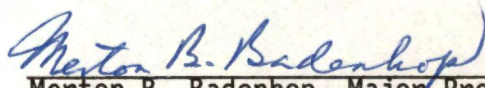
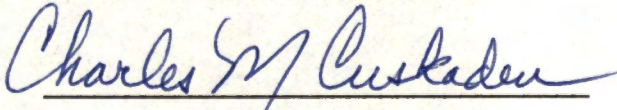


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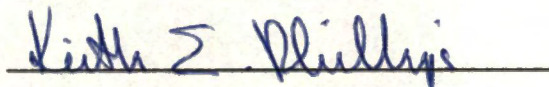
I am submitting herewith a dissertation written by Peter Udo Iniodu entitled "Small Farm Production Credit for Food Crop Expansion in the Cross River States of Nigeria." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.

  
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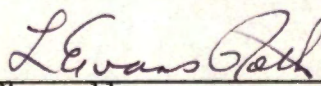
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SMALL FARM PRODUCTION CREDIT FOR FOOD CROP EXPANSION  
IN THE CROSS RIVER STATE OF NIGERIA



A Dissertation  
Presented for the  
Doctor of Philosophy  
Degree  
The University of Tennessee, Knoxville

Peter Udo Iniodu

June 1981

**3051900**



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## ABSTRACT

Limited access to formal institutional credit and paucity of financial capital at the farm level have prevented the Cross River State food crop farmer from adapting to simple, low-cost technological change. These limitations have perpetuated traditional agricultural techniques and the concomitant low farm income in the state.

This study was designed to provide an empirical examination of the capacity of production credit to induce technological change among the food crop farmers in the Cross River State of Nigeria and to measure the impact of such change on the farmer's income. In attempting to estimate the effects of production credit on the farmer's income and to determine the credit needs of the farmers, three representative farm LP models were formulated on the basis of survey data from Ika Clan in Abak LGA of the state. The first two models were based on traditional technology without and with borrowing activity, respectively. The third model represented modern technology made possible through borrowing. The objective was to maximize net farm returns subject to limitations imposed by operating capital and institutional credit.

The result of the study showed that the farmer's own operating capital was inadequate to execute an optimal farm plan, even under traditional technology. It showed that the farmer could increase his net farm income by borrowing from institutional sources to execute an optimal farm plan under traditional technology. Private credit was unprofitable under this technology because of high interest rates. Net farm income per acre was highest under modern technology made possible



through the use of credit both from institutional and private sources. Results of this study suggested, other things being equal, that the adoption of modern technology through borrowing would significantly improve farm income. However, credit from noninstitutional sources was profitable only within narrowly defined limits.

Also, the optimal cropping pattern given by the solutions of the models suggested some form of quasi-specialization among the food crop farmers. The model results showed the high opportunity costs associated with the nonoptimal crops forced into the cropping pattern under the existing practices and explained, in part, the reason for the low farm incomes of food crop farmers.

Finally, (with effective constraints on land, operating capital, and institutional credit resources), labor, particularly male labor, was highly under-utilized in all periods and in all the models. The marginal value productivity of male labor in all the models and periods was zero. This implied that removal of one unit of male labor would not reduce farm output.

On the basis of the result of the study and evidence of limited credit facilities to the small farmers, some desirable features of an agricultural credit program for the state were suggested for effective distribution of credit to deserving and qualified farmers.



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## CHAPTER I

### INTRODUCTION

#### A. PLACE OF AGRICULTURE IN DEVELOPING COUNTRIES

For many decades, the agricultural sector of many developing countries received little attention. Agriculture was associated with backwardness and underdevelopment and, therefore, often left to fend for itself. Politicians and policy makers in developing countries, in an effort to promote economic growth, frequently emphasized industrialization as the primary means of economic progress. Such a view frequently led to the allocation of the limited resources available to the industrial sector in national development plans at the expense of agriculture.

The discrimination against agriculture in budgetary allocation has not been eliminated, but there is increasing awareness of the contribution of agriculture to economic growth. Johnston and Mellor, for example, have enumerated five important contributions of agriculture to growth (68:556-9): (a) increased food supply; (b) release of labor for industry; (c) enlarged agricultural export; (d) increase in capital accumulation; and (e) increase in employment and rural income. Metcalf also recognized the dominant role of agriculture in developing economies (87:74). He stated:

. . . agriculture is the most dominant industry in nearly all underdeveloped countries with typically 40-60 percent of the G.N.P. from agriculture and 50-80 percent of the labour force employed in agriculture.



Even within the agricultural sector, there is discrimination in resource allocation between commercial crops and food crops in favor of commercial crops. Agricultural development programs are often designed to expand the export crops subsector at the expense of food crops. Yet, one of the important measures of economic development is the ability of a nation to feed its population out of its domestic resources. Neglect of the food crop subsector seems contrary to this self-sufficiency goal in food production.

#### B. SITUATION IN NIGERIA

Most of the food crop production in Nigeria, as in other developing economics, is on small farms whose operators live in small villages. In fact, agriculture alone employs about 70% of the Nigerian labor force (42:70). The majority of the Nigerian farmers are food crop producers. The relatively few commercial farmers are also involved in food crop production.<sup>1</sup> The food crop subsector, however, seems to have received less attention than it deserves in the economic development program budgets of Nigeria. For instance, only 34% of the allocation for agricultural research was devoted to research in food crop production in the Second National Development Plan, 1970-74 (46:115). This was about half of the amount allocated to research in commercial agriculture. Yet, policy makers throughout the nation frequently profess increased food production as a major goal of economic policy.

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<sup>1</sup>Large scale commercial farmers constitute about 5% of the farming population.



Yotopoulos has argued that agricultural development requires positive changes in the production surface brought about by technological change (139:125). In the Nigerian case, technological change involves the introduction of fertilizer, hybrid seeds, and pesticides into traditional agriculture to improve the efficiency of existing resources. This is consistent with the proposition that, as agriculture becomes modernized, the farmer must combine his labor with more capital in the form of simple machines, improved seeds, fertilizers, herbicides, and pesticides to increase output per unit of labor and per unit of land (106). The adoption of new technology which will improve the efficiency of other resources requires financial capital at the farm level. However, scarcity of financial capital at the farm level is a constraint to food crop expansion among the Nigerian small farmers.

Nigerian small farmers are basically subsistence farmers. Their production is mainly for household consumption. Therefore, any addition to income will likely be absorbed into the consumption stream rather than saved. This implies that the operators of small Nigerian farms have a high marginal propensity to consume and a low marginal propensity to save. Thus, while capital accumulated through savings forms the foundation of the farm financial structure in advance agriculture (99:78-79), there is a dearth of capital for agricultural improvements in Nigeria and other low income economies due to low rate of savings. Miller has suggested that the meager savings of the small farmers be supplemented with borrowed funds if the recommended inputs are to be purchased for increased efficiency of resource use in food crop production (89).



### C. STATEMENT OF PROBLEM

Like the rest of Nigeria, the Cross River State is predominantly an agricultural economy. About 65% of its working population is engaged in agriculture and 62.6% of its gross domestic product (GDP) is derived from agriculture (92:55). Traditional agriculture which Helleiner defined as "small scale, nonmechanized" farming is dominant and embraces production both for domestic consumption and for export (55:45-46).

The agricultural sector in the Cross River State includes both the food crop and export crop subsectors. The latter subsector has been dominated by oil palm production from the inception of export trade between Nigeria and England in the 16th century (107:53-59). Except for maize, the major food crops are root crops and include the various species of yams and cassava. Minor food crops are plantain and banana, vegetables, beans, fruits (oranges, pineapples, mangoes, etc.), okra, and pepper.

While agriculture is primarily of the subsistence type, there is some amount of internal trade in agricultural products. Helleiner has noted that agriculture accounts for 95% of the total Nigerian food consumption and added:

By no means all of the nonexported traditional agricultural production is for subsistence consumption; there exists a considerable internal trade in domestically produced food-stuffs and other agricultural produce. This domestic exchange takes place not only at the village market level where it would still be consistent with a concept of "village subsistence" production but also on an intervillage, interarea, and even inter-regional basis. (55:45)

Industrial development in Nigeria, in general, and in the Cross River State, in particular, is still in its infancy. The industrial



sector accounts for only 0.7% of the total employment (92:99). All the major industrial establishments are either government owned or quasi-government owned. The private sector has a weak industrial base because of a shortage of capital as well as paucity of managerial and entrepreneurial skills.

Agriculture is the dominant industry in the state in terms of its contribution to gross domestic product and employment. More importantly, the agricultural sector provides food for the growing population. Bain has estimated that foodstuffs account for 80% of the agricultural production of Nigeria and that the country is nearly self-sufficient in food production (12:158).

Food crop production in the state is the concern of a large number of independent small scale farmers<sup>2</sup> whose farms are scarcely above 3 acres per farming family (92:56). A dominant practice used is the shifting cultivation technique. By this method, the farmer leaves each parcel of land in fallow for 4 years after cultivation to regain its natural fertility. The farmer adopts this technique because he has no other means of building up the fertility of the soil or of making his land more productive.

