total of families studied)

Village	Total Garden Families	Acreage cultivated per family	Per cent of Total Cultivated Area			
			Yams	Cassava	Maize	Cocoyams
Mbaise Division						
Amakam Ezi-East	5	5.2	10.2	53.2	27.2	9.2
Ikenga Ezi-East	3	3.4	6.5	52.3	29.1	12.1
Uvuru Ezi-West	4	5.7	6.0	53.3	34.0	6.7
Ahiara Ekwerazu	4	3.9	0.9	53.7	24.5	20.9
O.P.I. Ekwerazu	4	3.0	2.2	48.3	24.0	25.6
Umuokirika	3	2.4	1.0	54.5	19.6	24.9
Mbaitolu-Ikeduru Division						
Oratta Ikeduru	5	6.1	5.2	49.5	32.5	12.8
Mbieri Ikeduru	3	4.7	4.1	53.3	27.8	14.7
Achi Mbaitolu	3	4.9	6.2	48.2	32.6	13.1
Iho Dimezie	4	7.0	13.2	44.0	30.0	12.8
Ogwa Ikeduru	3	5.2	5.8	53.5	30.8	10.0
Owerri Division						
Nekede Owerri	3	10.9	17.4	46.6	30.3	6.4
Amafor Owerri	5	7.7	10.2	53.0	28.2	8.7
Ohaji Owerri	3	5.3	7.8	58.0	28.7	5.5
Irete Owerri	4	8.8	6.0	57.3	31.1	7.6
Orji Owerri	4	7.8	4.8	56.1	31.8	7.5
Mbaise Division	23	3.9	4.5	52.6	26.4	16.6
Mbaitolu-Ik.Div.	18	5.2	5.3	51.1	30.4	12.7
Owerri Division	19	8.1	9.2	54.2	30.0	7.1
Owerri Province	60	5.7	6.3	52.7	28.8	12.4

Intercropping or mixed-cropping, is claimed by farmers to possess many advantages. The system has also been shown by agricultural experts and extension workers, to be preferable to single cropping, especially as a soil conservation measure. Interplanting maintains continuous plant cover, and thus minimizes loss of soil and nutrients through erosion or leaching. By cultivating both shallow- and deep-rooted plants crops draw on nutrients at various levels. Mixed cropping of yams or cassava with maize prevents lodging of maize. Intercropping is also known to discourage weed growth and maximize labour returns, and farmers claim that the system keeps them fully occupied for a longer period of the year. The economic use of space in those parts of Owerri with acute land shortage, is the most significant reason, while the claim that the practice makes for overall higher yields, is open to debate.

4.3 Farming Cycle and Work Calendar

The farming cycle in Owerri Province, and the way the farmers' activities are patterned throughout the year, are governed by rainfall characteristics, especially the time of onset and close of the rainy season. The dry Harmattan 'opens up' the bush from November to January, making it possible for clearing to commence in December and January. Large trees are lopped, and the loppings burnt together with materials cut from the undergrowth. Burning starts in February with the expectation of early rains in March, and lasts throughout February and March. In some years, the rains arrive late, making it possible for weeds to recolonize the cleared farmland, and thus necessitating a second clearing

and burning. Planting of the major crops, such as yams and maize, begins in March and ends in April. Cassava may be planted at any time of the year, depending on the location of the land with respect to moisture availability. Cocoyams, generally, are planted between May and August. Planting in the riverine areas of the Imo Basin proceeds as soon as possible after the flood recedes. It is then possible, where soil fertility permits, to raise two crops of maize in one year.

The peak periods of farmwork are usually between March and July (Table 5) and these correspond with the time of hoeing, planting, staking and heavy weeding. Table 6 illustrates the most important farming activities during the year.

4.4 Land Preparation

Following clearing and burning, holes about 15 to 18 ins. in diameter and about 9 to 15 ins. deep are made on the free-draining sandy soils, which are then partly filled with ash and organic debris. Seed yams are buried in these partially-filled holes. The holes are then filled with earth, and made into small mounds about 12 to 18 ins. high. On the poorly-drained land along the river banks, bigger mounds and, less often ridges, are made. On the edges of these mounds, maize and vegetables are planted. Other crops occupy the spaces between yam mounds. Where only cassava is planted, the stem cuttings from mature plants 9 to 12 ins. long, are either entirely buried horizontally, or two-thirds buried at an angle of 45° on soil lightly opened with the hoe. On the whole, the method of seed bed preparation is unsatisfactory. Light surface hoeing

TABLE 5

AVERAGE MONTHLY FARM LABOUR IN MAN-DAYS OF 205 FARM OPERATORS IN OWERRI PROVINCE, (1970-71 FARMING SEASON)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Monthly Average	Av. annual Total
12	18	26	25	25	24	24	15	18	13	6	7	18	216

Note:

(i) Time spent in digging crops as needed for day-to-day consumption is not usually regarded by farmers as farm labour, while time spent in harvesting crops for storage, enters into the calculation of farm labour.

(ii) One man-day is the equivalent of seven man-hours.

TABLE 6

FARM CALENDAR IN OWERRI PROVINCE, EASTERN NIGERIA

Month	Activities
January	Clearing of land; planting on the riverine areas.
February	Clearing of land; early burning of land starts.
March	Land preparation; planting of yams, maize and vegetables.
April	Planting of yams and cassava; early weeding on yam plots commences.
May	Weeding of yam plots; planting of cassava intensified; early vegetables harvested.
June	Period of heavy weeding; planting of cocoyams and cassava and harvest of early maize.
July	Harvest of first yam crop and planting of cassava. Second weeding begun.
August	Yam harvests, and second weeding continued; August 'break' permits second crop of maize on good soil.
September	Second weeding concluded; planting of late cassava and harvest of late vegetables.
October	Harvests of main crop of yam and early cassava; planting of late cassava concluded.
November	Late harvests and storage of crops; clearing on both sides of the river banks begins.
December	Clearing and planting of cassava and vegetables along the river banks; harvest and storage of cocoyams.

on the heavier soils prevents tubers from growing freely downwards, as in yams, or expanding laterally,as in cassava. The digging stick, machete and the hoe, are the main farm implements. Farmers who employ the spade instead of the hoe in opening up the soil, are known to produce better yields of the yam crop, especially on garden land.

4.5 Crop Yields

Obtaining accurate data on crop yields is a difficult task, since there is no general harvest in which all of any single crop is put in one place. Furthermore, there is no pure crop, since in the mixed- or inter-cropping system, a combination of different crops are planted together. However, rough data on crop yields was obtained by estimation of the number of baskets of a particular crop type, harvested from a given plot of land, and worked out to the acre. The weight was expressed in lbs., after carefully obtaining the weighted mean of standard baskets of the various crops; (1 basket of yams, 67 lbs; cassava, 64 lbs; maize 34 lbs; cocoyams 62 lbs). Yield estimates were also based on the leading crop in the mixed-cropping system, and allowance was made for seed requirements, as in the case of yams and cocoyams.

Differences in crop yields, were observed to vary between farms of different lengths of fallow, (Table 7). Differences in yields were also noted between garden- and farmland of the same lengths of fallow. In such cases, the garden or compound land, produced better crops due to the application of animal manure and kitchen refuse. Excellent yields were also recorded on some garden land, where 'fertility was conserved

TABLE 7

ESTIMATED AVERAGE YIELDS OF 4 MAJOR FOODCROPS, IN SELECTED VILLAGES OF OWERRI

(Yields lbs per acre)

Village	Site Description	Crop/ Fallow Ratios	Actual No.yrs. Fallow	Yams (lbs)	Cassava (lbs)	Maize (lbs)	Cocoyams (lbs)
1. Mbaise Division							
Amakam	Porous sands; grass fallow; manured compound land.	1-3/1-4	2	3216	9280	408	1178
Ikenga	Clayey sands; grass-herb fallow	1-4/1-4	3	2546	6784	510	1488
Uvuru	Reddish-black sands; secondary bush fallow.	2-3/2-5	5	4623	11200	680	2046
Ahiara	Reddish-brown sands; poor grass fallow	1-4/1-3	1	1273	4672	306	1178
OPI Ekwerazu	Reddish-brown porous sands on grass with shrub fallow	1-3/1-2	2	1407	2880	272	1302
Umuoki-rika	Very loose brown sands; poor grass fallow.	1-4/1-2	-	1206	2880	238	1116
2. Mbaitolu-Ikeduru Division							
Oratta	Brown sands; grass fallow; manured compound land.	1-3/1-4	4	4824	9088	816	2046
Mbieri	Brown sands; shrub with grass.	1-3/2-3	2	2948	7680	612	1798

TABLE 7 (continued)

Achi	Porous sands; shrub -tree fallow	1-3/2-6	4.5	2546	5888	510	1240
Iho	Porous brown sands; grass-bush fallow.	1-4/1-5	3	2144	5760	340	1116
Ogwa	Brown sands; grass with shrub fallow.	1-3/1-3	2.5	1340	5440	374	1364
3. Owerri Division							
Nekede	Reddish black sands; secondary bush.	1-2/3-6	5.5	5695	12160	986	3596
Amafor	Reddish-brown sands; mature secondary bush	1-2/5-10	8	9045	14080	1292	4030
Ohaji	Reddish-black porous sands; mature secondary bush.	1-2/6-10	7.5	8174	16000	1428	4836
Irete	Brown porous sands; tall secondary bush.	1-2/4-7	5.5	4958	8192	1088	2728
Orji	Reddish-brown sands; shrub fallow.	1-3/2-5	3	3082	7168	612	2418
1. Mbaise Division				2379	6282	402	1385
2. Mbaitolu-Ikeduru Division				2760	6771	524	1513
3. Owerri Division				6191	11520	1081	3522
4. Owerri Province				3689	8072	652	2093

on spots', by preparing deep yam holes and filling with animal manure, kitchen refuse or green grass, a month or two prior to the planting period.

It would appear from Table 7, and other evidence collected from the field, that the length of the different fallows which determines the level of organic matter accumulation, supplemented by the application of animal manure, is mainly responsible for explaining differences in crop yields. Other factors, such as good seed bed preparation, early care in staking and weeding, the degree of interplanting of crops, and the quality of seeds, are deemed to be of secondary importance.

A comparison of the figures obtained in the three divisions, shows significant differences in crop yields. By further comparing the estimated crop yields for the three divisions (Table 7), with the approximate data on crop yields from previous studies by Johnston[73] and Phillips[74], (Table 8), it is noted that for a majority of places, crop yields in Owerri Province, fall below their crude estimates.

4.6 Farm Expenditure

Farm expenditure consists mainly of money spent in purchasing seed yams and cocoyams, a few farm implements, such as knives, hoes and occasionally spades, and for paid hired labour. For some families, there is substantial expenditure on livestock.

Table 9 shows that farm expenditure in Owerri is low, if we exclude family labour, amounting on the average, to £N4.35 per acre. A family or household, on the average, spent £N29.33 or £N1.9 per head on farmwork for the 1970-71 farming season.

TABLE 8

COMPARISON OF CROP YIELDS OBTAINED (TABLE 7) WITH ESTIMATES OF FOOD-CROP YIELDS IN OTHER PARTS OF WEST AFRICA

Food-crop	Average Crop Yields in Owerri Province (lbs per acre)				Johnston's Estimate of approx. Staple Food-Crop Yields in West Africa		Phillip's Estimate of Yields of some basic Food-Crops in Nigeria. (lbs per acre)
	Mbaise Div.	Mbaitolu-Ikeduru Div.	Owerri Div.	Province	Metric tons per hectare	lbs/acre	
Yams	2379	2760	6191	3689	6.0	5439	4480-15680
Cassava	6282	6771	11520	8072	8.0	7252	11200-22400
Maize	402	524	1081	652	0.7	635	1200-2000
Cocoyams	1385	1513	3522	2093	3.0	2720	4000-8000

TABLE 9

FARM EXPENDITURE IN THREE DIVISIONS OF OWERRI PROVINCE, 1971 (FAMILY LABOUR EXCLUDED)

Division	No. of Garden Families	No. of Persons	Total Acreage farmed (1971)	Farm Expenditure (₦)					
				Implements and seeds	Hired Labour	Total	Per acre	Per Family/ Household	Per Head
Mbaise	96	1481	521.93	1432.05	859.35	2291.4	4.4	23.87	1.55
Mbaitolu-Ikeduru	50	753	360.32	1082.7	674.4	1757.1	4.9	35.1	2.33
Owerri	59	967	499.4	1257.88	706.5	1964.38	3.93	33.3	2.03
Province	205	3201	1381.65	3772.63	2240.25	6012.88	4.35	29.33	1.9

TABLE 10

TOTAL FARM EXPENDITURE IN OWERRI PROVINCE - 1971 (FAMILY LABOUR INCLUDED)

Division	No.of Garden Families	No. of Persons	Total Acreage farmed (1971)	Labour (Man-Days)			Farm Expenditure (£)						
				Family	Hired	Total	Implements and Seeds	Hired Labour	Family Labour	Total	Per Acre	Per Family/ Household	Per Head
Mbaise	96	1481	521.93	53740	5729	59469	1432.05 (13.8%)	859.35 (8.3)	8061.0 (77.9%)	10352.4	19.83	107.84	7.0
Mbaitolu-Ikeduru	50	753	360.32	35308	4496	39804	1082.7 (15.4)	674.4 (9.6)	5296.2 (75%)	7053.2	19.58	141.1	9.37
Owerri	59	967	499.4	51277	4710	55987	1257.88 (13.0%)	706.5 (7.3%)	7691.55 (79.7%)	9655.93	19.34	163.66	10.0
Province	205	3201	1381.65	140325	14935	155260	3772.63 (13.9%)	2240.25 (8.3%)	21048.75 (77.8%)	27061.63	19.59	132.0	8.45

Note: (a) £ N = Can $3.05

(b) Hired labour was calculated at 3/- per man-day.

The figures presented in Table 9, however, mask the true position of things because family labour, when translated into cash terms accounted for the largest single item of farm expenditure. (Table 10). If the cost of 140,325 man-days contributed as family labour by the 205 families/households, at a standard labour rate of 3/- per man-day were considered, this would give £N21,048.75, and would bring the total farm expenditure of farm labour alone (family and hired labour) to £N23,289 or 86.1% of total farm expenditure for the 1970-71 farming year. The overall farm expenditure for the same period would total £N27,061.63. This would give a total farm expenditure of £N19.59 per acre, and £N132 per family/household or £N8.45 per head. These figures are far greater than those obtained for Table 9, exclusive of family labour cost.

4.7 Land Availability

Much of the problem which underlies subsistence agriculture in Eastern Nigeria in general, and Owerri Province in particular, results mainly from a small land area per head of the agricultural population.

(a) Total Land Owned

The sample survey of 205 families/households, comprising 3,201 persons, (Table 11), shows that the average acreage owned per head in Owerri Province is roughly half an acre. Land owned per person in Mbaise Division, falls below the average acreage for the province being only 0.42, while the figure for Owerri Division is nearly one and a half times the average value for the province.

More revealing than the average acreage owned per head, is the

nature of land distribution per head of the sample population. Table 12 shows that for Owerri Province, 79.1% of the sample population owned less than 0.75 acre per head (this accounts for 56.9% of total land available), and 20.9% had more than 0.75 acre per head. Owerri Division appeared to own more land per head, since it had only 60.8% with less than 0.75 acre per head compared with Mbaise and Mbaitolu-Ikeduru Divisions, with 90.8% and 79.7% respectively. Mbaise Division had the smallest acreage per head, with 30.4% of its population owning less than 0.25 per head, and 43.9% with between 0.25 and 0.5 acre per head. For the other two divisions, most of the people owned between 0.25 and 0.75 acre per head. In Mbaise, 94.3% of the people possessed less than 0.5 acre per head.

(b) Cultivated Land, and Land under Fallow (1971)

Owerri Division, which owned the largest acreage per head (0.79), farmed 65.8% of its land, leaving 34.2% under fallow, (Table 13). Corresponding figures for Mbaitolu-Ikeduru were 80.4% cultivated, and 19.6% fallow. Mbaise Division, with the least land per head, (0.42 acre), farmed 84.9%,leaving only 15.1% under fallow. The figures in Table 13 suggest that areas which owned more land per head of its sample population, cultivated more land, and also had more land under fallow per head.