In addition, the major inputs of agriculture in the state are land and labor. Capital is limited to two traditional implements--the machet for clearing the bush and chopping wood and the hoe for tilling. The only important source of power is human energy. Under these conditions both agricultural output per unit of input and agricultural income

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<sup>2</sup>Information on the number and characteristics of farm population was not available and the state government has acknowledged that such information, where available, is inadequate (92:58).



in the state are low. As a result, the capacity of the farmer to save for agricultural improvement is limited.

Institutional credit sources are not accessible to the small scale farmers. Their major sources of credit are relatives, neighbors, and friends who provide liberal and flexible repayment terms. But funds from these sources are limited. Consequently, small farmers also obtain credit from private money lenders who charge higher interest rates than the other sources and financial institutions. High rate of interest reduces the profitability of an agricultural credit and, sometimes, discourages farmers from adopting innovation.

#### D. OBJECTIVES

The low rate of savings by farmers and the scarcity of credit facilities at the farm level are major constraints to food crop expansion in the Cross River State. These constraints have inhibited the use of productive capital needed for proper combination with land and labor to raise the efficiency of these resources. This research is based on the assumption that the provision of credit to augment internal savings will facilitate the introduction of improved agricultural practices, such as the use of fertilizer and hybrid seeds, into the traditional agriculture of the Cross River State.

The purpose of this study is to examine the extent to which production credit to small farm operators in the state can induce expansion in food crop production. The study seeks to estimate the amount of credit needed for farm operation and to suggest ways of



operator to execute an optimal farm plan under each farm size group, given the net worth of the operator. Three farm plans representing small, medium, and large size farms were prepared from the data defined below for each of the following situations (119:504-505).

#### Model A

Plans in this model were based on the technology currently employed by farmers. Both investment and financial capital were limited to that which was available to the farmers. Credit was not introduced. The purpose of this model was to determine whether farmers in the different size groups could use their own resources to execute optimal farm plans under the existing traditional technology.

#### Model B

This model was similar to Model A in terms of technology used. But here, credit was introduced. The purpose was to estimate the amount of credit required to supplement funds from farm savings in order to execute an optimum farm plan with existing technology. The positive change in net farm income between Model A and Model B measured the effect of credit in improving the efficiency of other resources under traditional practices.

#### Model C

Plans in this model utilized both "improved" technology<sup>3</sup> and borrowed funds. They provided estimates of the optimum credit needs

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<sup>3</sup>"Modern" or "improved" technology, as used in this study, basically refers to the use of chemical fertilizers, hybrid seeds, and pesticides for planting purposes as well as the use of such simple tools as spades, shovels, and forks for more efficient tillage.



of farm operators in the different farm size groups, given their net worth and the rates of interest on borrowed funds. The rates of interest used for the borrowing activities were the averages from the two sources of credit--institutional and private. The difference in net farm income between Model B and Model C measured the effect of selected changes in technology.

#### F. RATIONALE FOR USING LP

The use of LP in small farm planning has much appeal and is being widely adopted. One of the most practical approaches to small farm planning is through mathematical programming models because small farm systems are complex and involve a large number of planning constraints (69:376-381). Among the complexities in the area of study are the large number of crop enterprises, the simultaneous planting of many crops on the same piece of land, and the allocation of limited land and financial capital among the alternative enterprises. LP has proved effective in handling problems of this nature.

Secondly, LP appears to be superior to alternative models in its valuation of fixed resources. Land and labor are the major inputs of the Cross River State agricultural system. Land, in general, is a limiting resource. Under the "marginal approach," for example, land, as a fixed resource, is not used in determining resource allocation. But with LP, it is possible to value land in terms of its opportunity cost given in the solution of the model. This value provides information as to the possible change in net farm income due to the provision of an extra unit (acre) of land. In addition to giving the opportunity



cost of fixed (as well as variable) factors, the LP solution shows clearly what the limiting resources are and the extent of such limitations.

Finally, in its search for the optimal solution, the LP technique examines total rather than partial effects. For example, in examining the effect of an additional unit of institutional credit, it takes into consideration the effect of additional quantities of all other inputs along with the additional unit of credit. But under the marginal approach, only the partial effect of the additional unit of credit would be examined while other inputs were held constant. Etuk has stressed that LP can be used to provide a more adequate analytical description of "whole-farm situations" than other farm planning techniques (38:18; 97:2).

#### G. LIMITATIONS OF LP

The basic limitation of LP in this study is that the model is not designed for a mixed cropping situation. In the area under study, different crops are planted simultaneously on the same piece of land. For example, yam, fluted pumpkin, melon, okra, pepper, and beans are planted together simultaneously. This makes it difficult to treat these crops as independent activities. However, this problem was overcome by grouping crops planted together simultaneously into activity groups and treating each group as a single activity. Thus, "yam group 1" (YAMG 1) comprised yam, fluted pumpkin, melon, okra, pepper, and beans while "yam group 2" (YAMG 2) consisted of yam, cocoyam, and fluted pumpkin. This approach made it easy to deal with costs that



were common to all crops in the group like plot clearing, burning, gathering of stumps and unwanted materials, and weeding.

#### H. SOURCE OF DATA

Typical data required for farm plans in LP models include technical coefficients, technical and economic restrictions that limit the freedom of choice of the farmers, and input and product prices (31:26). The data for this study came from primary sources. They were cross-sectional data based on a questionnaire developed by the researcher (Appendix A). Data used in calculating the technical coefficients representing the input requirements for each activity were land, male and female labor by time periods, the amount of "own" capital needed per unit of activity (including interest-free loans from friends and relatives), and the amounts and value of purchased inputs (where applicable). Similarly, the constraints limiting the freedom of choice of farmers were calculated from data based on resource restrictions--land, labor, capital, the demand for labor outside the family farm, and the average amount of credit from institutional sources. Input and output prices used in calculating the coefficients of the objective function were based on the local marked prices during the survey year (1978).

Data collection was done by enumerators in five villages in Ika Clan of Abak Local Government area of the Cross River State. The enumerators did the survey in their native villages. The villages were Ikot Osukpong, Ikot Inyang Esse, Ikot Idomo, Ikot Okoro, and Urua Inyang. Ika Clan was selected because it is typical of the



traditional farming areas in the state. It produces large quantities of yam, maize, cassava, and fluted pumpkins. Its surplus food crop products, particularly cassava products, are used for intrastate and interstate trade.

Data collection was done by random sampling since the result of the data analysis was to be used to make inferences about the population from which the sample was drawn (30:9). Consequently, every farmer in the five villages had an equal and non-zero probability of being included in the sample, except for the selection of the village head. Each village head was added to the list of the randomly selected farmers in his village. A total of 158 farmers was included in the sample. Data were collected by personal interview and were based on the questionnaire developed for that purpose. Information needed to complete the questionnaire required frequent contact with the farmers by the enumerator at every stage of the farming operation to ensure accuracy.

#### I. THE REPRESENTATIVE FARM STRUCTURE

After the survey, the 158 farms were divided into three size groups representing small, medium, and large size farms. Small farms were defined as those that were 2 acres or less in size. There were 104 farms in this group or 66% of the farms surveyed. Medium farms were larger than 2 acres but no larger than 5 acres and accounted for 27% of the farms (43 farms) under study. All farms larger than 5 acres were classified as large farms. There were 11 large farms or 7% of the total.



The data collected from the survey were first sorted according to size groups and then according to the models described under "Methodology." Then, a typical situation, representing the average resources available for each model, resulted in a detailed study of enterprise combinations subject to limitations imposed by the availability of resources.

The "average resources" or "representative farm" approach to small farm planning was employed in this study because the major farm inputs throughout the area were relatively homogeneous. It has been argued that where such resource homogeneity exists, LP solutions to a representative farm plan can be used as a guide to the planning of individual farms (15:363). Consequently, the solutions to the models analyzed in this study should be useful, not only to the area under study and the Cross River State, but also to other traditional agricultural communities with similar resources.

Another reason for using averages was that they were relatively reliable because they vary less than individual values when repeated samples are taken from one and the same population (49:33). Also, averages take each individual item in the sample into account and are, therefore, fairly representative of the data.

But the use of averages has one major limitation. A single extreme value--very large or very small--may bias an estimated average value to the extent that it is no longer representative of the individual values in the sample. This situation often generates a problem which raises questions about the appropriateness of averages in a representative farm model. But this problem has been eliminated or,



at least, minimized in this study in two ways. First, by breaking up the farms into size groups, extreme values have been avoided. The absence of extreme values and the homogeneity of resources in the area appear to have justified the use of averages. Second, when a model required "an all inclusive"<sup>4</sup> average, the Collinson recommendation of excluding extreme values was followed (28:134-135). Accordingly, the three farms that measured more than 8 acres were excluded when deriving such averages.

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<sup>4</sup>"An all inclusive" average is defined as one derived from data encompassing the three farm size groups (small, medium, and large) in a particular model.



## CHAPTER II

### FINANCING AGRICULTURAL DEVELOPMENT

Agricultural expansion requires increased use of productive inputs which are essential for increased crop yields and constitute agricultural capital. This class of capital--tangible capital--differs from intangible capital in that the latter comprises accumulated stock of knowledge, skills, and know-how. But both types of capital are important in the development process. "The process of adding to the stock of capital over time is capital formation." According to traditional economic theory,

the annual produce of any nation can be increased by increasing the number of its productive labourers, or the productive power of those labourers who had before been employed by introducing better machine. In either case, additional capital is always required. (91:43; 120:326)

Capital formation for agricultural development in low income countries involves increasing the stock and improving the quality of simple agricultural tools as well as increasing the amounts of fertilizers, chemicals, and pesticides used in the production process. Since it requires an increase in the stock of productive capital over time, capital formation is synonymous with investment.

Economists often stress the importance of the accumulation of capital goods as the focus of agricultural (and economic) development and argue that:

- i. well-equipped labor forces in developing countries will enhance productivity in those countries and boost the per capita standard of living;
- ii. increasing the capital stock is crucial because it is difficult to increase the supply of arable land;



- iii. the process of capital formation can be cumulative once it is initiated; and
- iv. capital can substitute for other resources in the production process. (84:443)

These propositions suggest a need for proper approach to the important task of capital formation for agricultural development.

#### A. SOURCES OF AGRICULTURAL CAPITAL

The sources of agricultural capital are assumed to represent "a continuum between pure equity and pure debt financing." Included in the sources of agricultural capital are savings, gifts and inheritances, outside equity capital, leasing, contract production, and borrowing (99:78-99). But development economists usually emphasize savings and borrowing as the major sources relevant to developing countries.

#### B. SAVINGS

Savings are generally regarded as the backbone of agricultural capital. They provide not only capital per se, but a "risk-bearing ability" and a demonstrated capacity to earn and save." These are two very essential components of a strong credit rating (99:78). Savings are defined as that part of income not spent on current consumption of goods and services. A society has to refrain from current consumption to release resources from consumer goods production so that investment spending can occur to absorb these resources for the production of capital goods.

But the rate of savings has been seen to be lower in low income than in high income countries. According to economic theory, as income



rises, the propensity to consume declines and the propensity to save rises. This means that at higher income levels, consumers tend to spend a smaller percentage of their income. It also means that poor countries have higher propensity to consume and lower propensity to save than rich countries. But, in absolute amounts, consumption spending rises as income rises. A World Economic Survey by the United Nations has supported this theory of consumption. The report of the survey stressed that when income is low, consumption tends to preempt all or most of it; but as income rises, the percentage of it that is diverted to savings also tends to rise. It added that at low income levels, any increase in income "is likely to go entirely or almost entirely into consumption," whereas at higher levels of income, increments move more readily into savings (128). This pattern of relationship between savings and income appears to pose a problem to developing countries in their attempts to raise their rates of savings for agricultural capital formation.

Many economists have strongly supported the belief that savings are the major, most reliable, and most profitable source of agricultural capital. But some of them are doubtful about the availability of savings in sufficient amounts for the needed capital formation of the developing agricultural economies. Miller, for example, pointed out that in developing countries where the majority of the citizens have little more than enough for mere subsistence, it is difficult to decrease the proportion of income spent on consumption so that savings, and hence, the supply of capital can be increased (89:2).



The notion that low rate of saving was a result of low incomes in developing countries was seen by economists in the 1950's as posing an absolute barrier to growth. Among the popular propositions that evolved during the period was the theory of the "vicious circles" of poverty by Ragnar Nurkse (105). By this theory, two mutually reinforcing vicious circles perpetuate poverty in low income countries but each of these circles standing alone is still capable of doing so. The first of these circles, according to Nurkse, is concerned with the scarcity of capital, low income, and low savings rate. The farmer's income is low because his per capita output is low; productivity is low because of little or no capital formation; and the paucity of capital formation is a result of little savings. The other vicious circle is concerned with market limitations--small market size, low income, and low rate of investment.

The basic interpretation of the vicious circles concept is that the poverty of a country is, by itself, an obstacle to growth. Since the country is poor, it does not develop; and because it does not develop, it remains poor. Thus, according to this theory, poverty is self-reinforcing.

While accepting the vicious circles theory as "internally consistent," Everett E. Hagen noted its flaw that "neither low income, low productivity, and low saving, nor low income, small market size, and low investment in the low income countries in fact form the vicious circle that is addressed." In order to show how unrealistic the theory was to the real world situation, Hagan presented a tabular illustration of the growth rate of "the countries supposedly hopelessly



immobilized in poverty" (53:20) which showed that while the vicious circle theory was being formulated, growth was occurring in the low income countries (Table 2.1).

Hla Myint rejected the vicious circles theory on the grounds of its limitations which he said should be illustrated by looking at the economic performance of the developing countries during the period, 1950-60. During this decade, Myint pointed out, the gross domestic product of developing countries as a group grew at an average annual rate of 4.4% and gave them a growth rate of per capita income of a little over 2% per annum (98:119-127).

Pierre Moussa cited examples of African countries in the French community where the rates of savings were nearly 20% of the gross national product. Moussa added that there were both rich and poor people in the low income countries and blamed the low rate of savings in poor countries on the behavior of the rich. The rich, Moussa contended, spent on luxuries and even when they saved, they seldom made productive use of their savings (96:76).

Moussa's argument is an illustration of the consumption behavior of the rich in developing countries. Usually, the high income group in the society are the elites who try to adopt the western standard and pattern of life. They place priority on the consumption of luxury goods and are prone to purchase imported goods. In many cases, they are government employees because government is the largest employer of labor in developing countries. Thus, while there may be scarcity of financial capital at the farm level, there may, at the same time be misplaced priorities in the allocation of the available savings.



Table 2.1. Average Annual Rates of Growth, 1960-71, GNP Weights,  
Country Groups Classed by Per Capita GNP in 1971.

| Per capita GNP<br>in dollars, 1971 | Average annual rates of growth<br>in GNP (percent) |            |
|------------------------------------|----------------------------------------------------|------------|
|                                    | Per capita                                         | Aggregate  |
| More than 2,200                    | 3.4                                                | 4.4        |
| 1,001 - 2,200                      | 6.3                                                | 7.4        |
| 501 - 1,000                        | 4.4                                                | 6.5        |
| 201 - 500                          | 3.4                                                | 6.0        |
| 0 - 200                            | <u>2.1</u>                                         | <u>4.2</u> |
| World average                      | (4.1)                                              | 5.4        |

Source: Everett E. Hagen, *The Economics of Development*, Homewood, Illinois: Richard D. Irwin, Inc., 1975, p. 20, reproduced from World Bank Atlas, 1973.



Therefore, it seems plausible to assume that it is the inequalities of wealth and conspicuous consumption by the rich that limit the amount of savings available for agricultural investment.

Panikar noted the high rate of actual net savings of Indian farmers, estimated at 8% of their income, but remarked that the bulk of these savings went into unproductive use. From the result of a study in Hyderabad in 1949-50, Panikar showed that 25% of the savings were used to repay debts, 48% for consumer durables and ceremonies, 9% for land purchases, and only 18% for agricultural production (111). His study showed that it was not lack of capital in agriculture that inhibited development, but lack of farmer motivation to use the financial resources they already had for development. Other studies have dismissed the notion of the vicious circles and its attendant absolute shortage of savings for agricultural investment in developing countries. Cairncross pointed to the building of magnificent monuments in developing countries as evidence of the possibility of capital formation (25:251). W. Arthur Lewis blamed scarcity of savings on the skewed distribution of income because over 40% of the national income is squandered by the top 10% of the income earners living luxuriously on rent (77:236).

But, in his "Agricultural and Economic Development of Brazil," Nicholls argued that in advance agriculture like that of the United States, part of the high income earned from agriculture goes into saving and private domestic capital formation. On the other hand, in developing countries like Brazil, income from agriculture is dissipated in private and public conspicuous consumption (100:218).



Neither the role of savings as the major source of agricultural capital nor that of productive capital in the process of agricultural expansion can be overemphasized. Capital is one of the major factors associated with underdevelopment. Capital increases investment which generates higher incomes and higher levels of savings and borrowing. Borrowing entails some burden in the future. The extent to which borrowed funds can be serviced and repaid seems to depend on how much can be saved at the farm level in the future. Consequently, increasing ability and willingness to save at the farm level are essential elements of agricultural development. However, while saving is a more reliable source of agricultural capital, other possible sources of agricultural finance should be explored if optimum returns are to be expected.

### C. BORROWING

Borrowing (credit) is the other important source of capital for a developing agricultural economy. In classical economic theory, borrowing occurs to facilitate the purchase of capital goods that can add to total production in the future. Credit is defined as the "ability to command the capital of another in return for a promise to pay at some specified time in the future (99:91)." As defined, credit is based upon confidence with regard to the future solvency of the borrower and in his repayment capacity.

#### Theoretical Basis of Credit

Classical economic theory (4:129-130) asserts that both lending and borrowing are interest elastic and that there exists a positive



rate of interest at which the supply of, and the demand for, loanable funds are equal. This theory assumes perfect competition in the money market where interest rate--the price of loanable funds--plays the allocative role.