Distribution of cultivated land per head, 1971 (Table 14), in Owerri Province, shows that 91.1% of the sample population farmed less than 0.75 acre per head. Farmers who cultivated between 0.25 and 0.5 acre per head, accounted for the largest single group in the divisions- Mbaise, 47.6% of the sample population (48.6% of cultivated land, 1971); Mbaitolu-Ikeduru, 55.2% (44.6% of cultivated land, 1971); and Owerri,

TABLE 11

LAND AVAILABILITY IN OWERRI PROVINCE - ACREAGE OF LAND OWNED BY FAMILIES/HOUSEHOLDS

Division	Total Garden Families	Number of Persons	Total land owned	Percent of Total acreage owned	Acreage owned per Family/ Household	Acreage owned per Head
Mbaise	96	1481	614.82	33.7	6.4	0.42
Maitolu-Ikeduru	50	753	448.08	24.6	8.96	0.60
Owerri	59	967	758.93	41.7	12.9	0.79
Province	205	3201	1821.84	100.0	8.9	0.57

TABLE 12

LAND DISTRIBUTION PER HEAD OWNED IN OWERRI PROVINCE, 1971

Land owned per head (acres)	MBAISE				MBAITOLU-IKEDURU				OWERRI				PROVINCE			
	No.of pers.	% of sample	Acrg. owned	% Acrg.	No.of pers.	% of sample	Acrg. owned	% Acrg.	No.of pers.	% of sample	Acrg. owned	% Acrg.	No.of pers.	% of sample	Acrg. owned	% Acrg.
<0.25	450	30.4	85.6	13.9	53	7.0	13.3	3.0	79	8.2	17.2	2.3	582	18.2	116.4	6.4
0.25-0.50	650	43.9	248.4	40.4	289	38.4	115.5	25.8	271	28.0	102.8	13.5	1210	37.8	466.8	25.6
0.50-0.75	244	16.5	154.5	25.1	258	34.3	156.3	34.9	238	24.6	142.7	18.8	740	23.1	453.5	24.9
0.75-1.00	89	6.0	82.7	13.5	88	11.6	76.8	17.0	134	13.9	111.6	14.7	311	9.7	271.1	14.9
1.00-1.25	39	2.6	41.9	6.8	34	4.5	39.7	8.9	19	1.9	20.5	2.7	92	2.9	102.1	5.6
1.25-1.50	-	-	-	-	26	3.5	37.7	8.4	120	12.4	169.6	22.3	146	4.6	207.3	11.4
1.50-1.75	9	0.6	1.6	0.3	5	0.7	8.7	2.0	44	4.6	65.0	8.6	58	1.8	75.4	4.1
1.75-2.00	-	-	-	-	-	-	-	-	28	2.9	45.3	6.0	28	0.9	45.3	2.5
Over 2.00	-	-	-	-	-	-	-	-	34	3.5	84.3	11.1	34	1.0	84.2	4.6
TOTAL	1481	100.0	614.82	100.0	753	100.0	448.1	100.0	967	100.0	758.9	100.0	3201	100.0	1821.9	100.0

TABLE 13

LAND UNDER CULTIVATION AND FALLOW IN OWERRI PROVINCE (1971)

Division	No. of Garden Families/ Households	No. of Persons	Total Acreage owned	Land Under Cultivation (1971)				Land Under Fallow (1971)			
				Total Acreage	Percen-tage	Acreage per Family	Acreage per Head	Total Acreage	Percen-tage	Acreage per Family	Acreage per Head
Mbaise	96	1481	614.82	521.93	84.9	5.44	0.35	92.89	15.1	0.96	0.07
Mbaitolu-Ikeduru	50	753	448.09	360.32	80.4	7.21	0.49	87.77	19.6	1.76	0.11
Owerri	59	967	758.93	499.40	65.8	8.50	0.52	259.53	34.2	4.4	0.27
Province	205	3201	1821.84	1381.65	75.8	6.74	0.43	440.19	24.2	2.15	0.14

TABLE 14

DISTRIBUTION OF CULTIVATED LAND PER HEAD IN OWERRI PROVINCE (1971)

Land cultivated per head (acres)	MBAISE				MBAITOLU-IKEDURU				OWERRI				PROVINCE			
	No. of pers.	% of sample	Acrg. cultv.	% Acrg.	No.of pers.	% of sample	Acrg. cultv.	% Acrg.	No.of pers.	% of sample	Acrg. cultv.	% Acrg	No.of pers.	% of sample	Acrg. cultv.	% Acrg.
<0.25	546	36.9	115.2	32.1	53	7.0	13.3	3.7	153	15.8	31.9	6.4	752	23.5	160.4	11.6
0.25-0.50	705	47.6	254.35	48.6	416	55.2	160.7	44.6	362	37.4	147.3	29.5	1483	46.3	562.4	40.7
0.50-0.75	190	12.8	115.9	22.2	195	25.9	109.8	30.5	298	30.8	181.4	36.3	683	21.3	407.1	29.5
0.75-1.00	40	2.7	36.5	1.1	84	11.2	71.4	19.8	119	12.4	94.4	18.9	243	7.6	202.3	14.6
1.00-1.25	-	-	-	-	5	0.7	5.2	1.4	11	1.1	13.0	2.6	16	0.5	18.2	1.3
1.25-1.50	-	-	-	-	-	-	-	-	24	2.5	31.3	6.3	24	0.8	31.3	2.3
1.50-1.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.75-2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Over 2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	1481	100.0	521.9	100.0	753	100.0	360.3	100.0	967	100.0	499.4	100.0	3201	100.0	1381.6	100.0

TABLE 15

DISTRIBUTION OF FALLOW LAND PER HEAD IN OWERRI PROVINCE (1971)

Land under fallow per head (acres)	MBAISE				MBAITOLU-IKEDURU				OWERRI				PROVINCE			
	No.of pers.	% of sample	Acrg. fal-low	% acrg. fal-low	No.of pers.	% of sample	Acrg. fal-low	% acrg. fal-low	No.of pers.	% of sample	Acrg. fal-low	% acrg. fal-low	No.of pers.	% of sample	Acrg. fal-low	% acrg. fal-low
No Fallow	493	33.3	-	-	85	11.3	-	-	88	9.2	-	-	666	20.8	-	-
< 0.25	919	62.0	69.2	74.5	557	73.9	44.7	50.9	610	63.1	60.1	23.4	2086	65.2	174.5	39.7
0.25-0.50	66	4.5	21.9	23.6	87	11.6	29.5	33.6	61	6.3	24.0	9.3	214	6.7	75.5	17.2
0.50-0.75	3	0.2	1.7	1.9	24	3.2	13.55	15.5	100	10.3	62.4	24.0	127	4.0	77.4	17.5
0.75-1.00	-	-	-	-	-	-	-	-	73	7.5	63.8	24.5	73	2.3	63.8	14.5
1.00-1.25	-	-	-	-	-	-	-	-	17	1.8	18.9	7.3	17	0.5	18.9	4.3
1.25-1.50	-	-	-	-	-	-	-	-	11	1.1	14.5	5.6	11	0.3	14.5	3.3
1.50-1.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.75-2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Over 2.00	-	-	-	-	-	-	-	-	7	0.7	15.3	5.9	7	0.2	15.3	3.5
TOTAL	1481	100.0	92.9	100.0	753	100.0	87.77	100.0	967	100.0	259.5	100.0	3201	100.0	430.9	100.0

37.4% (29.5% of cultivated land, 1971). Mbaise Division had 36.9% of its sample population with less than 0.25 acre per head, compared with only 7% in Ikeduru, and 15.8% in Owerri. In general, no family/household cultivated more than 1.5 acres per head in Owerri Division, 1.25 acres in Mbaitolu-Ikeduru, or more than 1 acre per head in Mbaise Division.

Table 15 shows the distribution of fallow land per head, 1971. It will be noted that 20.8% of the sample agricultural population in the Province (33.3% in Mbaise Division, 11.3% in Mbaitolu-Ikeduru, and 9.2% in Owerri), had no land under fallow in 1971. Land per head under fallow was less than 0.75 acre in all parts of Mbaise. Owerri Division shows an irregular distribution of fallow land. While 90.1% of the farmers fallowed between 0.25 and 1.5 acres per head, and 0.7% had just over 2 acres of fallow land per head, no families/households had between 1.5 and 2 acres of fallow land per head. In all the divisions, people with less than 0.25 acres of fallow land per head formed the largest group, making up 62% of the sample agricultural population in Mbaise, 73.9% in Mbaitolu-Ikeduru, 63.1% in Owerri Division, and 65.2% in the province.

Tables 11 to 15 reveal that agricultural land in Owerri Province is unequally distributed, both within and between the divisions. This is accounted for by laws of inheritance, and by the land tenure system. In general, border areas (e.g. villages adjoining Okpala in Ngwa Division of Aba Province, and those close to Port-Harcourt Province in the Rivers State), were found to possess more land than the hinterland.

Evidence of unequal distribution of land was also seen in two neighbouring villages of Irete Clan in Owerri Division. One of the

villages has abundant land, and is credited with having subjugated its neighbour, and dispossessed it of most of its land.[75] As the two villages bequeathed what land they claimed to successive generations (in the absence of any change in the power structure), the question of disparity in land ownership has been perpetuated. These reasons explain why it is possible for some farmers to have much of their land under fallow for a period of 4 - 10 years, while farmers in the less-favoured villages cultivate what land they own regularly, and can afford at most 1 to 3 years of fallow land.

4.8 Land Tenure System, Size of Farms and Fragmentation

In all parts of Owerri Province agricultural land is owned. All land belongs to the family or kindred, but individuals who inherit the land within the family system, have the right to use their share of the family land as they wish.

Table 16 illustrates the various tenure systems, under which land was held in Owerri Province in 1971. Land that was inherited accounted for 69.6% of the total land owned in the whole province; 65.2% of land owned in Mbaise, 67.5% in Mbaitolu-Ikeduru, and 74.4% in Owerri Division. Since land held under other forms of tenure - pledge, purchase, gift or loan - was land that was formerly inherited before being given out in the form in which it is now held, it could be argued that the percentages of inherited land quoted in Table 16 are underestimated.

Inheritance of land is by far the most permanent and stable means

TABLE 16

AVERAGE ACREAGE AND PERCENTAGE SHARE OF LAND HELD UNDER THE DIFFERENT SYSTEMS OF LAND TENURE IN OWERRI PROVINCE (1971)

Division	INHERITED		PLEDGE		PURCHASE		OTHERS		TOTAL	
	Acreage	%	Acreage	%	Acreage	%	Acreage	%	Acreage	%
Mbaise	400.9	65.2	155.5	25.3	47.3	7.7	11.1	1.8	614.8	100
Mbaitolu-Ikeduru	302.5	67.5	115.2	25.7	29.1	6.5	1.30	0.3	448.1	100
Owerri	564.6	74.4	141.9	18.7	31.1	4.1	21.3	2.8	758.9	100
Province	1268.0	69.6	412.6	22.6	107.5	5.9	33.7	1.9	1821.8	100

of land acquisition. Permanency of tenure means that the farmer can carry out worthwhile improvements on the farm, since he regards the land as his exclusive property. Land on loan or pledge, is the least stable method of acquiring land and is generally most poorly used. The user is often reluctant to manure it, and there is the tendency to cultivate it repeatedly, before such land reverts to the owner. Land can now be purchased outright, although a family frowns on individual members who sell land. Acquisition of land through pledge, loan or exchange, is an important source of increasing the family's share of village land, but it can do nothing to improve the ratio of land to population.

The land tenure system of family inheritance, and subdivision of farm-holdings, results in excessive fragmentation, leading to small and uneconomic sizes of land holdings. The average size of farm holdings in the province is 0.62 acres, (Table 17). Average size of farm holdings for the divisions are: Mbaise, 0.51 acre, Mbaitolu-Ikeduru, 0.58 acre, and Owerri, 0.76 acre. These figures do not explain internal fragmentation of the same holdings during each farming year, as further subdivision takes place at the family level, where the family head divides available plots of land amongst members of his family and some close relatives.

Size distribution of the farm holdings (Table 18), shows that 2,557 (86.1%) of 2,970 farm holdings, are less than 1 acre in size. Of these 407 farm holdings (13.7%), are less than 0.25 acre in size; 982 (33.1%) are between 0.25 and 0.5 acre in size; 664 (22.4%) are between 0.5 and 0.75 acre in size; and 506 (17%), between 0.75 and 1 acre in size. The degree of fragmentation is worse in Mbaise and Mbaitolu-Ikeduru

LOCATION AND SIZE OF A FAMILY HOLDING, AMAKAM VILLAGE,

EZINIHITTE, MBAISE DIVISION

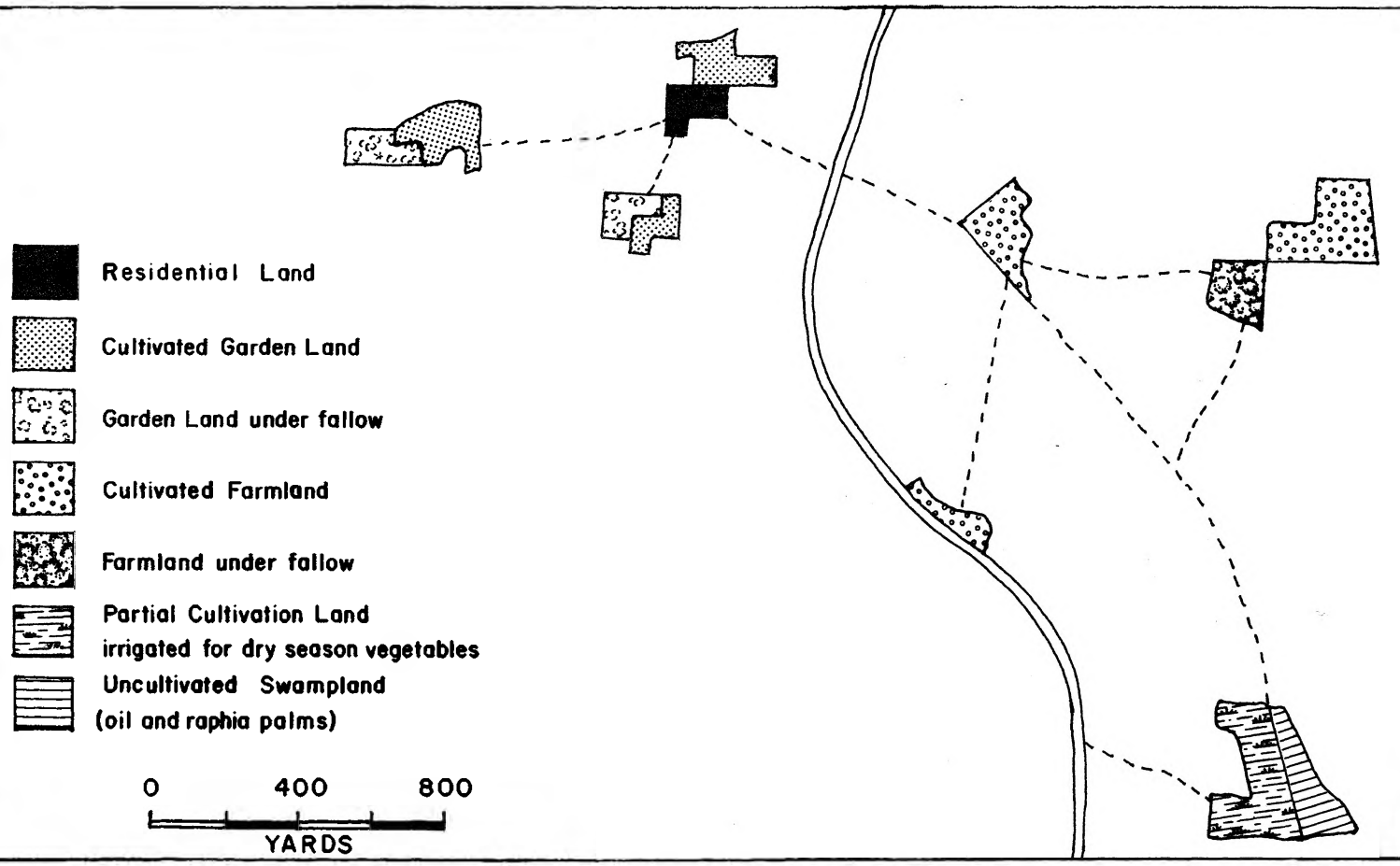


Fig 3

TABLE 17

AVERAGE SIZE OF FARM HOLDINGS IN OWERRI PROVINCE, 1971

Division	No. of Garden Families/house-holds	Total no. of persons in Families/H.	Total no. of Farm Hold-ings	Total Acreage of Farm Hold-ings	Average size of Holdings
Mbaise	96	1481	1197	614.8	0.51
Mbaitolu-Ikeduru	50	753	769	448.1	0.58
Owerri	59	967	1004	758.9	0.76
Province	205	3201	2970	1821.8	0.62

TABLE 18

SIZE DISTRIBUTION OF LAND HOLDINGS IN OWERRI PROVINCE, 1971

Average size of farm holdings	Mbaise Division			Mbaitolu-Ikeduru Division			Owerri Division			Province		
	No. of farm hold-ings	% of total hold-ings	Total acre-age	No. of farm hold-ings	% of total hold-ings	Total acre-age	No. of farm hold-ings	% of total hold-ings	Total acre-age	No. of farm hold-ings	% of total hold-ings	Total acre-age
<0.25	133	11.1	22.3	113	14.7	18.9	161	16.0	29.1	407	13.7	70.3
0.25-0.50	471	39.3	177.5	261	33.9	97.8	250	24.9	93.0	982	33.1	368.4
0.50-0.75	362	30.2	214.7	161	20.9	100.1	141	14.0	82.8	664	22.4	397.7
0.75-1.00	194	16.3	155.5	142	18.5	119.1	170	16.9	141.6	506	17.0	415.4
1.00-1.25	25	2.1	28.70	43	5.6	48.3	101	10.1	113.6	169	5.7	190.7
1.25-1.50	12	1.0	16.1	49	6.4	64.5	83	8.3	115.8	144	4.8	196.4
1.50-1.75	-	-	-	-	-	-	52	5.2	86.6	52	1.8	86.6
1.75-2.00	-	-	-	-	-	-	27	2.7	51.3	27	0.9	51.3
Over 2.00	-	-	-	-	-	-	19	1.9	45.0	19	0.6	45.0
TOTAL	1197	100.0	614.8	769	100.0	448.7	1004	100.0	758.8	2970	100.0	1821.8

Divisions, where 96.9% and 88% of the total farm holdings respectively, are less than 1 acre in size. It is only in Owerri Division that farm holdings greater than 1.5 acres are found, and this would appear to be due to the greater land area per head available.

4.9 Summary

This chapter has outlined the main features of agriculture in Owerri Province. Agricultural practice was defined as "Rotational-Bush Fallowing", characterized by a rotation of fields rather than crops, by cutting and burning of bush, and by the general absence of draught animals or tractors, poor implements and low farm expenditure. It was shown to be a subsistence economy with some cash cropping and extensive inter-cropping.

Five fallow types (semi-permanent, short, short to medium, medium to long, and long to very long), based on the ratio of length of fallow to cropping period, were identified. The main types of crops were outlined, and it was emphasized that cassava has replaced yams as the dominant crop, because it is usually more tolerant of exhausted soils.

Crop yields were observed to vary, especially on land of different lengths of fallow, and also between garden and farmland. Family labour is the most important farm investment, and accounted for over 75% of total farm expenditure in 1970-71 farming season.

Land owned per head in the province averaged half an acre. In most cases, acreage owned per head was less than 0.25 ranging to 0.5 acres. Land cultivated per head (1971) in many cases approached acreage per head

owned, leaving many families with scarcely any fallow land for next year's planting. It was also proved that the problem of land shortage was less serious in Owerri Division than in the other two divisions.

Land ownership through inheritance was found to be the commonest method of land acquisition as far as security of tenure and permanent land rights are concerned, although this is known to have led to subdivision of farm holdings, resulting in excessive fragmentation. Small and uneconomic size of farms between less than 0.25 and 0.75 acre, made up 69.2% of all farm holdings.

CHAPTER V

DETERMINATION OF THE RELATIONSHIP AND RELATIVE IMPORTANCE OF VARIABLES ASSOCIATED WITH AGRICULTURE IN OWERRI PROVINCE

The purpose of this chapter is to outline the methods used to determine a linear relationship between the variables involved in agriculture, and to test hypothesized relationships between certain selected elements, which are known to influence agricultural practice.

5.1 Definition of Variables and Statement of Hypothesis

(a) Determining the relationship between pairs of variables involved in agricultural land use

In this model specification, X is the independent variable, and Y the dependent variable.

Size of family (X) and total acreage of farmland owned (Y).

It is hypothesized that larger families would own and cultivate bigger farm acreages, and that given land mobility, the family's total acreage of farmland would tend to increase as its size grows, since it must endeavour to acquire more land through pledge, gift, loan or purchase in order to supplement inherited land. A positive correlation is therefore expected between (X) and (Y).

Size of family (X) and land acreage per head owned (Y).

Large families usually own more land but smaller acreages per head. Consequently, it is proposed that there would be a negative

relationship between (X) and (Y).

Total farm acreage owned (X) and Amount of fallow land (Y).

It is widespread practice among farmers to leave a certain portion of land to fallow each year. Since the amount of fallow land depends among other things on the total land owned, it is believed that a positive relationship exists between (X) and (Y).

Total farm acreage owned (X) and Land-Use Factor (Y).

Land-Use Factor establishes the relationship between length of cropping and fallow. The period of fallow to number of years of cultivation, was found to depend largely on total land available. It is therefore proposed that a positive correlation would exist between (X) and (Y), and that higher values of (X) and (Y) would give higher correlation coefficients.

Total acreage cultivated 1971 (X) and Total farm labour input (Y).

In Owerri province, land shortage is a problem not labour, and acreage of cultivated land is not limited by labour availability. It is therefore hypothesized that total labour input on the farm would be determined by land acreage cultivated, and that a positive relationship would exist between the two.

Size of family (X) and Family labour (man-days) provided (Y).

It is proposed that the amount of labour which a family can provide, depends on its size and age composition. Consequently, a positive relationship is expected between (X) and (Y).

(b) and (c) Determining the relationship between Variables which affect acreage per head cultivated in the Divisions

in 1971, and testing the relative importance of those Variables.

In this model specification, (X_1) to (X_7) are the independent variables, and (Y) the dependent variable.

Family size (X_1)

Since land owned per head is not proportional to family size, it is proposed that acreage per head cultivated in 1971, would bear a negative relationship with size of the family.

Total farm acreage owned (X_2)

It is common knowledge that where land is the most important factor of agricultural production, the amount of land which a family cultivates during each farming season depends on the total land which that family possesses. It is expected there would be a positive correlation between (X_2) and (Y).

Total acreage of fallow land (X_3)

The decision to fallow a certain percentage of a family's total land, at the beginning of each farming season, is governed by a number of factors, the most important being the amount of land available . If more land is fallowed, less land is cultivated. Consequently, a negative correlation would be expected between (X_3) and (Y).

Family labour (man-days) employed (X_4)

In a hand-labour economy in which a class of farm labourers has not yet evolved, the size holding that can be adequately cultivated (assuming enough land is available), will be limited by the number of labour units the family can provide. A positive relationship between (X_4)

and (Y) would be expected.

Percentage of Inherited Land (X_5)

This variable is used as an indicator of land immobility. The ease or difficulty of acquiring more land may contribute to determining the acreage of land per head which farmers cultivate at any one time. An attempt to measure the degree of mobility was made by means of a proxy variable - percentage of inherited land. Different types of land tenure have varying degrees of security as far as permanent land rights are concerned. It is assumed that the ease of acquiring more land bears an inverse relationship with the security of tenure. Since inherited land is the most secure type of tenure, and is readily the commonest method of land acquisition, it could be postulated that there is widespread land immobility. A significant positive relation between X_5 and Y would imply that additional land is easy to acquire, and land immobility, expressed as a percentage of inherited land is not a restrictive influence on acreage per head. Consequently, a negative relationship is expected between X_5 and Y.

Distance Factor (miles) (X_6)

In areas where farms are located far from the home, distance travelled by the farmer to and from the farm, could markedly reduce acreage cultivated per head, because of the extra labour and time involved in trekking and transporting crops over long distances. It is therefore hypothesized that a negative relationship exists between X_6 and Y.

Land-Use Factor (X_7)

The amount of land available for each year's cultivation depends

on the percentage of total land which the farmer reserves as fallow land. Since the Land-Use Factor is an expression of the crop/fallow time ratio, a negative correlation would exist between X_7 and Y.

Land-Use Factor could also serve as an indicator of soil potential. A high value of Land-Use Factor would mean a longer fallow to cropping period and vice versa. By deduction, this would mean a higher level of organic matter accumulation, better yields, and lower acreage of cultivated land per head. Consequently, a negative correlation would be expected between X_7 and Y.

5.2 Method of Analysis

(a) The Pearson Product-Moment Correlation Coefficient was used to test the strength of a linear relationship between different set of variables involved in agricultural land use in parts of the province.

The formula used in calculting (r) is given as:

$$r = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

where X and Y, are the two variables; and

N, is the number of observations.

The significance of the Correlation Coefficient, is evaluated by means of the Z distribution, using the formula:

$$Z = r\sqrt{N - 1}\,, \quad \text{since } N \text{ is greater than } 30;$$

where r = the correlation coefficient; and

N = the number of pairs of data studied.

If Z is more than ± 1.96, r is significant, at the 0.05 level. The use of the Pearson Product-Moment Correlation Coefficient involves the making of some assumptions about the population from which the sample is taken: (a) the population from which the sample is taken is normally distributed. (b) the distribution of each variable and their joint distribution are normal. With the exception of the distribution of the variables in two divisions, which were found to approximate to normal, the distributions are positively skewed. (c) the relationship between two variables is linear. Using a linear approximation to a function that is not linear will result in errors of estimate that will be increasingly larger, in relation to the degree with which the true function departs from a straight line. One result of this, is that the correlation coefficient is usually an underestimate of the true correlation that holds between two variables, rather than an overestimate.

Table 19 lists the correlation coefficients, Z values and names of variables involved in agricultural land use in the three divisions of Owerri province for 1971. It is evident from the results obtained that all the pairs of variables tested, with the possible exception of family size and land acreage owned per head, show positive correlations. The negative relationship between the size of family, and land acreage owned per head was expected. However, while the negative correlation between family size and acreage of land owned per head was found to be significant in the case of Mbaise; r, was found to be insignificant at the 0.05 level in both Mbaitolu-Ikeduru and Owerri Divisions. (Table 19, (B) and (C)). This would imply that land acreage which individuals own

TABLE 19 (A)

RELATIONSHIP BETWEEN PAIRS OF VARIABLES INVOLVED IN AGRICULTURAL LAND USE

MBAISE DIVISION, 1971

No. of observations (n) 96 Significance at the 0.05 level: Z ± 1.96

Pairs of Variables tested	r	z
Size of family (X) and total acreage of farmland owned (Y)	0.57	5.56
Size of family (X) and land acreage per head owned (Y)	-0.26	-2.53
Total farm acreage owned (X) and acreage under fallow, 1971 (Y)	0.79	7.70
Total farm acreage owned (X) and Land Use Factor (L.U.)(Y)	0.41	3.99
Total acreage cultivated 1971 (X) and total farm labour (man-days) employed (Y)	0.74	7.22
Size of family (X) and family labour in man-days, provided(Y)	0.68	6.63

TABLE 19 (B)

RELATIONSHIP BETWEEN PAIRS OF VARIABLES INVOLVED IN AGRICULTURAL LAND USE,

MBAITOLU - IKEDURU DIVISION, 1971

Nc — No. of observations (n) 50 — Significance at the 0.05 level: Z ± 1.96

Pa	Pairs of Variables tested	r	z
Si	Size of family (X) and total acreage of farmland owned (Y)	0.72	5.04
Si	Size of family (X) and land acreage per head owned (Y)	-0.22	-1.54
To	Total farm acreage owned (X) and acreage under fallow, 1971 (Y)	0.66	4.62
To	Total farm acreage owned (X) and Land Use Factor (L.U.) (Y)	0.29	2.03
To (m	Total acreage cultivated 1971 (X) and total farm labour (man-days) employed (Y)	0.83	5.81
Si	Size of family (X) and family labour in man-days, provided (Y)	0.89	6.23

TABLE 19 (C)

RELATIONSHIP BETWEEN PAIRS OF VARIABLES INVOLVED IN AGRICULTURAL LAND USE, OWERRI DIVISION, 1971

No. of observations (n) 59 Significance at the 0.05 level: Z ± 1.96

Pairs of Variables tested	r	z
Size of family (X) and total acreage of farmland owned (Y)	0.57	4.34
Size of family (X) and land acreage per head owned (Y)	-0.20	-1.52
Total farm acreage owned (X) and acreage under fallow, 1971 (Y)	0.94	7.15
Total farm acreage owned (X) and Land-Use Factor (L.U.) (Y)	0.72	5.48
Total acreage cultivated, 1971 (X) and total farm labour (man-days) employed (Y)	0.78	5.95
Size of family (X) and family labour in man-days, provided (Y)	0.80	6.09

per head in these divisions, is not necessarily explained by family size.

(b) The Pearson Product-Moment Correlation Coefficient, was also used to test the significance of the variables, associated with farm acreages per head cultivated in Owerri province in 1971 (Table 20). This test was considered necessary, since the average acreage per head under cultivation at any one time (C), is a major factor in determining land requirement per head, and will form the main part of the discussion in Chapter VI.

Results of the test, Table 20 (A) - (D), show the expected negative correlation between family size and land acreage per head cultivated (1971), was upheld in all the divisions, though this negative relationship was significant only in the case of Mbaise Division and the Province. The hypothesized positive relationship between X_2 and Y, was upheld in all cases; that between X_4 and Y was proved for Owerri Province only, rejected in the case of Mbaise and Owerri Divisions, and gave negative results for Mbaitolu-Ikeduru.

The other variables (X_3, X_5, X_6 and X_7) which were expected to yield negative results with acreage per head cultivated in 1971, gave positive results, with the exception of Mbaitolu-Ikeduru where percentage of inherited land was found to correlate negatively with Y, though insignificantly.

(c) Multiple with Partial Correlation was used to determine the degree of importance of Variables X_1 to X_7 which affect Y (Table 21 (A) to (D). The multiple correlation coefficients give an indication of the degree to which the predictor (independent) variables X_1 to X_7 taken

TABLE 20 (A)

RELATIONSHIP BETWEEN THE VARIABLES ASSOCIATED WITH (C) OR ACREAGE CULTIVATED PER HEAD

MBAISE DIVISION (1971)

No. of observations (n) 96 Significance at the 0.05 level: Z ± 1.96

Variable	r	z
Family size (X_1)	-0.337	-3.28
Total farm acreage owned by family/household (X_2)	0.439	4.28
Total acreage under fallow, 1971 (X_3)	0.698	6.80
Family labour in man-days employed (X_4)	0.050	0.49
Percentage of inherited land (X_5)	0.086	0.84
Distance Factor (miles) (X_6)	0.328	3.20
Land-Use Factor (X_7)	0.518	5.05

TABLE 20 (B)

RELATIONSHIP BETWEEN THE VARIABLES ASSOCIATED WITH(C) OR ACREAGE CULTIVATED PER HEAD,

MBAITOLU - IKEDURU DIVISION (1971)

No. of observations (n) 50 Significance at the 0.05 level: Z ± 1.96

Variable	r	z
Family (X_1)	-0.201	-1.41
Total farm acreage owned by family/household (X_2)	0.435	3.05
Total acreage under fallow, 1971 (X_3)	0.617	4.32
Family labour in man-days employed (X_4)	-0.108	-0.76
Percentage of inherited land (X_5)	-0.067	-0.47
Distance Factor (miles) (X_6)	0.253	1.77
Land-Use Factor (X_7)	0.744	5.21

TABLE 20 (C)

RELATIONSHIP BETWEEN THE VARIABLES ASSOCIATED WITH(C) OR ACREAGE CULTIVATED PER HEAD, OWERRI DIVISION (1971)

No. of observations (n) 59 Significance at the 0.05 level: Z ± 1.96

Variable	r	z
Family size (X_1)	-0.219	-1.67
Total farm acreage owned by the family/household (X_2)	0.465	3.54
Total acreage under fallow, 1971 (X_3)	0.458	3.49
Family labour in man-days employed (X_4)	0.110	0.84
Percentage of inherited land (X_5)	0.008	0.06
Distance Factor (miles) (X_6)	0.360	2.74
Land-Use Factor (X_7)	0.709	5.40

TABLE 20 (D)

RELATIONSHIP BETWEEN THE VARIABLES ASSOCIATED WITH(C) OR ACREAGE CULTIVATED PER HEAD, OWERRI PROVINCE (1971)

No. of observations (n) 205 Significance at the 0.05 level: Z ± 1.96

Variable	r	z
Family size (X_1)	-0.233	-3.33
Total farm acreage owned by family/household (X_2)	0.499	7.13
Total acreage under fallow, 1971 (X_3)	0.500	7.14
Family labour in man-days employed (X_4)	0.162	2.31
Percentage of inherited land (X_5)	0.074	1.06
Distance Factor (miles) (X_6)	0.389	5.56
Land-Use Factor (X_7)	0.651	9.30

TABLE 21 (A)

MULTIPLE WITH PARTIAL CORRELATION : TO DETERMINE THE RELATIVE DEGREE OF IMPORTANCE OF VARIABLES (X_1) TO (X_7) ASSOCIATED WITH ACREAGE PER HEAD CULTIVATED IN MBAISE DIVISION, 1971 (Y)

	Variable Entered	R	Multiple		Increase in RSQ		No. of Independent Variables included
			RSQ	%	RSQ	%	
3	Total acreage under fallow (1971)	0.6976	0.4867	48.7	0.4867	48.7	1
1	Family size	0.8107	0.6573	65.7	0.1706	17.1	2
2	Total farm acreage owned by family	0.8367	0.7001	70.0	0.0428	4.3	3
7	Land Use Factor	0.8473	0.7179	71.8	0.0179	1.8	4
5	Percentage of inherited land	0.8521	0.7261	72.6	0.0082	0.8	5
4	Family labour in man-days employed	0.8528	0.7272	72.7	0.0010	0.1	6
6	Distance Factor (miles)	0.8529	0.7274	72.7	0.0002	0.02	7

TABLE 21 (B)