#### The Demand for Credit or Borrower's Side

As already stated, entrepreneurs borrow for increased utilization of capital goods to expand production. Classical economists argue that increased employment of capital, like increased employment of other factors, results in a positive but diminishing marginal product. Consequently, the rational entrepreneur borrows only if the productivity of the additional capital warrants the payment of interest on the borrowed funds at the existing market rate. From this theory, the borrowing schedule is an inverse function of the rate of interest. From the above assumptions, the classical theory states that under perfect competition, borrowing for investment will continue until the expected marginal rate of returns from borrowed funds equals the rate of interest. This is the profit maximizing theory of the firm which requires the equality of marginal cost and marginal revenue. Following this traditional theory, the small farmer is expected to borrow up to the point where the interest rate (his marginal cost) is equal to the marginal contribution from the borrowed funds or the value of the marginal product of capital, VMP. This assumes that there is no risk and no constraint on the availability of loanable funds.

However, recent developments in economic theory have shifted emphasis from profit maximization by firms to utility maximization.



This is especially true of traditional agricultural societies like Nigeria where production decisions made by millions of independent household units involve multiple goals. Becker has suggested that in incorporating the goals and replacing profit maximization with utility maximization, a firm may act as if it maximized a utility function that depends not only on profit but also on other variables. To the small farmer in traditional agriculture, maximizing total product rather than profit seems to be the major objective because the primary purpose of farming is to satisfy household needs. In fact, maximization of total agricultural product is not only the goal of the small farmers but also the major objective of almost all government agricultural development programs in developing countries. Thus, while the productivity of borrowed capital and the rate of interest are important, other variables are equally significant in determining the level and economic use of borrowed funds in traditional agricultural production.

#### The Supply of Credit or Lender's Side

The traditional theory assumes a positive time preference on the part of lenders. This means that lenders value consumption at the present time more than consumption in the future. Therefore they will lend or surrender their right to current consumption only if they expect a positive return from lending. Accordingly, lending is an upward sloping function of the rate of interest.

But interest rate alone is not the sole determinant of lending decisions. Lending involves risks of loss of capital. To guard



against the risk of capital loss or loan delinquency, lenders frequently insist on having loans secured. Ladman and Tinnermeier have acknowledged delinquency in Bolivia as the most threatening problem to the agricultural banking system which decapitalizes the banking institution and makes it dependent on external funding (74:962-966). However, despite the risks, unsecured loans are made solely on the basis of the reputation and financial position (new worth) of the potential borrowers (89:12). The ability of the farmer to repay the loan out of current or expected income also influences decisions to make loans.

In addition, lending involves some costs. The lending and administrative costs have a significant influence on lending decisions. Thus, lending decisions depend not only on the rate of interest, but also on other economic, social and financial considerations.

#### D. REVIEW OF PREVIOUS STUDIES

The role of production credit in accelerating the pace of agricultural development has received much attention among development economists. The proponents of production credit to small farmers have argued that small farmers need credit to augment their meager savings. Lewis stated that saving was essential for successful farm operation, but farmers needed much more than they could save (77:128-129). Leibenstein pointed out that per capita income rises with increases in resource use per head. Consequently, if resources--capital, labor, entrepreneurial ability, technical knowledge, and credit facilities increase, income per head will rise (76:42). Higgins advocated augmenting savings with borrowing but noted that borrowing is inflationary



(57:506-512). But Eckaus argued that limited capital will generate inflation in the absence of full employment and that it may magnify the tendency to use resources inefficiently (34:539-565). Sen acknowledged that need for small farmer credit in India and suggested that credit should be stretched as far as possible to meet legitimate needs and should be made "available on tap" (118). Mosher referred to credit as one of the accelerators of agricultural development but noted that credit should not be taken as a substitute for new technology (94:141). Brenner contended that the demand for agricultural credit grows with progress in agricultural development (22).

According to the Farm Credit Administration, the ability of a credit system in helping to "carry worthy borrowers during one or more years of low prices" and to absorb any losses if they occur is important from the standpoint of farmer-borrower as well as the individual institution concerned (45:1). In addition, economists in advanced agricultural countries have recognized the importance of production credit for agricultural development. In Buck's view, the real seriousness of the agricultural capital problem to newly established farmers is not in its preventing such farmers from "ever developing even a barely adequate economic farm unit or more than a meager level of living." Such farmers operate ineffectively and far below capacity because of inadequate capital resources needed for efficient farm operation. He argued that apart from the limited savings, earnings, and inheritance of the beginning farmers, credit must be the alternative means of obtaining the needed capital. He particularly stressed



the importance of intermediate credit for working capital and referred to it as the "missing link in the credit picture." He stated:

Credit now available to this group is inadequate--not necessarily in amount but in kind. Available short-term credit is geared largely to annual operating needs. The traditional loan for six, nine, or twelve months provides too short a time to permit repayment from earnings of investment in farm development and reorganization. . . . The missing link in the credit picture . . . is intermediate credit for working capital, the earnings from which support a repayment schedule amortized over a period of not less than three to seven years. (24:7)

Empirical evidence from many developing areas confirms the view that institutional credit can facilitate and accelerate the adoption of improved techniques for agricultural development. In his study of farms in Brazil, Rao (114) found that small farm operators are hindered from using the available technologies like fertilizer and chemicals which are highly productive at the margin because most of the institutional credit, which facilitates their adoption, goes to the larger farmers. Baker showed that capital shortages lower returns to other inputs, e.g., land and labor. He argued that improvement in capital complements requires correlated changes in the producing units and in the financial sector. Such changes, according to Baker, depend on the farmer's credit "reserve"--his borrowing capacity. The generation of farm level borrowing capacity is necessary if effective financial intermediaries are to be developed (13:118-131). In his regression analysis on "Bank Credit and Agricultural Production in India," Mishra found a positive correlation between production credit and farm income and recommended "that the quantum of crop loan per family" needs to be increased by the banks and an increasing portion of it be used for productive purposes (90:225-227). However, the low level of variation



explained by regression (11%) suggested that simple regression is not an appropriate model for this analysis since the farm family income is explained by variables other than credit.

But while an increasing number of economists support supplementing savings with credit, others have been skeptical as to the merit of credit in accelerating the adoption of innovation and raising farmers' incomes. Schultz, for example, contended that there are no rewarding investment opportunities open to farmers within the economic confines of traditional agriculture; therefore, the rate of return on investment geared toward expanding farm production is too low to create "incentive to acquire credit or to increase savings for this purpose" (117:17; 57). In supporting Schultz, Long stated that development in traditional agriculture will come only after new information and input have made capital more productive. He added that giving loans to poor farmers at low interest rates will do little to improve the welfare of the farmers unless such loans are accompanied by other inputs which shift their production function. His studies showed that credit programs have little impact on output of agriculture with stagnant technology and little success in countries with inadequate markets (79:991-1008; 80:73-90). Dantwala warned that no institutional credit program can make an intrinsically nonviable enterprise viable (32:52-66). In his view, where the farm holding is extremely small in size and capital intensive, any surplus of returns over cost (in a profitable farming situation) may be too small to enable the farmer to repay the loan. Mellor suggested that cooperative credit programs should better accompany or follow programs of technological change rather than precede them



(86). Mellor's line of thinking was pursued by Abbott who attributed the failure of institutional credit programs in developing countries to lack of coordination of agricultural credit with other supporting services (2:239-246). George Patrick emphasized managerial ability as a prerequisite for a successful loan utilization. He advised that ability to estimate how much credit a farmer needs is essential to farmers because each farmer needs enough resources to operate a growing profitable business to warrant repayment (112:68-76).

Patrick's point with regard to the amount of loan deserves some comments. In developing agriculture, it often happens that the lending institutions, especially cooperatives, make arbitrary decisions to reduce the amount of loans needed by farmers. Where a farmer receives a loan short of his needs, he may either resort to seeking loans from other sources for optimal factor combinations or he may face the danger of disequilibrium in resource allocation. In other words, failure to get the appropriate amount of credit disrupts efficient farm operation.

In his evaluation of the credit situation in Latin American countries, Dale Adams found that credit shortage was not the most pressing issue. Rather than concentrate on provision of credit, Adams recommended placing emphasis on realistic pricing of rural credit and mobilization of domestic rural savings for credit use through interest rate incentives. In his view, the going interest rate does not reflect the opportunity cost of capital (5:163-172). He suggested that market forces should be allowed to play the allocative role in the credit market so that higher interest rates may make credit available to the small operators as the larger farmers back away from credit with high cost.



There has also been a growing body of literature on the potential of agricultural credit in promoting agricultural development in Nigeria. Norman justified his contention that institutional credit is needed by the small farmers from the evidence that the supply of agricultural investment funds is small because "savings from the farmers' low incomes are minimal." His estimate of the average annual income of the farming family in Northern Nigeria is in the region of ₦200.00 to ₦400.00. Like Vigo (131), Norman argued that institutional credit to the small farmers had, in the past, been almost nonexistent and that credit from noninstitutional sources is costly. He recommended a program of agricultural credit to small farmers to encourage greater investment in agriculture (103). Miller laid down some preconditions for a successful use of agricultural credit and warned that unless such preconditions exist or are being created, extending credit to small farmers may be a disservice to them. His reason was that these small farmers "may become burdened with debt obligations with little if any increase in their incomes from which to repay." But he assured that where the proper conditions exist, a well-managed agricultural credit can give "a strong boost" to agricultural development by accelerating the rate of adoption of improved technology (89:5).

Kriesel showed that commercial banks have extended credit for large scale plantation operations but not to small farmers. He added that agricultural cooperatives which are supposed to deal with the small farmers reach less than 5% of these farmers. From his research findings Kriesel stressed that the degree of economic growth and



development are generally associated with improvements in the effectiveness of financial institutions (72:109-111).

Ugoh advocated the creation of government-sponsored credit institutions but warned that such institutions "must be removed from the aegis of the civil service," should be governed by a Board of Directors which should be responsible for policy making, and should own its own staff. He suggested channeling credit to the small farmers through local credit clubs which already exist in the villages (126:8-9). In view of the difficulty of financing agriculture, Ijere advocated the establishment of an agricultural credit bank to finance the agricultural sector. Like Patrick, Ijere said that knowledge of farm management should be a prerequisite for credit advancement. He suggested that the teaching of farm management to small farmers should lie with the staff of the agricultural credit bank, the Ministry of Agriculture, and the departments of agricultural sciences of the various universities (62:125-145).

In his "Redemption of Pledged Property through Rural Credit," Adegboye pointed out that the Nigerian cocoa farmers usually pledge their cocoa farms to obtain money for agricultural development and for other purposes, including investment in children's education. This practice, according to Adegboye, causes untold hardships to the farmers and results in "a decrease in the potential income to the economy." To stem off these hardships, he called for a government financed credit program whereby loans can be advanced to such pledgers to instill in them a sense of ownership and responsibility (6:63-76, 7:181-189). Essang's study showed that only farmers with high incomes and large



holdings benefit from credit from commercial banks and other institutional sources. Small and poor farmers are denied such facilities because they lack loan securing assets. They therefore resort to credit from licensed buying agents and private money lenders whose rates of interest are considerably higher than those from institutional sources (37).

In contrast to the optimistic views about the merits of small farmer's credit expressed above, some economists doubt if the infusion of agricultural credit into the Nigerian agricultural sector can, in fact, promote economic growth and development. Wells (133:321) as well as Bauman, Connelly, and Whitney (16) contended that despite considerable experimentation, Nigeria's credit programs have been ineffective. Their studies which showed high default rates led to the conclusion that "there is significant experience of credit with no responsibility for repayment." They aptly observed from the various credit programs in the country that there are scarcely new elements in new programs because "each succeeding program has been essentially a repetition of its predecessor."

In his study of capital, credit, and savings in Northern Nigerian agriculture, King found a positive evidence of ability to save in the informal local savings group in the northern states. In each of the villages surveyed, he found that there exists a traditional credit institution in which a group of individuals mutually agree to bind themselves together and provide cash assistance to members who are involved in some social or economic obligation (70:17-21; 71). This form of traditional savings/credit organization is



known to exist in almost all parts of Nigeria under different (local) names. In the Abak Local Government Area where this study was made, it is called "Etibe" and is the major means of saving and capital accumulation since there is no banking facility in this area.

From his study, King concluded that government backed agricultural credit programs do not necessarily promote agricultural development. At times, the farmer's environment of social obligations and nonfarm opportunities cause them to use any available funds for purposes other than agricultural investment. Under this type of situation, King did not encourage any supervised credit scheme to the Nigerian small farmer. Rather, he suggested encouraging and supporting domestic savings through the local credit institutions and creating conditions which make agricultural investment profitable and attractive.

Malton posed the hypothesis that the savings and investment capacity of the small farmers in Northern Nigeria was minimal and represented a fundamental constraint to expanded investment even for relatively low cost improved input packages. A test of Malton's hypothesis revealed the existence of dissavings among the poorest farmers and positive savings among households in the "most affluent decile" of his sample. Under the assumption of full-time female employment, Malton's estimate showed maximum potential savings varying from (-) ₦23 for the poorest household group to ₦277 for the most affluent, reflecting 7% dissaving and 32% positive saving for the poorest and most affluent groups, respectively. From this result, Malton stated:

. . . given an adequate return on investment, the levels of observed savings would support increased annual farm outlays



of approximately ₦50. . . . Thus, when annual savings capacity alone is considered, it can be concluded that credit supplements would be necessary to support increased farm expenditures of that magnitude only among the poorest 40 percent of the population. (82:79)

Ijose and Abaelu, (63) and Osuntogun (109:1-12), like Ugoh have made detailed reviews of past agricultural credit programs to assess their merits and demerits and have suggested some mechanisms for modifications of future programs. However, none of them attempted to assess the credit needs of the small farmers nor empirically tested the impact of credit in accelerating the adoption of innovation and in raising output and the incomes of farmers.

The above studies were concerned with the analysis and evaluation of the merits of small farm production credit as an essential source of agricultural finance in low income agriculture. There have been differences of opinion about the desirability of credit among traditional farmers. But all have agreed that savings are the most reliable and most profitable source of agricultural finance. Even the advocates of small farm production credit as a source of agricultural improvement have contended that credit should be used to augment, not to replace savings.

These studies, particularly those dealing with Nigeria, have provided the basis on which the present study is based. However, they were carried out in areas with different cultural, economic, and social conditions from those that prevail in the Cross River State. In fact, the only study of agricultural credit that has involved the Cross River State was that of Ugoh which was just an evaluation of the operation of the Fund for Agricultural and Industrial Development (FAID) of



former Eastern Nigeria (126:1-12). No attempt was made to estimate the effect of credit on the net incomes of the farmers. This study has therefore attempted to estimate both the effect of improved technology made possible through credit advance and the optimum credit needs of the small farm operators, given their net worth.





## CHAPTER III

## CHARACTERISTICS OF AGRICULTURE IN IKA CLAN

## A. LAND

Land in Ika Clan and throughout the Cross River State (Appendix C) is the joint property of the extended family system. The method of acquisition of land and the pattern of land use in the area affect the pattern and level of agricultural operation.

Land Tenure and Farm Size

Since land is jointly owned, the right to cultivate it is granted to the farmer by the head of the system. By tradition, every male is entitled to some parcels of land from his father and/or paternal relations. Each recipient of land is required to retain all of it intact for eventual transfer to future generations within the family system. The individual can pledge the land for immediate cash needs, but he must redeem it as soon as possible, provided the pledgee has retained the land through, at least, one farming cycle.<sup>1</sup> Outright sale of any inheritance or holding, especially to anybody outside the extended family system, is prohibited by tradition.

The practice whereby every male has a share of the family land implies that the size of the farm holdings is inversely related to the number of males in a family. Neither education nor employment outside

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<sup>1</sup>A farming cycle lasts five years including the year of cultivation. This provision entitles the pledgee to cultivate the plot, at least, once.



the agricultural sector excludes any male from his claim to land. Thus, the land tenure structure in Ika Clan (and the Cross River State) has given rise to smaller and smaller units of operation per farmer.

The pattern of land acquisition is further complicated by the fact that certain types of land or certain areas within the community are recognized as being more suitable for the production of particular crops than others or are traditionally set aside for those particular crops. Since every farmer attempts to raise all crops, every son requires a share of each type of his father's land. Consequently, the land tenure structure results not only in small farm holdings, but also in fragmentation of those small holdings. The average number of holdings per farmer in the survey was 4.2 (Table 3.1). Farmers in the small size farm group had fewer holdings than those in the medium and large size groups. A survey of the farm size structure in former Eastern Nigeria by Smock showed that the average farmer operated six different plots at different locations each year (121:197). Thus, the division of a father's land (almost) equally among his sons rather than primogeniture and the desire of each son to be self-sufficient in all crop production have resulted in small and fragmented land holdings.

A few economists have lent support to the Nigerian land tenure structure. Oluwasanmi stated that the system acts as a strong cohesive force in an agrarian society (108:734). He added that the system affords the farmer a stake in the assets of the community, provides security for every member of the family, prevents the emergence of a landed aristocracy, and moves the economy towards an equitable distribution of the community's resources.



Table 3.1. Total and Average Number of Holdings by Farm Size Groups in Ika, 1978.

| 1                                       | 2              | 3                     |
|-----------------------------------------|----------------|-----------------------|
| Farm size group                         | No. of farmers | Total no. of holdings |
| Small                                   | 104            | 316                   |
| Medium                                  | 43             | 205                   |
| Large                                   | 11             | 137                   |
| Total                                   | 158            | 658                   |
| Average no. of holdings (658/158) = 4.2 |                |                       |

Source: Computed from survey.



Whatever its assumed "merits," a land tenure pattern which encourages fragmentation of farm holdings tends to render the operation of such holdings uneconomic. From the standpoint of development, such a system is likely to hinder the freedom of enterprising farmers from effectively mobilizing labor and capital for increased production. One reason is that since land is seldom sold, the farmer finds it difficult to expand the scope of his operation. He is confined to the area originally allotted to him. Even when an adjacent plot is pledged to him, he is reluctant to make any long term improvement on it because of the fear that the land may be redeemed before the next cropping season. In this case, the system gives rise to inefficient use of the land, labor, and capital resources and retards technological and entrepreneurial innovations (1:39).