MULTIPLE WITH PARTIAL CORRELATION TO DETERMINE THE RELATIVE DEGREE OF IMPORTANCE OF VARIABLES (X_1) TO (X_7) ASSOCIATED WITH ACREAGE PER HEAD CULTIVATED IN MBAITOLU-IKEDURU DIVISION, 1971 (Y)

	Variable Entered	R	Multiple		Increase in RSQ		No. of Independent Variables included
			RSQ	%	RSQ	%	
7	Land Use Factor	0.7439	0.5534	55.3	0.5534	55.3	1
3	Total acreage under fallow, 1971	0.8073	0.6518	65.2	0.0984	9.8	2
4	Family labour in man-days employed	0.8414	0.7080	70.8	0.0562	5.6	3
2	Total farm acreage owned by family	0.8925	0.7166	79.7	0.0886	8.9	4
1	Family size	0.9266	0.8585	85.9	0.0619	6.2	5
5	Percentage of inherited land	0.9285	0.8620	86.2	0.0035	0.4	6
6	Distance Factor	0.9300	0.8650	86.5	0.0029	0.3	7

TABLE 21 (C)

MULTIPLE WITH PARTIAL CORRELATION TO DETERMINE THE RELATIVE DEGREE OF IMPORTANCE OF VARIABLES (X_1) TO (X_7) ASSOCIATED WITH ACREAGE PER HEAD CULTIVATED IN OWERRI DIVISION, 1971 (Y)

Variable Entered	R	Multiple		Increase in RSQ		No. of Independent Variables included
		RSQ	%	RSQ	%	
7 Land Use Factor	0.7091	0.5028	50.3	0.5028	50.3	1
1 Family size	0.7488	0.5606	56.1	0.0578	5.8	2
6 Distance Factor (miles)	0.7750	0.6006	60.1	0.0400	4.0	3
4 Family labour man-days employed	0.7867	0.6189	61.9	0.0182	1.8	4
2 Total farm acreage owned by family	0.7951	0.6321	63.2	0.0133	1.3	5
3 Total acreage under fallow, 1971	0.8502	0.7229	72.3	0.0908	9.1	6
5 Percentage of inherited land	0.8504	0.7231	72.3	0.0002	0.02	7

TABLE 21 (D)

MULTIPLE WITH PARTIAL CORRELATION TO DETERMINE THE RELATIVE DEGREE OF IMPORTANCE OF VARIABLES (X_1) TO (X_7) ASSOCIATED WITH ACREAGE PER HEAD CULTIVATED IN OWERRI PROVINCE, 1971 (Y)

Variable Entered	R	Multiple		Increase in RSQ		No. of independent Variables included
		RSQ	%	RSQ	%	
7 Land Use Factor	0.6508	0.4235	42.4	0.4235	42.4	1
1 Family size	0.6955	0.4837	48.4	0.0602	6.0	2
2 Total farm acreage owned by family	0.7772	0.6040	60.4	0.1203	12.0	3
3 Total acreage under fallow (1971)	0.8432	0.7110	71.1	0.1070	10.7	4
6 Distance Factor (miles)	0.8469	0.7172	71.7	0.0062	0.6	5
4 Family labour in man-days employed	0.8485	0.7200	72.0	0.0028	0.3	6
5 Percentage of inherited land	0.8488	0.7205	72.1	0.0005	0.05	7

together, actually predict the criterion or dependent variable Y. A partial correlation was also performed, in which the effect of one or more variables was isolated at each point in the computation, by the addition of one variable at that stage. It was thus possible to determine the extent to which that added extra variable helped to explain the average acreage of cultivated land in the divisions in 1971.

Results of the exercise (Table 21, A - D), prove that the combined correlation coefficients of the variables X_1 to X_7 with Y in all the divisions are high, the value being 0.93 for Mbaitolu-Ikeduru and 0.85 each for Mbaise, Owerri and the Province. In Mbaise Division, total acreage under fallow in 1971, (X_3), (Table 21(A)), accounted for 48.7% of the explanation, followed by size of the family (X_1), which explains 17.1% of the relationship. In the two remaining divisions and for the province in general, the Land-Use Factor (X_7) provided the fullest explanation, accounting for 55.3% of the correlation in Mbaitolu-Ikeduru, 50.3% in Owerri Division, and 42.4% in the province.(Table 21(B)-(D).

The order of importance in which the variables predict or explain cultivated acreage per head in the province in 1971 (Table 21(D)), is as follows: Land-Use Factor 42.4%; total acreage owned by the family/household, 12%; total acreage under fallow in 1971, 10.7%; and the size of family, 6%. The Distance Factor (miles), is generally unimportant, compared with the factors already mentioned except in Owerri Division, where it accounts for 4% of the explanation. In Owerri Division, farms are located far from the village centre especially in boundary villages. The amount of labour contributed by the family/household (man-days), and the percentage of

inherited land, produced very little effect in the combined multiple correlation (0.05%) to explain cultivated land per head in various parts of the province in 1971.

5.3 Conclusion

The overall results of the analysis show that not all the propositions were upheld in the divisions at the same level. However, many of them were found to conform to expectations, especially the predicted values of the combined variables in the multiple correlation analysis. (Table 21 (A) to (D).

Where positive correlations emerged in place of negative hypothesized relationships as in Table 20 (A) to (D), the results were rejected at the 0.05 level of significance, implying that the positive relationships could be chance events. These may be due to the complex relationships and interconnection between the various independent variables.

The socio-economic factors which influence farmers' behavioural and decision-making processes in subsistence agricultural economies are many and varied, sometimes too complex to warrant a complete, reliable interpretation or application of statistical analysis. While the results obtained in Tables 19 to 21 could prove to be a useful guide and aid our understanding of the agricultural practice in Owerri Province, a cautious and 'not too literal' approach to the interpretation of the results obtained, must be kept in view.

CHAPTER VI

FORMULATING THE CRITICAL POPULATION DENSITY FOR PARTS OF OWERRI PROVINCE

This chapter will seek to establish how much land per head people need to subsist on, and which they can cultivate effectively under the present system of bush-fallowing and to available farm techniques, without depleting the land. An attempt will also be made to establish the carrying-capacity of the Divisions and the Province, expressed in persons per square mile which, while providing for fairly standard yields, will also ensure adequate fallows, good soil conservation, and an adequate diet.

6.1 Essential Data Required in Formulating the C.P.D.

(a) Information on soils or soil-vegetation association (V-S). These have been examined in Chapter III, and the results of the physical and chemical characteristics of the soils are presented in Table 2. Appendix I also contains a full description of the soils. On the basis of the soil-vegetation characteristics described in Chapter III, crop yields per acre (lbs) (Table 7), and consequently, land requirement per head (acres) (Table 27), were computed.

(b) Cultivable percentage of land. (P) This was based on the Nigerian Census of Agricultural returns, (1950-51 and 1957-60), in which 35.5% of the land area of Owerri Province, was found to be under farm

crops, and 61% to be under bush rotation, giving a total cultivable percentage of 96.5 or 678.4 sq. miles.

(c) Average acreage under cultivation per head at any one time.(C)

The average acreage per head cultivated in the three divisions, (1971) is shown in Table 13, and the distribution of cultivated land per head (1971) in Table 14. The values in acres are: Mbaise, 0.35; Mbaitolu-Ikeduru, 0.49; Owerri 0.52; and Owerri Province, 0.43.

(d) Land-Use Factor (L.U.)

This is the relationship between the duration of cultivation on each land type, and the period of subsequent rest required for the restoration of fertility. L.U. is the inverse of the fraction of time during which the particular land unit is cultivated; that is, the ratio (C + F)/C, where C is the number of years of cultivation; and F, the number of years of fallow.

A summary of the past and present ranges, and average value of the Land-Use Factor for the three divisions in Owerri Province, is presented in Table 22. The calculation was based on the crop/fallow time ratio which individual families/households now practise, and that which obtained before the present drastic reduction of fallow periods and prolongation of the cropping period.

In recommending what may be called the 'ideal' crop/fallow time ratio and L.U. for different parts of the Province, (Table 24), a number of factors was considered. These include comparison of the past and present crop-fallow time ratios as practised in Owerri (Table 22); the 'weighting' of opinions and experiences of farmers on the issue of fallow periods and crop performance, and the study of the local requirements of different crops on garden (compound) and farmland. Reference was also

TABLE 22

A SUMMARY OF THE ESTIMATED PAST AND PRESENT LAND USE FACTOR (L.U.) AS PRACTISED IN PARTS OF OWERRI PROVINCE

Division	PAST PRACTICE *			PRESENT POSITION		
	Crop-Fallow Time Ratios	Range of L.U.	Average L.U.	Crop-Fallow Time Ratios	Range of L.U.	Average L.U.
Mbaise	1-2/3-6	2.5 - 7.0	4.0	2-4/1-5	1.3 - 2.6	1.74
Mbaitolu-Ikeduru	1-2/5-8	3.5 - 8.0	5.3	2-3/1-6	1.4 - 2.8	1.90
Owerri	1-2/5-12	5.0 -13	6.7	1-2/2-15	1.1 - 6.2	2.80
Province	1-2/3-12	2.5 -13	5.3	1-4/1-15	1.1 - 6.2	2.20

* This data is based on the response of those farmers who indicated that they had farmed their land for more than 10 years. (See Appendix 2 Form B, p. 141)..

TABLE 23

ESTIMATED CROP/FALLOW TIME RATIOS FOR DIFFERENT FALLOW SYSTEMS IN SELECTED AREAS OF TROPICAL AFRICA

Place	Fallow	Normal		Excessive		References
		C/F Ratio	L.U.	C/F Ratio	L.U.	
Umuahia, E. Nigeria	Acioa bateri	$1\frac{1}{2}$ / 4 - 7	4.7	$1\frac{1}{2}$ / $2\frac{1}{2}$	2.7	Vine, (1954)
Alayi, E. Nigeria	Microlobium spp.	$1\frac{1}{2}$ / 7	5.7	Not given	-	Vine, (1954)
Abeokuta, W. Nigeria	Thicket	Not given	-	2 / 4 - 5	3.3	Vine, (1954)
Ilesha, W Nigeria	Thicket	2 / 6 - 7	4.3	Not given	-	
Parts of Yoruba country	-	2 / 6 - 8	4.5	2 / 3 - 4	2.8	Vine (?)
Liberia	Forest	1-2/ 8 - 15	8.7	Not given	-	Reed (1951)
Sierra Leone	Forest	$1\frac{1}{2}$ / 8	6.3	$1\frac{1}{2}$ / 5	4.3	Waldock et.al. (1951)
West Africa	Moist semi-deciduous forest	2 - 4/6 - 12	4.0	Not given	-	Irvine (1934)
System as a whole	-	$1\frac{1}{2}$ - 2/4 - 7	4.2	$1\frac{1}{2}$-2/2-$2\frac{1}{2}$-3	2.4	Nye and Greenland (1960)
	-	2 - 4 /8 - 10	4.0	-	-	Nye and Greenland (1960)

TABLE 24

SUGGESTED CROP-FALLOW TIME RATIOS AND LAND-USE FACTOR FOR PARTS OF OWERRI PROVINCE, BASED ON THE ESTIMATES IN TABLE 22 AND THE RECOMMENDATIONS IN TABLE 23

Division	Suggested Crop-Fallow Time Ratios	Range of Land-Use Factor (L.U.)	Average Land-Use Factor (L.U.)
Mbaise	$1\frac{1}{2}$ - 2 / 6 - 10	5 - 6	5.6
Mbaitolu-Ikeduru	$1\frac{1}{2}$ - 2 / 6 - 9	5 - 5.5	5.0
Owerri	$1\frac{1}{2}$ - 2 / 5 - 8	4.3 - 5	4.7
Province	$1\frac{1}{2}$ - 2 / 5 - 10	4.3 - 6	5.3

made to studies done by Vine and others (Table 23), on fertility ratios of fallow systems in Nigeria and other parts of West Africa.

Interviews with farmers revealed that they did not always compute fallow periods in years. They were able to tell when fallow land matured for cultivation, and could judge this state by the type of trees and grasses that grew, and by the wealth of vegetation litter, as well as earthworm activity. They were able to name local soil types, and knew that these soil types took varying periods of years to rejuvenate. Such names as "wet land (Ala-mmiri), "dry-land" (Egbelu), "clay-land" (Ala-uro), "former residential land" (Ala-Okpulo), showed on a micro-scale, that farmers knew the characteristics of their land well. The patchy occurrence of the 'bush' in various stages of regrowth, and the repeated cultivation of the same land, clearly suggests that the system has broken down.

By studying the amount of nutrients stored in different tropical forest and grass fallows and in the soil, and by comparing these with nutrients removed in harvest by common native crops, Vine, Irvine, Nye and Greenland and others,[76] have been able to suggest the normal crop/fallow time ratios practicable under shifting cultivation. (Table 23). They recommended crop/fallow time ratios of between $1\frac{1}{2}$ - 4 years to 4 - 15. These would give Land-Use Factors of 4 to 8. With the exception of the example on Sierra Leone, all the studies point to any crop/fallow system with L.U. less than 4, as excessive.

The critical factor seems to be the maintenance of a crop/fallow period, which will prevent a rapid change from woody plants to grass fallow,[77] while Nye and Greenland[78] imply that cropping at the normal

crop/fallow time ratio could be prolonged for many cycles, without a noticeable erosion of the soil, a change in the type of fallow, or a marked decline in yields.

On the basis of all available evidence (Tables 22 and 23), the suggested crop/fallow time ratio and associated L.U. for the three divisions in Owerri Province, are presented in Table 24. The figures suggest that well-maintained fallows of dense coppice growth, with crop/fallow time ratios of $1\frac{1}{2}$ - 2/5 - 8 years, are capable of maintaining soil fertility for a long time. It would appear, however, that to bring the 'overfarmed' areas of parts of Mbaise and Mbaitolu-Ikeduru Divisions to a proper stage of woodland recolonization, a longer period of fallow -- up to 10 years in the first instance - would be needed immediately. This period could gradually be shortened in the future, as the soil recovered.

6.2 Land Requirement per head; Estimated Carrying-Capacity (persons), and Critical Population Densities (C.P.D.) of parts of Owerri Province.

Allan's formula for calculating land requirement per head of the agricultural population, in a traditional land-use system, has already been stated (page 9-10) and was given as:

$$100 \text{ L.U.} \times \frac{C}{P}, \text{ when}$$

L.U., is the Land-Use Factor;

C , is the Cultivation Factor; and

P , is the Cultivable Percentage of Land.

Tables 25 and 26 show the Land Requirement per head (acres), the estimated Carrying-Capacity (persons), and the Critical Population Densities (persons per square mile), of parts of Owerri Province, based on the present and suggested Land-Use Factors respectively, and on the acreage per head cultivated in the divisions in 1971.

Under the present L.U. in the divisions, (Table 25), land requirement per head is highest in Owerri division (1.51 acres), which owns and cultivates more land per head of its population (Tables 11, 13), and lowest in Mbaise Division (0.63 acre), where land shortage is most critical. Mbaitolu-Ikeduru Division has a land requirement per head value of 0.97 acre. In terms of the human-carrying capacity of land, Mbaise is credited with 1,016 persons per square mile, Owerri 424, and Mbaitolu-Ikeduru 660.

Using the suggested average L.U. in estimating the land requirement per head in the three divisions (Table 26), the values obtained are over 2 acres in each case, and roughly $2\frac{1}{2}$ acres for Mbaitolu-Ikeduru and Owerri. Because of the higher suggested L.U., the estimated carrying-capacity of the divisions has decreased. However, Mbaise division exhibits a surprisingly higher value of C.P.D. of 315 per sq. mile, compared with 252 for Mbaitolu-Ikeduru and 253 for Owerri.

These figures are palpably misleading. Population pressure usually causes an increased cultivated acreage, partly as a reaction to declining yields. Following this argument, Mbaise and Mbaitolu-Ikeduru Divisions most likely would need a greater land area per head to produce the same food requirements, as Owerri Division, considering the poorer

TABLE 25

ESTIMATED HUMAN - CARRYING CAPACITY OF PARTS OF OWERRI PROVINCE, BASED ON PRESENT LAND-USE FACTOR, AND AVERAGE ACREAGE CULTIVATED PER HEAD, (1971)

Division	Total Area (sq.mls.)	Total Area (acres)	Cultivation Factor (C) (acres)	Present Average Land-Use Factor (L.U.	Land Requirement per head (acres)	Estimated Carrying-Capacity (ECCP) (persons)	Critical Population Density (C.P.D.) (persons per sq. mile)
Mbaise	159.9	102,336	0.35	1.74	0.63	162,438	1,016
Mbaitolu-Ikeduru	129.5	82,880	0.49	1.9	0.97	85,443	660
Owerri	413.6	264,704	0.52	2.8	1.51	175,300	424
Province	703.0	449,920	0.43	2.2	0.99	423,181	602

NOTE: In all cases, the cultivable percentage of land used for the calculation was 96.5

TABLE 26

ESTIMATED HUMAN - CARRYING CAPACITY OF PARTS OF OWERRI PROVINCE, BASED ON THE SUGGESTED LAND-USE FACTOR (TABLE 24), AND AVERAGE ACREAGE CULTIVATED PER HEAD (C) (1971)

Division	Total Area (square miles)	Total Area (acres)	Cultivation Factor (acres)	Suggested Average Land-Use Factor (L.U.)	Land Requirement per head (acres)	Estimated Carrying - Capacity (E.C.C.P.) (persons)	Critical Population Density (C.P.D.) (persons per sq. mile)
Mbaise	159.9	102,336	0.35	5.6	2.03	50.412	315
Mbaitolu-Ikeduru	129.5	82,880	0.49	5.0	2.54	32,630	252
Owerri	413.6	264,704	0.52	4.7	2.53	104,626	253
Province	703.0	449,920	0.43	5.3	2.36	187,668	267

soils, and the overcultivated fields. The E.C.C. and the C.P.D. obtained with the Cultivation Factor (C) (1971), are therefore questionable. The E.C.C. and C.P.D. (Tables, 25 and 26) have been overestimated in the case of Mbaise and Mbaitolu-Ikeduru based on lower figures of land requirement per head, while those for Owerri Division have been underscored due to a greater land requirement per head used in the calculation.

The reasons for such over- or under-estimation as the case may be, could be attributed to the following reasons:

(a) The average acreage per head cultivated in the three divisions in 1971 (C) is not based on need for land, but on land that was actually available for cultivation. For an area with enough or surplus land, acreage cultivated per head at any one time may be used as a reliable basis for estimating the need for land, since it could be assumed, farmers carve out as much land as they can conveniently cope with, and the Cultivation Factor, may be limited only by the techniques of hoe-production and the amount of family labour. Where pressure of population is the rule, the use of average acreage per head cultivated at any one time in computing land requirements per head, is greatly limited in scope, and the results obtained are likely to be open to doubt as shown in Tables 25 and 26.

(b) Acreage cultivated per head of the population varies from year to year, and depends on a number of factors the most important being: the economic position of the farmer at the beginning of the farming season, how much land the farmer has, the possibilities of acquiring more land through pledge or loan, and the opportunities that exist for

participation in other profitable non-farm activities.

(c) Acreage per head cultivated 1971, ignores the varying crop yields in terms of varying lengths of fallow and soil conditions in the three divisions. (Table 7).

Because of the above reasons, a Cultivation Factor (C) based on need for a certain acreage of land per head, which could be cultivated efficiently using present farming techniques, and which would meet the annual food requirements of the family/household, would appear to offer the most reliable criterion for estimating the land requirement per head. Table 27 shows such an approach. The Cultivation Factor (C), is based on the yearly requirements of land which would produce, on the average, an individual's need for essential food crops in the three divisions. The estimated average annual food requirements for each of 60 sample families/households in 16 selected villages in the province, from which the overall average food requirements per head was calculated, were computed as follows:-

Age Group		Food Unit Ratio
Unweaned babies	...	0
1 - 5 years	...	1
5 - 15 "	...	2
15 and over	...	4

The average food requirement per head in lbs. was calculated from the estimated number of baskets consumed per type of crop. (1 standard basket of yams = 67 lbs.; cassava, 64 lbs.; maize, 34 lbs.; cocoyams, 62 lbs.)

TABLE 27

CROP ACREAGES PER HEAD REQUIRED TO PRODUCE THE AVERAGE ANNUAL FOOD REQUIREMENTS (LBS.)

PER HEAD IN PARTS OF OWERRI PROVINCE

Division	YAMS			CASSAVA			MAIZE			COCOYAMS			CULTIVATION FACTOR (C)
	Av. Food reqd. per head (lbs. per annum)	Yields (lb per acre)	Crop acreage reqd. per head	Av. Food reqd. per head (lbs per annum)	Yields (lb per acre)	Crop acrg. reqd. per head	Av. Food reqd. per head (lbs per annum)	Yields (lbs/ acre)	Crop acrg. reqd. per head	Av. Food reqd. per head (lbs. per annum	Yields per acre (lbs)	Crop acrg. reqd. per head	
Mbaise	375.0	2379	0.16	998.4	6282	0.16	122.4	402	0.31	297.6	1385	0.21	0.84
Mbaitolu-Ikeduru	375.0	2760	0.14	998.4	6771	0.15	122.4	524	0.23	297.6	1513	0.20	0.72
Owerri	375.0	6191	0.061	998.4	11520	0.087	122.4	1081	0.113	297.6	3522	0.084	0.35
Province	375.0	3689	0.102	998.4	8072	0.123	122.4	652	0.188	297.6	2093	0.142	0.56

The average annual food requirement per head (lbs.) for each of the major staple food crops is divided by the estimated crop yields for each division (Table 7), to give the average acreage per head needed for cultivation in any one year: 0.84 acre in Mbaise, 0.72 acre in Mbaitolu-Ikeduru , 0.35 acre in Owerri, and 0.56 acre for the province.

The acreage per head needed at any one time to produce an individual's requirements of the major food crops during the farming year, (the Cultivation Factor) obtained in Table 27 is relatively stable, and is thought to be largely unaffected by the farmers' decisions at each farming year. It is also reliable because it takes into account, the varying land-producing capacities of the divisions. The Cultivation Factor also compares favourably with previous studies done on the amount of land, which an individual could subsist on in identical agricultural environments.

Given the ability, resources, habits and energy of the cultivating groups, a Cultivation Factor of about $\frac{1}{2}$ acre, has been thought of as common for subsistence systems in the forest regions of equatorial and subequatorial regions.[79] Galleti, Baldwin and Dina,[80] found for Yoruba cocoa-farming families in 8 sampled localities, that the mean area of food crops was 3 acres per family, the modal family consisting of a man, one or two women, and two or three children. This means that 4 to 8 people would subsist on 3 acres, giving a Cultivation Factor of between 0.38 and 0.75 acres, or an average of 0.5 acres. A survey of the Eastern Region of Ghana in 1959,[81] revealed that where farmers cultivated 0.19 acre per head, food was mostly bought; at a Cultivation Factor of 0.25 acre,

some food was bought; at 0.5 acre, food was neither bought nor sold; and where 0.85 acre per head was cultivated, some food was sold. The "food farmer" who cultivated 1.42 acres per head of his family, sold most of the food produced.

The impression gained from Table 27, was also supported by general enquiry in the field, and the opinions of agricultural officers in charge of the divisions, who considered, that on the average, 2 to 4 acres of food crops should provide ample food for a family of 5 (this would give a Cultivation Factor of between 0.4 and 0.8 acres), depending on the particular locality and soil.[82]

It now remains to formulate the final E.C.C. and C.P.D. for the divisions, using the suggested Cultivation Factor arrived at after introducing the necessary modifications to the original meaning of Allan's Cultivation Factor, as the "... average for the acreage under cultivation per head of population at any one time".[83] Table 28 gives the carrying-capacity and Critical Population Density of parts of Owerri province, under present crop-fallow time ratios, using the estimated average acreage required to produce the basic food crops needed per head. As ought to be expected, Owerri division has the highest human-carrying capacity in the province, with a C.P.D. of 627 persons per sq. ml., compared with 426 for Mbaise, and 457 for Mbaitolu-Ikeduru. The average C.P.D. for the province is 550.

Table 29 marks the final stage in the search for a reliable figure of C.P.D. for parts of the province. By using the actual acreage needed per head, in place of the acreage under cultivation per head in 1971,

TABLE 28

ESTIMATED HUMAN-CARRYING CAPACITY OF OWERRI PROVINCE, BASED ON PRESENT LAND-USE FACTOR, (TABLE 22), AND THE SUGGESTED CULTIVATION FACTOR (TABLE 27)

Division	Total Area (sq. mls.)	Total Area (acres)	Suggested Cultivation Factor (C) (acres)	Present Average Land-Use Factor (L.U.)	Land Requirement per head (acres)	Estimated Carrying - Capacity (E.C.C.) (persons)	Critical Population Density (C.P.D.) (persons per sq. mile)
Mbaise	159.9	102,336	0.84	1.74	1.5	68,224	426
Mabitolu-Ikeduru	129.5	82,880	0.72	1.9	1.4	59,200	457
Owerri	413.6	264,704	0.35	2.8	1.02	259,514	627
Province	703.0	449,920	0.56	2.2	1.3	386,938	550

TABLE 29

ESTIMATED HUMAN-CARRYING CAPACITY OF PARTS OF OWERRI PROVINCE, BASED ON THE SUGGESTED LAND-USE FACTOR (TABLE 24), AND THE COMPUTED CULTIVATION FACTOR (C), (TABLE 27)

Division	Total Area (sq. mls.)	Total Area (acres)	Estimated Cultivation Factor (C) (acres)	Suggested Average Land-Use Factor (L.U.)	Land Requirement per head (acres)	Estimated Carrying-Capacity (E.C.C.) (persons)	Critical Population Density (C.P.D.) (persons per sq. mile)
Mbaise	159.9	102,336	0.84	5.6	4.9	20,885	131
Mbaitolu-Ikeduru	129.5	82,880	0.72	5.0	3.7	22,400	173
Owerri	413.6	264,704	0.35	4.7	1.7	155,708	377
Province	703.0	449,920	0.56	5.3	3.1	198,993	283

(Table 27), and by raising the Land-Use Factor to the level necessary to ensure the revitalization of the soil (Table 24), the true estimates of C.P.D. figures for the divisions are obtained. Table 29 shows that Owerri Division is capable of supporting 377 persons per sq. mile, under the present agricultural practice, compared with 173 persons to the sq. mile for Mbaitolu-Ikeduru, and 131 persons to the sq. mile for Mbaise Division. For the province, the land carrying-capacity is limited to 283 persons per sq. mile. This is the estimated figure of C.P.D., beyond which overcropping and consequent soil exhaustion would thrive. Since all available evidence point to the fact, that this state had already been attained in most parts of the province for a long time, the estimated figures of C.P.D., in Table 29 could suggest the 'ideal' population density, which would ensure the gradual recovery of the soil to a reasonable state of fertility and crop production, and maintain it, in the absence of the introduction of modern scientific farming methods.

It is in the light of the above C.P.D. figures, (Table 29), that the gravity of the 'population problem' in Owerri Province, must be visualized. The present density of population for the province (1963 Census), is 830 persons per sq. mile, and the figures quoted by the Population Studies Centre at Ibadan University (1962 Mid-Year Estimates), is 851 per sq. mile. However, parts of the province, and especially Mbaise Division, are known to carry more than 1000 persons per sq. mile. As an example, other heavily populated divisions of Orlu, Okigwi, Awka, Uyo and Abak, which are often referred to in association with Mbaise Division as constituting the main "population problem area" of Eastern

Nigeria, contain 1,632, 1,267, 1,035, 1,171 and 1,016 persons to the sq. mile, respectively.[84]

It has been stressed that the bulk of the population in Iboland, is concentrated in a "geographical axis formed by Onitsha, Orlu, Okigwi and Mbaise areas ..... where the population exceeds 1,000 per sq. mile in many places, giving this area one of the world's most densely populated rural areas, subsisting on rootcrops, raised through hoe culture.[85] Church also refers to the Ibo farmers, as living in numerous scattered compounds, with the highest population densities in Nigeria of 1,350 per sq. mile.[86] Based exclusively on the 1971 agricultural sample population survey for the province, the agricultural population densities would be 1,542 per sq. mile for Mbaise, 1,075 for Mbaitolu-Ikeduru, and 815 per sq. mile for Owerri Division. When these excessively high population density figures are set against the estimated human-carrying capacities of 131 to 377 persons per sq. mile in the province, the magnitude of the problem is fully appreciated.

It may be argued that since not all of the farmers' sustenance is drawn from the land, a consideration of other non-farm income-earning activities would tend to raise the C.D.P. This is correct as a sample survey of the identifiable economic pursuits of 20 families/households in parts of the province, shows that if all proceeds from farm and non-farm activities were reduced into money equivalents, agriculture (including food crops, cash crops and livestock), would contribute £2,989.14, or 59.6%, while non-farm activities would yield £2,024.35, or 40.4% of total incomes.

(Appendix 3). Of the farm incomes, food crops contributed £1,496.4 (50.1%), Cash crops, £350.99 (11.7%), and livestock £1,141.75 (38.2%). Of the non-farm activities, trade and crafts accounted for £1,520.55 or 75.1%; migration, £277.7 or 13.7%; and remittances from abroad £266.1 or 11.2% (Appendix 3).

Using Spearman Rank Order Correlation, to determine the level of significance of non-farm contributions to the farmers' support, compared to incomes from agriculture, the values were found to be significant at both 0.05 and 0.01 levels (Appendix 3), thus confirming the importance of non-farm incomes in traditional agricultural systems.

If the results of the sub-sample of 20 families/households were extended to the entire province, the C.P.D. obtained in Table 29, would account for only 59.6% of the carrying-capacity of parts of the province. However, this is not an accurate deduction, since the sample is not large enough to yield conclusive results for the entire province, because the degree of engagement in non-farm activities varies from place to place, and even from year to year in the same place, depending on land availability and the relative rewards of agriculture, compared with other income-earning activities.

Expressed in terms of total carrying-capacity on land and other income-bearing activities, the C.P.D. would be: Mbaise, 220 per sq. mile; Mbaitolu-Ikeduru, 290 persons per sq. mile; Owerri Division, 633 per sq. mile, and Owerri Province, 475 persons per sq. mile. These values would still lag far behind the present population densities, and the fact of excessive population pressure, would still be proved. Moreover, the

calculation has only taken account of food requirements to the exclusion of the satisfaction of other essential requirements, such as clothing, transport, housing and education.

6.3 Conclusion as to Critical Population Density

The application of Allan's model of C.P.D. has confirmed the existence of rural overpopulation in all divisions of Owerri Province. Comparing the present population densities of about 800 to 1,000 persons per square mile, with the computed Critical Population Densities of 131 to 377 per square mile, parts of Owerri Province are shown to carry roughly three to eight times the 'optimum' size of population. Even when the proceeds of non-farm activities are considered, parts of Owerri Province would carry three to five times a population greater than the maximum.

The future is even more formidable. The present population of Owerri Province is 901,016 (1963 Census). With a population of 560,673 in 1952, this figure represents an increase of 60.7% in a decade, and an annual growth rate of 4.6%.[87] The reasons for such an astounding high rate of population growth is usually attributed to the lowering of death rates, consequent on improved health, while birth rates have remained high.[88]

Family size is large in all parts of the province. The survey of 205 families/households shows that the average family size was 6.6 in Mbaise, 5.1 in Mbaitolu-Ikeduru, 4.9 in Owerri Division, and 5.5 for the province. Cultural and religious practices, marriage habits, community

customs, and family organization, are all focussed toward maintaining high fertility. A premium is placed on social stability at the expense of social progress. Marriage is obligatory for everyone, and the motivation for getting children, ranges from such trifles as community criticism, to the more important reasons such as household help, old-age care, the desire to get male children, and the question of family survival.

Considering the annual growth rate of population, and the lack of any programmes of family planning, there is future fear that the C.P.D. figures quoted above would further decline. Equally, dim prospects would await any measures to improve or preserve the soil resources of the province, without a major breakthrough in modern scientific farming methods, especially intensive farming with fertilizer application.

CHAPTER VII

SUMMARY AND CONCLUSION

7.1 Summary

The main objectives of the study were:

(a) to verify the existence of pressure of population on land in parts of Owerri Province of Eastern Nigeria, from the point of view of present population densities, and generally observed conditions of land use and agriculture; and

(b) to determine the extent of rural overpopulation in these areas, through the application of Allan's Concept of Critical Population Density.

Information required for this study, was derived almost exclusively from field observations. Enquiry into forms of land use and agriculture was obtained by means of questionnaires and soil-vegetation surveys, which showed that the type of agriculture practised is "Rotational Bush Fallowing". The agricultural system makes use of fallows to restore or maintain the fertility of the soil, and is characterized by land rotation, cutting and burning of bush, general absence of draught animals or tractor, poor implements and low farm expenditure. It is purely a

subsistence agriculture with some cash cropping and extensive inter-cropping.

Five fallow types (semi-permanent, short, short to medium, medium to long, and long to very long) based on the ratio of length of fallow to cropping period, were identified. It was observed that 87.8% of the families surveyed maintained excessive crop/fallow time ratios of $1\frac{1}{2}$ -3/1-4 years, giving a Land-Use Factor of less than 3 in all cases. This implies that semi-permanent, short, and short to medium fallows predominate.

The major crops grown are yams, cassava, maize and cocoyams. Of these, cassava has emerged as the dominant crop occupying about 50% of total cultivated area, because it is usually more tolerant of exhausted soils than the other crops, and demands far less labour than yams.

The farming cycle was found to be governed by rainfall characteristics, and crop yields were observed to be responsive to land of different lengths of fallow and soil type, and also between garden and farmland.