One factor that has tended to perpetuate dependence on traditional agriculture and encourage land fragmentation into noncontiguous holdings is immobility of the agricultural labor force. This immobility is due to strong family and community ties, lack of training for other jobs, lack of funds to move, and scarcity of alternative opportunities. The consequence is undersize holdings which may be too small to provide even the barest subsistence for the farming family.

The current population trend in Nigeria shows the Cross River State as one of the most densely populated states in the country. The estimated population density of Nigeria for selected years is given in Table 3.2. The Cross River State is the fourth most densely populated state in the nation with a population density in each of the 6 years much higher than the national average. The average population





Table 3.2. Nigeria's Population Density for Selected Years (Persons per km<sup>2</sup>).

| States                         | 1961 | 1965 | 1970 | 1975 | 1980 | 1985 |
|--------------------------------|------|------|------|------|------|------|
| 1 Benue-Plateau                | 35   | 39   | 77   | 50   | 58   | 67   |
| 2 East Central                 | 303  | 335  | 382  | 430  | 498  | 578  |
| 3 Kano                         | 127  | 141  | 161  | 181  | 210  | 243  |
| 4 Kwara                        | 31   | 34   | 39   | 44   | 50   | 58   |
| 5 Lagos                        | 92   | 102  | 116  | 131  | 152  | 176  |
| 6 Mid-Western                  | 61   | 67   | 76   | 86   | 100  | 116  |
| 7 North-Central                | 56   | 62   | 70   | 79   | 92   | 106  |
| 8 North-Eastern                | 24   | 26   | 30   | 34   | 39   | 45   |
| 9 North-Western                | 32   | 36   | 41   | 46   | 53   | 62   |
| 10 Rivers                      | 81   | 82   | 102  | 115  | 113  | 154  |
| 11 South-Eastern (Cross River) | 97   | 107  | 122  | 137  | 159  | 185  |
| 12 Western                     | 120  | 132  | 151  | 170  | 197  | 228  |
| Nigeria                        | 57   | 63   | 72   | 81   | 94   | 109  |

Source: Federal Ministry of Agriculture and Natural Resources, 1974.



density per square kilometer ( $\text{km}^2$ ) of the Cross River State in 1961 was 97 as compared with the national average of 57 for that year. The estimated population density of the state for 1980 rose to 159 and the estimated national average rose to 94. The upward trend of population density and the limited employment opportunity outside the agricultural sector in the Cross River State may intensify pressure on agricultural land. As Abalu pointed out,

undersize holdings have the net effect of driving the marginal productivity of agricultural labour towards zero as well as driving the marginal value product of farm capital down at least to cost. (1:39)

This means that as larger quantities of labor per unit of land (and per unit of capital) are used, the efficiency of labor--the product per worker--rapidly decreases and the additional units of labor tend to add little to total output (75:153).

### Land Use

The Cross River State occupies a land area of 11,166 square miles. A 1972 survey of its land use pattern showed that only 16.2% of the land area was planted in food crops, 3.4% was devoted to cash crop plantations, and 21% was occupied by wild palm trees (92:20-21). Except for the area under forest reserves, the rest of the land was in fallow. In other words, about three times the area under food crops is left idle every year and reflects a four-year rotation system. The long fallow period is designed to allow the land enough time to regain its natural fertility because farmers seldom use artificial measures to improve or restore soil fertility after cultivation. This is the "shifting cultivation" method of agriculture.



### Shifting Cultivation

Shifting cultivation is the dominant food crop farming technique throughout the state except on government operated model farms. Otherwise called the "bush fallowing" method, the shifting cultivation technique involves rotation of farms rather than crops. By this technique, the farmer clears and cultivates a plot of land for 1 year and then leaves it for a number of years<sup>2</sup> in fallow to regain its fertility naturally.

Shifting cultivation is a traditional means of introducing some fallow break between periods under fertility extracting crops. Before growing crops, the natural vegetation which covers the land is cleared and burned and plant nutrients--phosphorus, calcium, and potassium--are released and added to the soil in the form of ash. Besides, a supply of nitrogen is made available for crop cultivation, although much is lost by burning (39:81-82).

But rotating plots and leaving land idle creates land scarcity or intensifies existing constraints on land and forces farmers to practice mixed cropping. Mixed cropping involves simultaneous planting of different crops on the same parcel of land without regard to soil types and specific crop requirements.

Shifting cultivation has resulted in dividing up agricultural lands in each village/region into farming zones, according to the

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<sup>2</sup>The duration of the fallow period varies between 3 and 6 years in various parts of the state depending on availability of, and population pressure on land. In the area of study, it was constant at 4 years in all the five villages.



duration of the fallow period adopted by the village/region. In the area of study, the farm lands were divided into four farming zones. The zones were not necessarily contiguous parcels of land. For instance, in the year of survey, the average number of widely separated areas that came under one zone in the five villages was three. The common element was that all lands in these areas must be cultivated the same year. Table 3.3 illustrates the pattern of land used as observed in the study area, the four-year fallow cycle.

There are four zones in the area, identified by the letters, A, B, C, and D. In any particular year, only one zone is brought under cultivation while the other three are fallowed. The zoning is done by the society rather than by the individual farmer. Consequently, the individual landowner cannot cultivate his own plot in an area that had not been declared "ready for farming." On the other hand, all holdings in any given zone must be cleared for cultivation when the zone is ready for cultivation. In fact, the rotation cycle and planting system are fixed and known in advance by all farmers.

Zone A is under cultivation in Year 1 and is left in fallow for the next 3 years. Zones B through D are in fallow when Zone A is under crops. In the second year, Zone B is brought under cultivation while the rest, including Zone A are in fallow. The cycle continues in this pattern until all the zones are successively brought under cultivation once in 4 years.

Two significant developments have occurred in the farming system of Cross River State in recent years. First, there has been a reduction in the length of cycle in almost all villages throughout





Table 3.3. Observed Pattern of Land Use in Ika Clan of Abak LGA, 1978.

| Year/<br>Zones | Year 1  | Year 2  | Year 3  | Year 4  |
|----------------|---------|---------|---------|---------|
| A              | Crops   | Fallow* | Fallow  | Fallow  |
| B              | Fallow  | Crops   | Fallow* | Fallow  |
| C              | Fallow  | Fallow  | Crops   | Fallow* |
| D              | Fallow* | Fallow  | Fallow  | Crops   |

\*Where the farmer faces acute shortage of land, second year crops may be planted but these are usually limited to crops like maize and cassava. Tradition permits this but not beyond the second year.



the state as a result of population pressure on land. The period of rotation has declined from a high range of 7 to 9 years to a low range of 3 to 6 years. Secondly, shortages of land have led to the introduction of "second year cropping" to supplement, but not to replace, shifting cultivation. By this innovation, farms in any zone may be planted the year following the first cultivation. In this event, crops believed to be most demanding of soil nutrients are planted during the first year. But in the second year, crops that exert less demand on the soil, like cassava, are planted (9:233-235). Zones under second year cropping are indicated by "Fallow\*" in Table 3.2., page 40. The fallow cycle is reduced by 1 year where this practice is followed.

Critics of the shifting cultivation technique have labeled it as "primitive" and "misguided" and associated it with low agricultural output. In particular, they have described it as a wasteful method because a considerable proportion of the land is left idle during the fallow period (9:247). The United Nations Food and Agricultural Organization officials remarked that:

Shifting cultivation of agriculture is not only a backward type of agricultural practice. It is also a backward stage of cultivation. (41:35)

Among the demerits often associated with the system are soil erosion and degradation, timber destruction, vegetation alternation, and the large amount of labor needed to cut down and clear the thick bush as well as low rate of stabilization and improvement of rural life (58:28).



On the other hand, sympathizers with the technique have referred to it as a natural way of bringing about soil regeneration. Ahn argued that by providing cover for the land, shifting cultivation protects the soil against "heating up," erosion, and leaching. He added that the technique supplies some organic materials to the soil and ensures quick regrowth of vegetation (9:248). Writing about the method as it applies to Nigeria, Stapleton pointed out that shifting cultivation is well suited to cultivation with the crude traditional implements--the hoe and the machet (123:10). Watson and Goldsworthy (132:294) found that the duration of fallow and the yield of yam are directly related and that the effect of longer fallow is to increase yam yield while the yield of grain was little affected.

There has been growing awareness in recent years about the problems of shifting cultivation and the difficulties of replacing it with an alternative system that is satisfactory to the people. An alternative system must be tried and proven superior to the existing one before it will be accepted and, above all, it must be sustainable.

The problem of small size of farm holdings in Ika Clan is due to population pressure on land, the agricultural technique currently employed, and the land tenure structure of the system. The population problem in Ika Clan (and in the Cross River State) is a sensitive issue and must be handled with care. The use of artificial devices to reduce fertility and control population is frequently opposed in accordance with culture and the teachings of religion. More so, the desire for a large number of children seems to be high in Ika Clan because children provide part of the labor needed by the farmer



(Table 3.4). Therefore, population policy aimed at reducing fertility is likely to be opposed. In addition, it may not provide the needed short-run solution. Policy directed toward providing employment outside the agricultural sector would appear more appropriate for the area.