The crucial problem of land availability was examined. Land owned per head in the province averaged half an acre. In most cases this was between less than 0.25 and 0.5 acre. It was proved in Tables 11 to 14 that Owerri Division owned and cultivated more land per head of its population, than either Mbaise or Mbaitolu-Ikeduru. Land ownership through inheritance, was found to be the commonest method of land acquisition, though this is known to have led to the fragmentation of farm holdings. Small and uneconomic size of farms between less than 0.25 and 0.75 acres made up 69.2% of all farmholdings.

Investigation into a linear relationship between pairs of variables involved in agricultural land use (Table 19), and especially between a set of seven variables which are known to influence amount of land cultivated per head at any one time (Table 20), was carried out by means of the Pearson Production-Moment Correlation Coefficient. The hypotheses were rejected, if results fell below the 0.05 significance level, or if the relationship indicated by the correlation coefficient, was contrary to that hypothesized. Multiple, with Partial Correlation Coefficient, was used to determine the relative degree of importance of 7 variables (Table 21) as they affect acreage per head cultivated in 1971.

The results of the first analysis, showed that all the pairs of variables tested, gave positive correlations, with the possible exception of family size and acreage per head owned, which returned a negative relationship. The second test of significance of the variables associated with cultivated farm acreages per head (1971), indicated that family size is negatively correlated with land acreage per head cultivated in Mbaise Division in 1971, and that, even insignificantly. The other variables gave positive results, and of these, only family labour (man-days), the percentage of inherited land, and distance factor (miles), were found to be insignificant at the 0.05 level.

Analysis of the Multiple Correlation Coefficient for the Province selected Land-Use Factor as the most important factor (42.4%), affecting acreage per head cultivated at any one time in the divisions, followed by the total acreage of land owned by the family or household (12%).

Next in order of importance were total acreage under fallow in 1971 (10.7%), and family size, (%). Not all the results obtained were found to conform to expectations, though it is strictly advised that caution must be exercised in interpreting the results of the tests due to the complex relationships and inter-connection between the various independent variables, and the socio-economic factors which influence farmers' behavioural and decision-making processes in subsistence agriculture.

All the information obtained from the survey was directed towards formulating the C.P.D. in Chapter VI. Four levels of C.P.D. for the divisions and the province were established, based on:

(a) present Land-Use Factor (L.U.), and acreage per head cultivated in 1971 (C). (Table 25)

(b) the suggested Land-Use Factor (L.U.), and average acreage per head cultivated in 1971 (C). (Table 26)

(c) the present Land-Use Factor (L.U.), and the computed Cultivation Factor (C). (Table 28); and

(d) the suggested Land-Use Factor (L.U.) and the Computed Cultivation Factor (C). (Table 29).

It was deemed necessary to go through all these four stages, in order to show the limitations of some of the factors used in the formulation of the C.P.D. at each stage. The figures of C.P.D. obtained at the first and second levels (Tables 25 and 26), were found to give erroneous information, because: (a) they gave wrong values of land requirement per head; and (b), they tended to overestimate the human carrying-capacities of Mbaise and Mbaitolu-Ikeduru Divisions, with

smaller land areas, shorter fallows, and poorer soils, and underscored those of Owerri Division, with longer fallows, better soils, and fewer problems of land shortage.

The fault was attributed to the Cultivation Factor, or acreage of land cultivated per head in 1971. It was found for obvious reasons, that land acreage per head of the population cultivated at any one time, did not truly reflect the need for land, since this depended very much on the amount of land owned by the family, and was subject to yearly changes due to the economic status of the farmer, the possibilities for acquiring more land, and the opportunities that existed for participation in other profitable non-farm activities.

A Cultivation Factor based on the need for land which would meet the annual food requirements of the family/household was devised. The estimated average annual food requirement per head (lbs.) was calculated based on age groups. This was divided by the estimated annual crop yields in lbs. per acre for each division, to give the average acreage per head needed for cultivation in any one year; Mbaise 0.84, Mbaitolu-Ikeduru 0.72, Owerri Division 0.35 and Owerri Province 0.56.

The computed Cultivation Factor was used to estimate the C.P.D. at the third and fourth levels. In stage 3, the computed Cultivation Factor was used with the present Land-Use Factor (L.U., (Table 28), to obtain the human carrying-capacities of parts of the province, given present crop/fallow time ratios. The results gave a C.P.D. of 426 per sq. mile for Mbaise, 457 per sq. mile for Mbaitolu-Ikeduru, 627 for

for Owerri Division, and 550 for the province.

At the final stage, where the recommended or suggested Land-Use Factor and the computed Cultivation Factor were used in deriving the C.P.D., the figures obtained were 131 per sq. mile for Mbaise, 173 per sq. mile for Mbaitolu-Ikeduru, 377 for Owerri Division, and 283 per sq. mile for the entire province.

When other non-farm income-earning activities were considered, the Critical Population Densities were raised to 220 per square mile in Mbaise, 290 in Mbaitolu-Ikeduru, 633 in Owerri Division, and 475 per sq. mile in the province. Compared with the official average population density of 830 persons per square mile for the province, and over 1,000 per sq. mile in many rural villages in the divisions, the fact of over-population on both land and other identifiable sources of sustenance, was proved.

7.2 Conclusion

The study has demonstrated the existence of overpopulation in all the divisions of Owerri Province, both in terms of land resources, and total probable sources of living. Evidence for this conclusion was based partly on some observed deteriorating conditions of land and living such as land shortage resulting in over-cultivated soils, a drastic reduction in the length of fallow, the prolongation of cropping periods and replacement of forest by oil palm bush or grass, excessive fragmentation of holdings, seasonal hunger and frequent food shortages. In some areas, local over-crowding has occurred. Under-employment on the

land and seasonal migration are rife.

The final and quantitative proof, however, is the use of Allan's Critical Population Density to determine the extent of overpopulation. The application of the model has proved that parts of Owerri Province are carrying population densities about three to eight times greater than their optimum, even when resources other than land are considered.

Estimated Critical Population Densities of 131 to 377 sq. mile based on land alone, or of 220 to 633 persons per sq. mile based on total identifiable resources, should be regarded as the critical population limits in each case, within which varying human-carrying capacities may exist for different areas in the province. The figures should not be regarded as fixed or permanent; rather they should be accepted only in terms of present farming methods, and within the existing social and economic organization.

The Land-Use Factor devised by Allan had helped us to distinguish shifting cultivation from the more common practices of rotational bush fallowing and semi-permanent cultivation. The theoretical model has furthered our understanding of 'overpopulation' in Owerri Province; it has also shown that previous generalized statements on the population problem in the province are inadequate, without reference to factors which influence agricultural practice in the area.

Allan's model has been successfully applied in Owerri Province of Eastern Nige[illegible] with some amendments on the Cultivation Factor.

The results obtained could be the basis of applied research and rural development planning such as, resettlement projects, internal population movement, location of crafts centres, and birth control measures.

APPENDIX I

SOIL PROFILE AND SITE DESCRIPTION,

OWERRI PROVINCE, NIGERIA.

Location: Amakam Ezinihitte East, Mbaise, Owerri.

Profile: I

Soil Order: Oxisols (Ferallitic Tropical)

SITE CHARACTERISTICS

Topography: Gentle upper valley-side, with c.4° of slope. Elevation c. 350 ft; tributary gullies with depths averaging 3 to 4 ins. (max. depth 6 ins.) open out from the road upslope. These are actively eroding during the rainy season.

Drainage: Well-drained normal site.

Parent Material: Coastal Plain Sands of Oligocene to early Pleistocene Period (Tertiary to Quaternary Age).

Vegetation/Land Use: Land is under permanent yearly cultivation with at most 1 year fallow in 3 to 4 years of continuous cropping. Currently supporting a poor cassava crop with thin stems and brown ('fired' or'burnt') leaves. In some cases, lower leaves are streaked with yellow marks, or are completely yellow, probably due to calcium deficiency. There are scattered oil palm trees (Elaeis guineensis).

Agricultural Information: A poor quality sandy soil on upper slope site with low productivity. It is however suitable for cash crop production. Usually the ploughed zone is fully saturated with water during the rains, but remains very dry in the dry season. The soil possesses poor qualities of nutrient retention, is overcropped and continues to be so because of shortage of land.

Remarks: Evidence of anthropogenetic factors clear from the layer containing charcoal, broken pots and bottles. The area must have been the site of a former dwelling place.

PROFILE DESCRIPTION

Depth.in ins.

0 to 20-21 Dark reddish brown (7.5R 3/3); fine, porous sands;

	structureless to fine weak crumb; slightly sticky; frequent patches of dark reddish brown (7.5R 3/2); humus deficient; few rootlets; boundary clear and smooth.
20-21 to 26-27	Very dark reddish brown to reddish black (7.5R 2/1.5); fine porous sand; weak friable coarse crumb; slightly sticky; strong black colour due mainly to presence of charcoal; small to medium angular fragments of charcoal, broken pots and bottles; moderately humic; few roots; boundary clear and smooth.
26-27 to 34-37	Dark reddish brown (7.5R 3/2); colour affected owing to downward leaching from the charcoal zone above; fine porous loose to friable sands; slightly sticky; very slightly plastic; slightly hard when dry; few roots; boundary smooth and gradual.
34-37 to 60+	Dark red (7.5R 3/4); compact loamy sands; sticky; very slightly plastic; very few medium to large roots.

Location — Amakam Ezinihitte East, Mbaise, Owerri.

Profile: — II

Soil Order: — Oxisols (Ferallitic Tropical)

SITE CHARACTERISTICS

Topography: — Moderately steep. Termite mounds and ant hills closeby.

Drainage: — Somewhat excessively drained shedding site.

Parent Material: — Coastal Plain Sands (eroded).

Vegetation: — Secondary succession mainly of shrubs and low bush with small trees (Acioa bateri, Dialium guineensis, Parinari speciosa) averaging 81 ins. high, with other plants such as the berbaceous Eupatorium odoratum, Sida spp., and Alcornea cordefolia, which form a closed canopy at about 7-8 ft. high. Below, there is enough space to permit movement. Few ground weeds.

Land Use:	Land where pit was sited has been under fallow for 3 years. Patches of land adjoining the pit carry crops of cassava and melon.
Agricultural Information:	The appearance of crops (e.g. stunted growth, tiny stems, brown to yellow lower leaves, etc.), all reflect a poor soil resulting mainly from over-farming.

PROFILE DESCRIPTION

Depth.in ins.	
0 to 5-6	Dark reddish brown (2.5 YR 3/3); porous sandy loam; weak to loose crumb structure; moist loose to friable; dry soft; slightly sticky; non-plastic; low to moderate organic content; frequent small to medium roots especially at the upper 3 ins.; smooth and clear boundary.
5-6 to 45-48	Dull reddish brown (5 YR 4/3); weak crumb structure; fine sandy loam; moist friable; dry soft to slightly hard; few large roots and small rootlets; slightly sticky; slightly plastic below 23 ins; low organic content; smooth boundary gradually merging to
45-48 to 60+	Dark reddish brown (2.5 YR 3/6); weak structural sandy loam; moist firm to friable; dry slightly hard; slightly sticky; slightly plastic; no roots; no organic content.

Location:	Amakam Ezinihitte East, Mbaise, Owerri.
Profile:	III
Soil Order:	Ultisols (Ferrisolic Tropical).

PROFILE DESCRIPTION

Depth in ins.	
0 to 10-11	Dark reddish brown (5 YR 3/2); fine sandy clay loam; weak to moderate fine crumb structure; moist firm to friable; dry hard and cracked; slightly sticky to sticky; slightly plastic; moderate organic matter

content; frequent fine worm channels, especially in the upper 5-6 ins.; small grass roots and other herbaceous plants; smooth clear boundary.

10-11 to 20-22 — Dull reddish brown (5 YR 4/3); fine sandy clay loam to fine sandy clay; moderate medium to large granular structure; moist firm; dry very hard and cracked; sticky; slightly plastic to plastic; low organic content; few fine brown (7.5 YR 4/3), dark reddish brown (5 YR 3/3) and dark red (10R 3/4) mottles; very few small to medium roots; few very fine worm channels to a depth of 18 ins.; smooth and gradual boundary.

20-22 to 32 — Brown (7.5 YR 4/3 - 4/4); fine sandy clay; moderate to strong medium to coarse granular structure; moist very firm; dry very hard; tendency to large cracks when dry; very sticky; slightly plastic to plastic; many fine yellowish brown (7.5 YR 4/4), dark reddish brown (7.5 R 3/2) and dark red mottles (7.5 R 3/4) with tongues of light gray (5 YR 8/1); no roots; low organic content;

32 to 45+ — Brown (7.5 YR 4/3); fine sandy clay with frequent rounded concretions and quartz gravel, and with frequent chalk tongues. Wet horizon not observed in section, but described from extracted sample.

SITE CHARACTERISTICS

Topography: — Nearly level to level land about 123 yds. from the bank of the Imo River. Slope estimated at 3-4°, and elevation c. 180 ft. a.s.l.

Drainage: — Poorly drained, receiving site with regular seasonal flooding.

a) Short-term seasonal flooding following heavy rains, which lasts for a few days only.

b) long-term flooding resulting from excess flood water received from the Imo River. Two marked periods during the regular flood season from late June/early July to October, these peaks being in July and September.

Vegetation: Guinea grass (Panicum maximum) and Elephant grass; (Pennisetum purpurem) herbaceous plants and assorted weeds on fallow land in succession to cassava planted the previous year.

Land-Use: Land is mainly devoted to cassava, (Manihot utilissima) maize, (Zea mays), and melon (Citrullus vulgaris). The short-maturing water yam (Dioscorea alata) is occasionally interplanted with the above crops. The practice is to plant the crops early in late January to February so that they will be ready for harvest before the onset of the floods and soil water-logging. Two- to three-year fallow periods are observed. The farming period is generally limited because of (i) the rainy season flooding, and (ii) dry-season soil hardening and drying especially the upper 0-15 inches of the profile. This horizon becomes very hard, cracks and breaks. It is possible to raise dry season (winter) vegetables with irrigated water from the Imo River.

Location: Oparanadim Nwafor, Ekwerazu Mbaise, Owerri

Profile: IV

Soil Order: Oxisols (Ferallitic Tropical)

PROFILE DESCRIPTION

Depth in ins.	
0-5 to 5-15	Dark reddish brown (7.5 R 3/2.5); porous fine sands; very weak platy tabular structure; moist loose; dry loose to powdery; non-sticky; non-plastic; inter-bedded thin non-uniform layers of dark reddish brown sands (5 YR 3/3.5); low organic content; small, frequent fibrous and fleshy roots with many hairs; high collapsidal incidence; boundary diffuse and irregular at first, then broken to wavy (undulating)
5-15 to 37-39	Dark reddish brown (2.5 YR 3/3.5); porous fine sands; weak crumb structure to structureless; very slightly sticky; non-plastic; moist loose to friable; dry soft to loose; many small to moderate angular charcoal fragments in a zone 35 to 39 ins. deep; low organic content; few medium woody roots; boundary smooth and gradual.

37-39 to 60	Dark reddish brown (2.5 YR 3/6); fine porous sands; weak fine crumb structure; moist friable; dry soft; slightly sticky; very slightly plastic; no roots; organic content low to absent.
60 to 83+	Dark reddish (7.5 R 3/4) sands, with a weak to moderate fine to medium crumb structure.

SITE CHARACTERISTICS

Topography:	Very gentle slope (7-8°); changes to moderately steep slope (15°) away from the direction of a stream c. $1\frac{3}{4}$ miles SW. Gully erosion on and at the approaches of a road 84 yds. from the site of pit.
Drainage:	Excessively drained due to fine porous sandy texture. Flood water after heavy rains disappears almost immediately; mainly downward penetration accompanied by some surface flow.
Parent Material:	Coastal Plain Sands of the Oligocene to Early Pleistocene Period.
Vegetation:	Soil too poor to support luxuriant growth of wild vegetation or cultivated crops. Abundant Guinea grass (Panicum maximum) 4-$8\frac{1}{2}$ ft. tall; herbaceous and few woody shrubs 2-3 ft. tall. Many open spaces, sometimes of bare soil surface, growing only a poor type of weed (e.g. bahama) and few ground creepers.
Land Use:	Usually cultivated because of land scarcity. A three- to four-year fallow is necessary to obtain a minimal reward from the labour invested on the land. Where this is reduced to one- to two-year fallow, or cultivated on a permanent yearly basis as now obtains in practice, crop yields have become negligible.
Agricultural Information:	Appearance of crops (cassava, maize, vegetables) show signs of mineral deficiency- dispersed and stunted leaves, brown or yellow leaves, tiny, elongated stems. It is on record that 1.6 acres of the school farm (where pit was sited) planted to maize in late March 1970, did not produce a single cob, although the maize stands grew to an unenviable height of

1 1/2 to 4ft. before they withered and died. Fine sandy deposits are brought down by floodwater. Infiltration capacity of this layered deposit is high. Moisture-retention capacity is very low, and land surface becomes dry within 30 to 45 mins. after rain.

Remarks: Charcoal fragments found at 35-39 ins. in the profile show the rate at which the sedimentation of the top soil by materials brought down by floodwater has proceeded. Depth of charcoal also probably represents the original surface soil, and points to the former wealth of vegetation cover before heavy slashing and burning. This land was overcultivated due to an increasing high density of population.

Location: Umumme Uvuru, Ezinihitte West, Mbaise, Owerri.

Profile: V

Soil Order: Oxisols (Ferallitic Tropical)

PROFILE DESCRIPTION

Dept. in ins.	
0 to 1	Reddish black (7.5 R 2/1) to very dark reddish brown (10 R 2/2); fine loamy sands; weak to moderate crumb; moist, friable; dry, loose; non-sticky; frequent worm channels; few worms; leaf structure partly preserved in the upper 1/2 in.; frequent fine matted fibrous roots; boundary smooth and sharp.
1-13 to 13-23	Reddish black (7.5 R 2/1); fine loamy sands; small weak to moderate crumb; moist, very friable to friable; dry, loose; non-plastic; sticky to slightly sticky; moderate to high organic content and even distribution between 0 and 13 ins.; tongue-like mottles of dark-reddish brown (7.5 R 3/3) to a depth of 23 ins; frequent small to fine worm channels to 15 ins.; frequent fine to medium woody roots; few fleshy, fibrous and rhizomatous roots; boundary irregular, tongueing and gradual.
13-23 to 42-45	Dark-reddish brown (7.5 R 3/3) to dark red (7.5 R 3/4); fine loamy sands; small to medium, moderate to

weak, crumb; moist, friable to firm; dry, soft to slightly hard; non-plastic; to slightly plastic; sticky; low to moderate organic content to a depth of 23 ins.; few, large, woody roots with frequent small to medium woody, fibrous and fleshy roots to a depth of 28 ins.; boundary smooth and gradual.

42-45 to 60+ — Dark red (10 R 3/6); fine to medium loamy sands; moderate medium to large crumb; moist, firm to very firm; dry, slightly hard to hard; sticky; slightly plastic; few large woody roots to a maximum of 49 ins.; no organic matter.

SITE CHARACTERISTICS

Topography: Very gently sloping, c3°, lower footslope of low hill.

Drainage: Well-drained site. Area is however, liable to a short period of flooding especially after very heavy rains. A large quantity of silt is brought down and deposited on the surface when the flood-water recedes.

Parent Material: Coastal Plain Sands of Oligocene to Early Pleistocene Age.

Vegetation: Thick secondary succession of woody trees, shrubs and herbs. Small emergent trees up to 15 ft. high e.g., Parinari speciosa, Dialum guineensis, and Acioa bateri. There is a lower stratum comprising shrubs and herbs 3 to 5 ft. high. In particular, the Eupatorium odoratum forms an almost impenetrable ground cover. Many ground weeds and creeping plants.

Land Use: One to two years of cultivation followed by 5 to 8 years of fallow. Last farmed in 1966, and due to be cropped again in February/March, 1972.

Location: Divisional Agricultural Farm, Nekede Owerri.

Profile: VI

Soil Order: Oxisols (Ferallitic Tropical)

PROFILE DESCRIPTION

Depth in ins.

0 to 6-7	Very dark reddish brown (10 R 2/2.5); fine porous sands; structureless to fine weak crumb; moist loose; dry loose; very slightly sticky; non-plastic; surficial, bleached sand grains thoroughly washed 'clean' by heavy rain-colours range from dark reddish brown sands (7.5 R 3/3) to brown (5.7 YR 4/6) and grayish brown (7.5 YR 6/2). Mottling of sand grains also include light reddish gray (7.5 R 7/1), reddish gray (7.5 R 6/1) to grayish red (7.5 R 6/2); frequent fine fibrous grass roots (c. 23 per sq. ft.) with greater concentration in the upper 6 ins.; low organic content; smooth and clear boundary.
6-7 to 18-21	Dark reddish brown (10 R 3/3.5); fine porous sands; small weak crumb to structureless; moist, very friable to loose; dry loose; slightly sticky; non-plastic; little organic content; very few fine to medium roots; smooth and gradual boundary.
18-21 to 60	Dark red (7.5 R 3/6); fine loamy sands; moderate to weak crumb structure; very sticky; slightly plastic; moist firm to friable; dry, slightly hard; no roots.

SITE CHARACTERISTICS

Topography:	Fairly level lowland area with low hills rising in all directions. Slope estimated at 2-3°; elevation c. 410 ft. a.s.l.
Drainage:	Well-drained. Water is usually retained on the surface for 25 to 40 mins. (depending on the duration of rainfall) before it is completely drained away.
Parent Material:	Coastal Plain Sands of the Oligocene to Early Pleistocene Period.
Vegetation:	Short grass fallow (1-3 ft. tall), with patchy open spaces. Ground creepers and a few scattered shrubs.
Land Use:	Usually devoted to vegetable gardening; now mainly under grass fallow.
Agricultural Information:	Some area is currently being grown to tomatoes and

other vegetables. Many of the plants are 'half-dead', with brown to yellow leaves. The stems of tomatoes especially show evidence of fungus attack. Soil is too porous with a low water-retention capacity. Yams give a poor yield. Cassava thrives fairly well, and gives a fairly rewarding harvest if two or three years of fallow are guaranteed, and if the tubers are allowed to remain at least 15 to 18 months in the ground from the time of planting.

Location: Ekeogba Road, Ohaji Farm Settlement, Owerri.

Profile: VII

Soil Order: Oxisols (Ferallitic Tropical)

PROFILE DESCRIPTION

Depth in ins.	
0 to $^{3}/_{4}$	Leaves with structure largely preserved especially in the upper $^{1}/_{2}$ in. Under this are found leaves with structure partly destroyed. Smooth sharp boundary to next horizon.
$^{3}/_{4}$ to 2	Reddish black (7.5 R 2/1); structureless porous sands; moist loose to friable; dry loose; slightly sticky; non-plastic; moderate to high organic content; slight visible remains of leaves in the humic layer; mottling of very dark reddish brown sands (7.5 R 2/2); fine fibrous and fleshy roots forming a complete root-mat; frequent root hairs and fine to medium secondary woody roots of trees; boundary smooth and sharp.
2 to 6-8	Dark reddish brown (10 R 3/2); fine porous loamy sands; fine loose to weak crumb; moist, loose to weak friable; dry, loose; slightly sticky; non-plastic; moderate organic content; few medium to large roots; frequent small to fine roots; smooth and clear boundary.
6-8 to 36-39	Dark reddish brown (10 R 3/3) to dark red (10 R 3/6); fine loamy sands; weak to moderate fine crumb; moist, friable; dry, soft to slightly hard; moderate to

low organic content; few medium roots and frequent small roots at the upper 15 ins; boundary smooth and gradual.

36-39 to 60+ — Dark red (10 R 3/6) to red (7.5 R 4.8); fine loamy sands; weak to moderate medium crumb; moist, friable to firm; dry, slightly hard to hard; sticky; slightly plastic; few large roots.

SITE CHARACTERISTICS

Topography: Nearly level to level landscape.

Drainage: Well-drained normal site. Potholes on nearby impacted, untarred road surfaces collect and retain floodwater 2 to 7 days after rainfall.

Parent Material: Coastal Plain Sands of Oligocene to Early Pleistocene Age.

Vegetation: Relict forest preserved on purpose to show what the former vegetation of the Farm Settlement looked like before it was acquired by Government.

Typical three-storey forest:

(a) Top storey: Tall smooth trees over 200 ft., sometimes branches for nearly 150 ft. Only a few crowns touch.

(b) Middle storey: Tall slender smooth trees 40 to 50 ft. with few branches. Most of their crowns touch.

(c) Lower storey: Shrubs, herbaceous plants and small trees 4 to 10 ft. high. They form a complete ground cover aided by the almost impenetrable Upatorium odoratum. Many ground weeds and creepers. Numerous epiphytes, hanging lianes and parasites.

Land Use: Area preserved as relict forest. Time of last cultivation estimated to be over 80 years.

Location: Iho Dimezie, Mbaitolu-Ikeduru, Owerri.

Profile: VIII

Soil Order: Oxisols (Ferallitic Tropical)

PROFILE DESCRIPTION

Depth in ins.	
0 to 7-9	Very dark reddish brown, (10 R 2/3); fine porous sands; structureless to fine weak crumb; moist, loose; dry, loose; very slightly sticky; non-plastic; frequent fine to small fibrous roots; few small to medium fleshy and woody roots; moderate organic content; smooth and clear boundary.
7-9 to 28-32	Dark reddish brown (7.5 R 3/2.5); fine porous sands; fine weak crumb to structureless; moist, very friable to loose; dry, loose to slightly hard; very slightly sticky; non-plastic; low organic content; very few small woody roots with many root hairs; smooth and gradual boundary.
28-32 to 60+	Dark red (7.5 R 3/5); fine loamy sands; moderate to small crumb structure; very sticky; slightly to very slightly plastic; moist, firm to friable; dry, slightly hard; no roots.

SITE CHARACTERISTICS

Topography: Nearly level to level ground with not more than 2° of slope.

Drainage: Well-drained normal site.

Parent Material: Coastal Plain Sands of Oligocene to Early Pleistocene.

Vegetation: Poorly - kept grass field. Weeds, grasses and ground creepers in competition. Few scattered shrubs.

Land Use: Not normally cropped. However, traces of former yam mounds and ridges indicate that the area must have been farmed recently.

APPENDIX 2 (Form A)

SOIL AND AGRICULTURAL SURVEY OF OWERRI PROVINCE, EAST CENTRAL STATE, NIGERIA

QUESTIONNAIRE DESIGNED FOR USE BY AGRIÇULTURAL OFFICERS IN CHARGE OF THE DIVISIONS IN OWERRI PROVINCE, (June - September, 1971)

1. (a) Have you carried out a current survey (detailed or sample) of the population of your division or any part of it since the end of the war? _____

   (b) If yes, what do you estimate the population to be _____

   (c) If your knowledge of the present strength of the population comes from a survey carried out say, at the State level, please give the number of people in your division _____

2. What is the size of your division? _____

3. (a) Is there the problem of land shortage amongst farmers in your division?

   If yes state (1) Common
   (2) Generally short of land
   (3) Sporadic shortage
   (4) Moderately critical
   (5) Highly critical.

   (b) How do the farmers try to combat this problem of land shortage?

   _____

   (c) What do you estimate to be the average acreage a farmer cultivates annually? _____

4. What do you estimate to be the level of food production in your division?

   (1) Very low (3) Average (5) High
   (2) Low (4) Fairly high (6) Very high.

5. Is your division subsistent in its own food supply?

   Explain fully _____

   _____

6. a. Have you or anybody (e.g. an organization) ever carried out a soil survey of your division to determine its potentials? _____

   b. If so, what were the main soil types found? _____

   c. Where in your division are those soil types located? _____

7. In the light of such survey, if any, what facts have you about:

   a. The mechanical properties, and

   b. The chemical characteristics of the soils.

8. a. Have you or any one else ever carried out a land use survey of your division? _____

   b. If yes, what were the dominant crops grown on the different types of soils? _____

   c. Which type of crops occupy the largest acreage of land? _____

   d. Did the survey reveal that crops were planted on the land most suited for them? _____

   e. Did the survey reveal any relationship between type of vegetation and soil? _____

   f. Did the survey reveal any relationship between type of vegetation and type of crop? _____

9. a. What is the prevailing system of farming or agriculture in your division? _____

   b. In your opinion is the method of farming satisfactory, given present state of technology? _____

   c. If unsatisfactory, what are its shortcomings?

      1. Wastes land
      2. Results in poor yields
      3. Taxes labour
      4. Makes innovation or change slow or difficult
      5. Any other.

10. One of the ways of measuring over-population is man/land relationship (i.e. the number of people which a particular area can support).

    a. Given this criterion for measuring pressure of population, would you consider your division:

       1. Under-populated
       2. Moderately populated
       3. Over-populated
       4. Critically populated.

11. What major changes would you like to see introduced by way of improving crop yields from farmers' land?

    _____

    _____

12. a. What changes, if any, have you introduced in the last 5 years in your division (e.g. fertilizer programme)

    b. Elaborate under suitable headings.

13. a. To what extent were these changes mentioned in 12(a) above adopted? _____

    b. Give a rough estimate of the number and or % of farmers who adopted such changes _____

c. Why, in your opinion, do most farmers fail to adopt such changes which you advocate or recommend? (e.g. Crop rotation, fertilizer application etc.) _____

_____

14. Which of the following means or devices do you mostly use to help farmers in your area of operation?

a. Supply of high-yielding strains of crops

b. Free supply of fertilizer

c. Sale of fertilizer

d. Credit loans

e. Formation of cooperate society

f. Agricultural Extension Services

g. Demonstration plots

h. Public lectures

i. Any other.

15. a. Do you maintain or run an experimental or demonstration farm in your division? _____

b. If you do, what is the dominant soil type(s) you have delimited on your demonstration plot? _____

c. What crops do you grow on your experimental plots? _____

d. What type of crop rotation system do you adopt?

1. 1st year _____
2. 2nd year _____
3. 3rd year _____
4. 4th year _____

e. Does your own method of growing crops substantially increase yields compared with the methods used by local farmers? _____

f. If so on what factors depends the success?

1. Rotation system
2. Use of fertilizer
3. Better implements
4. Tillage and sowing methods
5. List others.

16. What are the main nutrient deficiencies of the soil on your experimental farm? _____

17. a. What is the rate of fertilizer application for the different crops, if any, on your demonstration plots?

1. Yams _____ (lb/acre)
2. Cassava _____ "
3. Maize _____ "
4. Others _____ "

b. Which rate of fertilizer application (i.e. in lb/acre) give you the best results?

_____

c. Can you tell (quote figures) the differences in yields between fertilized and non-fertilized crops?

18. a. Can you raise two crops on the same piece of land in one year on your experimental farm? _____

b. How do you carry out this process? _____

c. Why is the same practice not easily possible with local farms?

_____

19. How do you maintain soil fertility in your demonstration farm?

1. Green manuring
2. Fallowing under cowpea, mucuna or any other
3. Farmyard manure
4. Compost manure
5. Use of fertilizer
6. Any other

20. a. How many agricultural extension workers have you? _____

b. How many times in one year do they visit the rural farmers in each clan/village in your division? _____

c. What exactly do they do when they go out on such field work?

1. Advise farmers
2. Actually demonstrate on farmers/ farms
3. Hold public lectures
4. Carry out detailed or partial surveys of the state of farms
5. Any other.

d. Have you found such visits to local areas by your extension staff particularly useful? _____

e. What makes you think so? _____

f. What is the total strength of your staff? _____

g. List under suitable headings, e.g.

1. Clerical
2. Extension workers
3. Agric. assistants
4. Demonstrators etc.

21. a. Has farm mechanization been tried in any part of your division _____

    b. With what results? _____

22. a. Are you personally in favour of mechanization of agriculture?_____

    b. If yes, what are your reasons? _____

    _____

    c. If no, what makes you object? _____

    _____

    d. What factors social, economic and physical are likely to limit mechanized agriculture in the whole state? _____

    _____

    _____

23. What alternatives would you suggest in matters of improved farm implements where you think mechanization is not the answer to the agricultural problems of your division? _____

    _____

    _____

    _____

24. What experiments have you carried out in connection with the following:

    a. Weed control

    b. Pest control

    c. Producing better strains or variety of crops and livestock

    d. Crop preservation

    e. Improving the native method of rotational bush fallow (shifting agriculture)

    f. Improving the quality of the soil

    g. Any other.

25. a. Are you in favour of land enclosure as a means to make farm holdings economically viable to operate profitably? _____

    b. If yes, what are your reasons?

    c. If no, why do you object?

26. What new discoveries in matters of soil improvement, land use or crop and animal husbandry made during the last civil war would you consider worth carrying over and improving during this period of peace?

27. What answers have you for the fragmentation of land holding?

28. What handicaps have you in carrying out well-meaning research and the improvement of agriculture in your division?

    1. Shortage of staff (personnel)

    2. Lack of funds

3. Lack of equipment

4. Lack of encouragement or support from the Ministry headquarters

5. List others you can remember.

29. Are there new areas (of virgin or common land) awaiting cultivation in your area? _____

30. a. Do you object to the present method of inter-cropping (mixed cropping) on farmers' lands? _____

b. If you do, suggest an alternative _____

_____

31. What plans have you for the improvement of agric. and soil and the production of more food in your division?

1. Now.

2. In the next 5 years.

3. In the next decade.

32. Which crops would you like to see farmers concentrate mostly on:

a. Food crops _____

b. Cash crops _____

c. Equal emphasis on both _____

33. a. Do you think opportunities exist for the expansion of food supplies in your division? _____

b. Through what means:

1. Expansion of acreage under cultivation

2. Improvement of present methods of farming

3. Purchase of food from outside your division.

34. Comment fully on any other facts which you consider important, but have been unavoidably omitted in this questionnaire.