There seems to be some scope for expansion of farm holdings through changes in the farming techniques. The bush fallow technique was necessitated by the scarcity of artificial means of regenerating the land after cultivation. The provision and use of chemical fertilizers can encourage simultaneous cultivation of all the land owned by the farmer rather than just one-fourth of it. This would provide a short-run and long-term solution to a long standing problem.

The pattern of land inheritance is similar throughout most of Nigeria and results in small size of operating unit per farmer. Because small operating units are uneconomic, governments in developing countries have advocated land reform which embraces redistribution of land, improvements in existing tenure legislation, resettlement schemes, and land consolidation or reorganization of farm units (41:4). The recent Nigerian land use decree was aimed at such reform.

The need for land reform in developing countries has been noted by development institutions. The Secretary-General of the UNCTAD, for example, has argued that the introduction of modern technology into developing countries requires changes in their economic and social structures and must entail "drastic changes in the systems of land tenure" which prevail in the developing countries (127).



Table 3.4. Composition of Farm Families in Ika by Farm Sizes, 1978.

| Class of family members | Size of farm |           |            | Total      |
|-------------------------|--------------|-----------|------------|------------|
|                         | Small        | Medium    | Large      |            |
| No. of families         | 104          | 43        | 11         | 158        |
| Male adults             | 172(1.65)    | 74(1.72)  | 28(2.55)   | 274(1.73)  |
| Female adults           | 239(2.30)    | 106(2.47) | 40(3.60)   | 385(2.44)  |
| Sons in schools         | 281(2.70)    | 113(2.63) | 36(3.30)   | 430(2.72)  |
| Daughters in schools    | 260(2.50)    | 110(2.56) | 30(2.70)   | 400(2.53)  |
| Totals                  | 952(9.15)    | 403(9.38) | 134(12.15) | 1489(9.42) |

Source: Computed from survey.

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But land reform movements appear to emphasize consolidation as the major aspect of reform. Consolidation seems to promise an immediate solution to the fragmentation and small size of holdings problems, but a compulsory land consolidation program in a society with limited employment opportunities outside agriculture and where the majority of the people depend on their land for livelihood has little chance of success. In view of this, drastic and radical changes as suggested above seem dangerous. In fact, the FAO authorities have observed that the traditional systems of agriculture are so entangled with all aspects of the farmer's life (land tenure, customs, traditions, religious beliefs, etc.) that to change them is to change the whole pattern of life of the people (39:82). This suggests that in attempting to modify the land tenure systems, care should be taken to avoid radically upsetting the people's pattern of life. Consolidation therefore requires consultation with and the cooperation of the farmers. The farmer requires sufficient information to appreciate the potential benefits of land consolidation. Such appreciation may facilitate voluntary compliance with any land reform and consolidation act.

In addition, consolidation should be planned ahead and be immediately followed by improved techniques if the expected economies of scale are to be realized. Consolidation may encourage land improvement and greater use of fertilizers as well as greater efficiency of management. But again, efforts must be made to avoid "trying to change too much too quickly" (9:233).



## B. LABOR

Some development economists have assumed that farm work is the only productive activity of the peasant farmers (27:105). While the major source of employment in the peasant society is agriculture, peasants do, in fact, engage in other economic and social activities. In Ika Clan, farmers were also engaged in other economic activities such as oil palm activities and local crafts and trade. Social activities included community services which occupied 1 day per week for males and less for females. Tables 3.5 and 3.6 show the distribution of days among various activities by periods<sup>3</sup> for men and women respectively in the area of study.

The average number of persons<sup>4</sup> per farm family in the five villages was 9 with slight variation between farm size groups (Table 3.4). However, the average number of persons in the larger size group was 12. Although not directly observed in this study, it appears the difference could be explained by dividing the farm families into two types of units: the simple unit and the composite unit (101:7). A simple unit consists of an individual married male with his wife (wives) and dependent children, while a composite unit is composed of two or more male adults together with their wives and children. There were a few cases in which adult, married sons still lived with and worked under their fathers.

The farm families consisted of male and female adults as well as sons and daughters in schools. Male adults were defined as adult

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<sup>3</sup>The farming year is divided into 3 periods based on the type of activities and demand for labor. The first period runs from January through April; the second period includes May through August; and the third period lasts from September to December.

<sup>4</sup>There was no record of children below school age and so these were not included in this calculation.



Table 3.5. Seasonal Distribution of Days Among Males in Ika by Activities, 1978.

| Distribution of days                               | Jan.-April |    | May-Aug. |    | Sept.-Dec. |    |
|----------------------------------------------------|------------|----|----------|----|------------|----|
| Total no. of days                                  | 120        |    | 123      |    | 122        |    |
| Less Sundays                                       | 16         |    | 16       |    | 16         |    |
| Less days for other economic and social activities | 50         | 66 | 59       | 75 | 60         | 76 |
| Days available for food crop production            | 54         |    | 48       |    | 46         |    |

Source: Computed from survey.

Table 3.6. Seasonal Distribution of Days Among Females in Ika by Activities, 1978.

| Distribution of days                               | Jan.-April |    | May-Aug. |    | Sept.-Dec. |    |
|----------------------------------------------------|------------|----|----------|----|------------|----|
| Total no. of days                                  | 120        |    | 123      |    | 122        |    |
| Less Sundays                                       | 16         |    | 16       |    | 16         |    |
| Less days for other economic and social activities | 54         | 70 | 64       | 80 | 69         | 85 |
| Days available for food crop production            | 50         |    | 43       |    | 37         |    |

Source: Computed from survey.



family members who lived permanently in the home and devoted full time to family farm work. They were fifteen years old and over and included the farmers themselves. Female adults were similarly defined. Sons and daughters in schools were children who were of school age and were actually attending schools. They assisted in farm work only during vacations. The numbers in parentheses are the average number of persons in the relevant category and size group per family.

While the average number of persons per farm family was 9, the actual number of persons per farm family ranged between 3 and 23. In rural Nigeria, it is the family unit that constitutes the basic labor force. Thus, the larger the size of the family, the larger the potential labor force. However, provision must be made for children who spend most of the time at school and only help in farm work during vacations.

One major feature of the labor force was the distinction between male and female labor. This distinction became necessary because, in the study area (and in Nigeria as a whole), certain tasks are performed by men and others exclusively by women. The clearing of thick bushes and pruning of tall trees, for example, require greater physical exertion than women can provide and are performed only by men. On the other hand, some activities such as weeding and carrying of inputs to, and products from, the farm are ascribed to women. Igwebuike has pointed out that, even when the male and female appear to be engaged in the same operation, they may, in fact, be performing separate tasks. He cited an example in which a man and his wife are said to be engaged in harvesting when the man is actually digging the tubers out of the ground, while the wife is engaged in gathering and carrying the tubers home (61:46:48).



Sex distinction in occupational assignments in traditional agriculture does not seem to imply that the male is more productive than the female. Rather, it is consistent with the principle of division of labor and specialization. Women, in general, appear to be faster than men in weeding and in "burying of crops in the ground" during planting whereas men are faster in some other operations. This type of specialization in productive activities among workers often results in increased production because it permits the development and refinement of skills, eliminates the waste involved in moving from one task to another, and simplifies the different tasks (122:21). Collinson, however, recognized productivity differentials among the sexes at different tasks when he stated:

When a woman works half the speed of a man on one operation and twice as fast on another, fixing her equivalent value at .50 on the basis of the first will grossly underestimate family labor capacity on the second. (28:201)

But when the average daily rate of remuneration was considered (Table 3.7), men were more highly paid than women in all the periods. This wage differential among sexes was explained in terms of the degree of physical exertion required by the male and female tasks rather than by the marginal productivity theory. Reynolds argued that differences in earnings can be explained by factors other than sex--differences in education, on-the-job training, work experience, etc. (115:159-160). He added that differences which can be explained in this way are regarded as "normal" even though they may be attributable in part to indirect discrimination in education and other respects. Differences in earnings based on the degree of physical exertion seemed to be one of those "normal" differences. From Table 3.7, the average



Table 3.7. Average Daily Wages for Male and Female by Periods (N) in Ika, 1978.

| Periods              | Male wage | Female wage |
|----------------------|-----------|-------------|
| January - April      | 1.40      | 1.00        |
| May - August         | 1.25      | 1.00        |
| September - December | 1.10      | 0.85        |

Source: Computed from survey.



daily wage for males was ₦1.40<sup>5</sup> while that of female was ₦1.00 during the first period. In the third period, male wage fell to ₦1.10 while female wage fell to ₦0.85 per manday. In either of the cases, men earned more than the women.

The total amount of male labor available per farm in mandays by size groups was obtained by multiplying the number of days available (by periods) for food crop activities in Table 3.5 by the average number of each category of males per farm family (by size groups) in Table 3.4, page 48, and summing up the products. In the same way, the computation of the total amount of female labor available per farm for food crop activities was based on similar figures from Tables 3.4 and 3.6. The labor of each son in school was calculated at one-half of the adult male labor based on observed performance. Likewise, the labor of each daughter in school was calculated at one-half of the adult female labor. The results of the calculation are given in Tables 3.8 through 3.10. Tables 3.8, 3.9, and 3.10 show the total amount of labor available for the representative farm in the small, medium, and large size groups, respectively, by periods. For example, the amounts of male labor available by periods for the small size representative farm (Table 3.8) in mandays were 95.9, 130.5, and 104.3 for Periods 1, 2, and 3, respectively, while those for female labor during the same periods were 121.3, 146.4, and 134.4, respectively. The totals in Tables 3.9 and 3.10 have similar interpretations for the medium and large representative farms, respectively.