APPENDIX 2 (Form B)

FARMERS' QUESTIONNAIRE, OWERRI PROVINCE
(June - September, 1971)

1. AREA:

Division	Clan	County	Village	Family or household

2. OCCUPANTS:

Total no. of occupants in the compound or household or family:

Men _____ Women _____

young boys and girls _____ children _____

How many can read and write in English and Ibo _____?

How many can read and write in Ibo only _____?

How many cannot read and write _____?

How many have gone beyond a primary school _____?

3. OCCUPATION:

What is your major occupation (full time) _____ ?

What are your other occupations (part-time) _____ ?

4. Could you please give me as close an estimate as possible of the no. of man-days/hours (whichever you find more convenient) of work spent on your farm by yourself, your household and hired labour?

Month	Operator	Wife/Wives	Children	Hired Labour
Jan.				
Feb.				
Mar.				
Ap.				
May				
June				
July				
Aug.				
Sept.				
Oct.				
Nov.				
Dec.				

5. OFF-FARM EMPLOYMENT:

Family/Household	Type of Work	No.of hours per week/ man	Income per month
1. Operator 2. Wife/Wives 3. Children			

6. How long have you resided in this locality or farmed your land?

Less than 1 year _____
1 - 5 years _____
5 - 10 years _____
10 - 20 years _____
Over 20 years _____

7. FARM SIZE AND FRAGMENTATION:

a. How many blocks/plots of land does your family/household own?

b. What is the size (acres) of the largest block?

c. What is the size (acres) of the smallest block?

d. How far apart (miles or yards) are these blocks of land (average distance)?

e. What is the distance (yards) of the nearest piece of land from your residence?

f. What is the distance (miles) of the farthest block from your House?

8. LAND AVAILABILITY:

a. What is the total area (acres) of land owned by your family/ household?

b. What is the average acreage of land owned per head by your family/household?

c. Are the different portions of land you have enough to support/ feed your family/household?

d. What total acreage of land did you cultivate in 1971.

e. What is the average acreage per head cultivated by your family/household in 1971?

f. Do you have surplus land, i.e. more than you require to sustain your household/compound/family? (acres)_____

g. Do you have any land shortage? (acres) _____

h. How many more pieces of land of the average size mentioned earlier, do you think you need to be able to produce enough food for your family/household? _____

9. How many people in your household/family do you think the land you now possess (no matter how acquired) can support or maintain? _____

10. How many more people in your compound do you think could be supported from both the land (agric.) and what you derive from other sources (e.g. trade, crafts etc.)? _____

11. Do you or any of your household ever migrate outside your normal place of residence at any time of the year? _____

What makes you migrate temporarily? _____

What time of the year? _____

What do you do while there? _____

What length of time do you spend there? _____

What benefits (cash, kind, etc.) do you bring back? _____

12. LAND TENURE:

How did you acquire the land you are now cultivating?

Inherited	_____	Acreage	_____
Bought (sale)	_____	Acreage	_____
Pledge	_____	Acreage	_____
Loan	_____	Acreage	_____
Gift	_____	Acreage	_____
Others	_____	Acreage	_____

13. What is the farthest distance you are willing to travel to acquire land (loan, purchase, rent, etc.) for cultivation? _____

14. FALLOW:

a. What is the total acreage fallowed in 1971?

b. What is the average acreage per head fallowed in 1971?

c. What is the average length of fallow or rest your land undergoes before cultivation?

Permanent cultivation (no rest) _____ _____ _____

		Yrs.of cultivation	No. of Plots	Total Acreage
1 - year fallow	_____	_____	_____	_____
2 - year fallow	_____	_____	_____	_____
3 - year fallow	_____	_____	_____	_____
4 - year fallow	_____	_____	_____	_____
More than 4 - year fallow	_____	_____	_____	_____

d. Do you have a different fallow period say for the different crops? _____

e. If so, what is the length of fallow you observe for:

Yams _____

Cassava _____

Maize _____

Cocoyam _____

Others _____

f. What factors determine the length of fallow you adopt?

Shortage of land _____

Type of crops grown _____

Distance of farm from the house _____

Soil exhaustion and loss of fertility _____

Size of family/household _____

15. SOIL:

You have obviously been farming for a good number of years and no doubt possess enormous experience about the soil on the land you cultivate:

How do you tell a fertile soil?

Colour	Presence of clay	Easy tillage
Presence of sand	Yields obtained	Drainage
Any other		

What types of soil have you on your farms? _____

How do you determine land that will be devoted to any particular crop? _____

What type of soil have you often chosen for?

Yams _____ Cassava _____

Maize _____ Cocoyams _____

Others _____

What crops do you grow on?

Upland (thin) soils _____

Stony areas _____

Rich soils _____

Seasonally waterlogged areas _____

Under shade (e.g. cocoa, raffia palms) _____

16. SOIL MAINTENANCE:

Which of the following methods (either singly or in combination) do you mostly adopt to maintain the fertility of your land?

a. Planting of mucuna or cowpea when land is not under cultivation _____

b. Simply allowing the land to fallow and regenerate to secondary regrowth (grass, shrub, bush or forest) _____

c. Application of farmyard manure _____

d. Application of fertilizer _____

e. Compost manure _____

f. Old pit latrine _____

17. Do you have problems of erosion on your farmland?

What type of erosion _____

How do you check it _____

18. Do you have both "garden land" (the plots of land immediately around your home) and "farmland" (those farther away from the home)? _____

Which one do you give more attention and why? _____

_____

_____

Which gives better yeilds or returns in terms of labour expended?

_____

19. a. Have you ever used fertilizer before? _____

b. Do you use fertilizer now? _____

c. If you do apply fertilizer to your crops, have you observed much difference in yield? _____

d. If you do not use fertilizer, what reasons have you for not doing so?

e.g. Tried it before with failure _____

Lack of money to purchase fertilizer _____

Its use has not been explained to you _____

Does not believe in artificial fertilizers _____

20. YIELD:

a. What is the yield from your various plots of land like? _____ (poor, fair, good, very good)

b. How many baskets of (1) yams, (2) cassava do you harvest from an acre of land? _____ _____

c. How many baskets of (1) maize, (2) cocoyams do you harvest from an acre of land? _____ _____

d. What is the difference in baskets of yams/cassava between yields from Compound (garden) and farmland? (Work out to the acre) _____

e. What is the difference in baskets of yams/cassava between yields from your most fertile and yields from your poorest land? _____

f. Do you usually produce more food crops than you normally need in year? _____

g. What happened to the 'surplus' production, if any? _____

_____

h. Does your family/household require more food crops than you normally produce in the year? _____

i. If so, what do you do to meet up with the shortage? _____

_____

21. CROPPING PRACTICE:

a. What crops do you usually grow on your land? _____

b. At what months of the year do the following farm activities take place?

1. Clearing the land and burning the brush _____

2. Planting and harvesting of yams, maize and vegetables _____

3. Planting and harvesting of cassava _____

4. Planting and harvesting of cocoyams and pepper _____

5. First and second weeding of farms _____

6. Others _____

c. How often in 5 years does rain come late and lead to poor crop yields? _____

d. What is your system of inter-cropping (mixed) cropping)? _____

_____

_____

_____

_____

e. Which of the following methods do you use:

Ridging _____

Large mounds _____

Small mounds _____

Scratching the ground lightly with a hoe, knife or other implement _____

f. How much labour (man-days) is expended on the following crops in one farming season?

Yams _____

Cassava _____

Maize _____

Cocoyams _____

Others _____

g. What system of land rotation do you adopt?

1st Year _____

2nd Year _____

3rd Year _____

4th Year _____

22. INVESTMENT AND IMPLEMENTS:

a. What implements do you use for farming? _____

b. What impressions have you about their quality? _____

c. Do you think better implements would facilitate your work and improve yields? _____

d. What better implements would you have in mind introduced?

1. improved hoes, knives, axes etc. _____

2. machinery _____

e. What is your annual investment (estimate if you are not sure) on the following:

purchase of seed yams _____

purchase of implements _____

purchase of other crops _____

hiring of labour _____

23. How many crops can you raise on the same piece of land in one year?

One crop _____ Why? _____

Two crops _____ Why? _____

24. How does the ownership of and right for the various crops by men and women affect:

1. Time of planting _____

2. Yields _____

25. What changes have you ever introduced on your farm?

(e.g. what you have done to improve yields) _____

_____

_____

26. What sources of information did you use to bring about these changes?

a. Past experience.

b. Experimentation (trial and error) on your own farm.

c. Observing other farms.

d. Talking to other farmers.

e. Direct contact through neighbours.

f. Agric. representatives.

g. Farm magazines.

h. Newspapers.

i. Radio.

j. Farm Organization (e.g. Co-operative farming Organization).

27. Do you keep livestock? What livestock have you and how do you care for them.

Livestock	Number	Maintenance (i.e.how kept & fed)	Approx. value of each

28. Have you ever felt the impact of Agricultural Extension Services? ___

State a. No. of visits to your Village in one year _____

b. Never visited your village in one year _____

c. Frequent visits (lectures, demonstrations) _____

d. Whether you ever benefitted or learnt anything from any nearby Agric. experimental station where you live _____

29. Which are the most pressing (major) problems facing you as a farmer?

a. Poor yields.

b. Poor tools.

c. Combatting weeds.

d. Climatic hazards (e.g. occasional drought, uncertainty of rains or too much rainfall).

e. Land shortage.

f. Lack of money to purchase equipment.

g. Crop preservation.

h. Crop and animal diseases.

i. Infertile soil.

j. Any other _____

30. a. What other earnings outside farm incomes from food crops have you?

    1. Local crafts.

    2. Temporary migration to other areas for job.

    3. Trade.

    4. Cash Crops.

    b. How far does each source of income in (a) help you meet up with purchases of foodstuffs arising from deficiencies?

    _____

31. GENERAL:

    a. Do you consider there are too many people living in your area compared with the amount of land available? _____

32. If yes, what are the signs you have noticed that make you think so?

    e.g. a. Undernourishment.

    b. Poor yields of crops.

    c. Land quarrel.

    d. Scarcity of land, even to buy.

    e. Shortening of fallow.

    f. Occasional migration.

    g. Any other.

33. What suggestions would you personally make to alleviate the situation?

    _____

    _____

    _____

    _____

34. Any other information concerning soils and agriculture in your area not contained in the above questions which you may like to give:

    _____

    _____

    _____

    _____

APPENDIX 3

DETERMINATION OF THE RELATIVE CONTRIBUTION OF FARM AND NON-FARM ACTIVITIES IN PARTS OF OWERRI PROVINCE

(Sub-Sample Survey of 20 Garden Families/Households)

TABLE 1. FARM AND NON-FARM INCOMES IN PARTS OF OWERRI PROVINCE

Garden Families	Size of Family/ Household	FARM INCOMES						NON-FARM INCOMES					
		Food-crops (£)	%	Cash-Crops (£)	%	Live-stock (£)	%	Trade & Crafts (£)	%	Migra-tion (£)	%	Remit-tances (£)	%
1	8	111.72	56.6	11.3	5.7	74.5	37.7	7.8	100.0	-	-	-	-
2	25	135.19	58.6	29.2	12.6	66.5	28.8	28.8	13.2	64.0	29.4	125.2	57.4
3	11	147.43	76.0	23.65	12.2	22.85	11.8	33.0	68.8	-	-	15.0	31.2
4	15	114.49	76.0	7.7	5.2	27.13	18.2	12.9	68.3	6.0	31.7	-	-
5	11	104.48	66.9	10.3	6.6	41.5	26.5	27.6	100.0	-	-	-	-
6	7	79.01	58.7	16.3	12.1	39.25	29.2	14.4	47.4	16.0	52.6	-	-
7	3	79.25	81.5	7.2	7.2	10.8	11.1	270.0	100.0	-	-	-	-
8	10	103.26	71.6	9.6	6.7	31.38	21.7	21.6	100.0	-	-	-	-
9	4	47.89	37.8	8.55	6.8	70.14	55.4	51.0	100.0	-	-	-	-
10	17	160.28	75.5	18.6	8.7	33.5	15.8	21.0	42.9	28.0	57.1	-	-
11	25	39.17	22.4	26.3	15.0	109.75	62.6	59.2	67.0	14.7	16.6	14.6	16.4
12	9	19.09	40.6	20.35	43.3	7.6	16.1	10.25	39.7	-	-	15.6	60.3
13	11	31.4	18.9	14.8	8.9	120.0	72.2	276.0	93.9	-	-	18.0	6.1
14	20	100.13	43.0	24.3	10.5	108.0	46.5	180.0	93.8	12.0	6.2	-	-
15	11	39.63	22.7	12.6	7.2	122.5	70.1	180.0	78.9	48.0	21.0	-	-
16	13	66.32	42.4	22.1	14.1	68.0	43.5	84.0	68.3	27.0	22.0	12.0	9.8
17	12	28.36	30.1	29.0	30.7	37.0	39.2	63.0	100.0	-	-	-	-
18	9	33.45	40.0	23.0	27.5	27.15	32.5	51.0	66.2	-	-	26.0	33.8
19	11	28.49	21.5	10.0	7.6	93.75	70.9	72.0	73.5	26.0	26.5	-	-
20	12	27.36	32.6	26.14	31.1	30.45	36.3	57.0	61.3	36.0	38.7	-	-
Total	244	1496.4	50.1	350.99	11.7	1141.75	38.2	1520.55	75.1	277.7	13.7	226.1	11.2

TABLE 2. SUMMARY OF FARM AND NON-FARM INCOMES IN OWERRI PROVINCE

No.	Agric. (£)	% Contribution	Non-Farm Income (£)	% Contribution	Total (£)
1	197.52	96.2	7.8	3.8	205.32
2	230.89	51.4	218.0	48.6	448.89
3	193.93	80.2	48.0	19.8	241.93
4	149.32	88.8	18.9	11.2	168.22
5	156.28	85.0	27.6	15.0	183.88
6	134.56	81.6	30.4	18.4	164.96
7	97.25	26.5	270.0	73.5	367.25
8	144.24	87.0	21.6	13.0	165.84
9	126.58	71.3	51.0	28.7	177.58
10	212.38	81.3	49.0	18.7	261.38
11	175.22	66.5	88.4	33.5	263.62
12	47.04	64.5	25.85	35.5	72.89
13	166.2	36.1	294.0	63.9	460.2
14	232.43	54.8	192.0	45.2	424.43
15	174.73	43.4	228.0	56.6	402.73
16	156.42	56.0	123.0	44.0	279.42
17	94.36	60.0	63.0	40.0	157.36
18	83.6	52.1	77.0	47.9	160.6
19	132.24	57.4	98.0	42.6	230.24
20	83.95	47.4	93.0	52.6	176.95
Total	£2,989.14	59.6	£2,024.35	40.4	£5,013.49

TABLE 3. DETERMINATION OF THE RELATIVE IMPORTANCE OF FARM AND NON-FARM INCOMES IN OWERRI USING SPEARMAN RANK ORDER CORRELATION (rho)

Garden Families/ House-holds	Farm Income (x)	Non-Farm Income (y)	Rank of x	Rank of y	d	d^2
1	96.2	3.8	1	20	-19	361
2	51.4	48.6	16	5	11	121
3	80.2	19.8	7	14	-7	49
4	88.8	11.2	2	19	-17	288
5	85.0	15.0	4	17	-13	169
6	81.6	18.4	5	16	-11	121
7	26.5	73.5	20	1	19	361
8	87.0	13.0	3	18	-15	225
9	71.3	28.7	8	13	-5	25
10	81.3	18.7	6	15	-9	81
11	66.5	33.5	9	12	-3	9
12	64.5	35.5	10	11	-1	1
13	36.1	63.9	19	2	17	289
14	54.8	45.2	14	7	7	49
15	43.4	56.6	18	3	15	225
16	56.0	44.0	13	8	5	25
17	60.0	40.0	11	10	1	1
18	52.1	47.9	15	6	9	81
19	57.4	42.6	12	9	3	9
20	47.4	52.6	17	4	13	169
						2660

TABLE 3 (continued)

$$\text{Rank-Order Correlation (rho)} = 1 - \frac{6 \Sigma D^2}{N(N^2 - 1)}$$

where D = difference between each X and Y pair

N = number of pairs of scores.

$$\text{rho} = 1 - \frac{6(2660)}{20(20^2 - 1)}$$

$$= 1 - \frac{15960}{7980}$$

$$= -1$$

TEST OF SIGNIFICANCE

Since $N < 30$

$$t = \text{rho} \sqrt{\frac{N - 2}{1 - \text{rho}^2}}$$

$$t = \text{rho} - 1 \sqrt{\frac{18}{1 - (-1^2)}}$$

$$= 4.24$$

At df 18 4.24 exceeds 3.92 at 0.01 level of significance

At df 18 4.24 exceeds 2.10 at 0.05 level of significance

Conclusion: Incomes from non-farm activities contribute significantly to the farmers' upkeep in Owerri Province, and, consequently, would increase the carrying-capacity of the province, thus significantly raising the Critical Population Density.

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