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<sup>5</sup>₦1.00 (Naira) = \$1.65 by 1978 exchange rate.



Table 3.8. Labor Available for Food Crop Activities in Mandays by Periods for Small Farms.

| Labor category      | No. of mandays available |                      |                        |
|---------------------|--------------------------|----------------------|------------------------|
|                     | Period 1<br>Jan.-April   | Period 2<br>May-Aug. | Period 3<br>Sept.-Dec. |
| Male:               |                          |                      |                        |
| Male adults         | 89.1                     | 79.2                 | 75.9                   |
| Sons in school      | 6.8                      | 51.3                 | 28.4                   |
| Total available     | 95.9                     | 130.5                | 104.3                  |
| Female:             |                          |                      |                        |
| Female adults       | 115.0                    | 98.9                 | 108.1                  |
| Daughters in school | 6.3                      | 47.5                 | 26.3                   |
| Total available     | 121.3                    | 146.4                | 134.4                  |

Source: Computed from survey.

Table 3.9. Labor Available for Food Crop Activities in Mandays by Periods for Medium Farms.

| Labor category      | No. of mandays available |                      |                        |
|---------------------|--------------------------|----------------------|------------------------|
|                     | Period 1<br>Jan.-April   | Period 2<br>May-Aug. | Period 3<br>Sept.-Dec. |
| Male:               |                          |                      |                        |
| Male adults         | 92.88                    | 82.56                | 71.12                  |
| Sons in school      | 6.58                     | 49.97                | 27.62                  |
| Total available     | 99.46                    | 132.53               | 98.74                  |
| Female:             |                          |                      |                        |
| Female adults       | 123.5                    | 106.21               | 91.39                  |
| Daughters in school | 6.4                      | 48.64                | 26.88                  |
| Total available     | 129.9                    | 154.85               | 118.27                 |

Source: Computed from survey.



Table 3.10: Labor Available for Food Crop Activities in Mandays by Periods for Large Farms.

| Labor category      | No. of mandays available |                      |                        |
|---------------------|--------------------------|----------------------|------------------------|
|                     | Period 1<br>Jan.-April   | Period 2<br>May-Aug. | Period 3<br>Sept.-Dec. |
| Male:               |                          |                      |                        |
| Male adults         | 124.2                    | 110.4                | 105.8                  |
| Sons in school      | 8.25                     | 62.7                 | 34.65                  |
| Total available     | 132.45                   | 173.1                | 140.45                 |
| Female:             |                          |                      |                        |
| Female adults       | 189.0                    | 162.54               | 139.86                 |
| Daughters in school | 6.75                     | 51.30                | 28.35                  |
| Total available     | 195.74                   | 213.84               | 168.21                 |

Source: Computed from survey.



In addition to family labor, hired labor was used during the first period which was found to be the peak of the farming season. Apparently, the use of male hired labor was not necessarily due to labor shortage but to two basic reasons. First, some of the tasks like pruning of oil palm trees were specialized activities and required the services of experts. Consequently, hiring such expert services even in the face of excess family labor was inevitable. Secondly, as it is well known, most farm activities depend on season. Clearing, for example, must be completed by the middle of January if other activities are to move on schedule along with changes in temperatures and rainfall. Thus, the earliest activities and tasks required a special effort and sense of urgency (73:199) to meet the time limitations imposed by uncontrollable forces. The activities which required urgency and for which hired labor was used included clearing of farm plots, pruning of trees, planting of yams and cocoyam, and yam staking. Female labor was hired mainly for yam, cassava, and cocoyam planting as well as for weeding.

### C. CAPITAL

Farm capital, defined as man-made productive assets designed to enhance agricultural production, may be divided into two classes in accordance with the duration of their productive life. These are physical or fixed capital and working or operating capital. These two classes together, constitute the aggregate capital and comprise the total stock of the produced means of production (36:212). Both are essential to production.



### Physical Capital

Produced goods which have productive life spans in excess of one farming season are often classed as fixed or physical capital. In the area of study and in the Cross River State, in general, physical capital is almost entirely limited to two simple tools--the matchet and hoe. The matchet is used mainly for clearing the farm plots, pruning and trimming of trees and plants, and for hacking down trees. The hoe, on the other hand, is used mainly for digging and tilling (long hoe) and for weeding (weeding hoe).

The average values of fixed capital in the survey by farm size were ₦12.36, ₦17.38, and ₦30.43 for small, medium and large farms, respectively (Table 3.11). Most of the items were purchased between January, 1976 and the beginning of the farming season in January, 1978; but some of them were more than 2 years old. No attempt was made to calculate the net investment in tools and equipment. However, tools like matchets and long hoes are usually replaced every 2 years. Weeding hoes, baskets, and other minor tools are usually replaced more often.

The sum of the values of matchets (including axes) and hoes formed the largest component of the value of fixed capital in Ika Clan (Table 3.12). In the small size group, for example, the sum of the values of these items was ₦10.48 or 85% of the total value of fixed capital per farm. The inverse relationship observed in Table 3.12 between the percentage value of the basic tools and the size of farm holding may be explained in terms of substitution effect. In this sense, as the farm size increases and the farmer becomes more "wealthy,"



Table 3.11. Average Values of Farm Tools/Implements per Farm by Size Group in Ika, 1978.

| Tools/Implements    | Value (N) |        |        |
|---------------------|-----------|--------|--------|
|                     | Small     | Medium | Large  |
| No. of farms        | 104.00    | 43.00  | 11.00  |
| Matchets and axes   | 4.87      | 6.93   | 11.24  |
| Long hoes           | 3.08      | 3.84   | 5.57   |
| Weeding hoes        | 2.53      | 2.97   | 4.03   |
| Shovels and spades  | 0.57      | 1.31   | 6.50   |
| Forks and rakes     | 0.00      | 0.18   | 0.39   |
| Others              | 1.31      | 2.15   | 2.70   |
| Total               | 12.36     | 17.38  | 30.43  |
| Average farm income | 134.16    | 249.96 | 507.71 |

Source: Computed from survey.



Table 3.12. Value of Matchets and Hoes as a Percentage of Total Fixed Capital by Farm Size in Ika, 1978.

| Farm size | Total value of fixed capital (₦) | Total value of matchets and hoes (₦) | Value of matchets and hoes as percentage of total fixed assets (₦) |
|-----------|----------------------------------|--------------------------------------|--------------------------------------------------------------------|
| Small     | 12.36                            | 10.48                                | 85                                                                 |
| Medium    | 17.38                            | 13.74                                | 79                                                                 |
| Large     | 30.43                            | 20.84                                | 68                                                                 |

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he attempts to substitute the more effective tools--spades and shovels--for hoes which are less effective in digging and tilling. As implied in Table 3.11, the ratios of the value of spades and shovels to total fixed capital (not shown on the table) are about 5%, 8%, and 21% for small, medium, and large farm, respectively.

### Operating Capital

The other component of farm capital in the study area was operating capital which comprised purchased input items that were used up within a single farming season. Operating capital included fertilizer, yam and pumpkin stakes, seeds, and hired labor. These items required cash expenditure; but part of the operating capital like "yam sets" and stakes were provided by the farmer. In some cases, only small proportions of the operating capital items were bought. Table 3.13 shows the average amounts of operating capital utilized during the survey by farm sizes.

The operating capital requirement for each activity was the average of the actual operating capital utilized by the farmers in each size group. Table 3.14 illustrates the operating capital needs of the various crop activities according to the models during the survey period. The requirements ranged from as low as ₦5.00 per acre for sole cassava in Model A--the traditional model--to as high as ₦226.89 for Yam Group 2 in Model C. Yam Group 1 and Yam Group 2 required high operating capital in all the models as did the maize, cocoyam, and fluted pumpkin activity group. On the other hand, the maize and cassava group as well as the sole cassava activity required moderate operating capital outlays.



Table 3.13. Operating Capital Used in Five Villages in Ika Clan by Farm Sizes during the 1978 Farming Season.

| Farm size | Operating capital used (N) |
|-----------|----------------------------|
| Small     | 39.00                      |
| Medium    | 58.00                      |
| Large     | 93.30                      |





Table 3.14. Operating Capital Requirements of Various Crop Activities in Five Villages in Ika Clan in 1978 by Farm Models (₦) per Acre.

| Crop activities                    | Model A | Model B | Model C |
|------------------------------------|---------|---------|---------|
| Yam Group 1                        | 90.41   | 95.78   | 165.65  |
| Yam Group 2                        | 123.91  | 142.90  | 226.89  |
| Maize, cocoyam, and fluted pumpkin | 52.47   | 71.46   | 119.81  |
| Cassava and maize                  | 5.50    | 8.00    | 23.00   |
| Cassava, cocoyam, and maize        | 33.90   | 36.40   | 82.50   |
| Sole cassava                       | 5.00    | 7.50    | 22.50   |

Source: Computed from survey.



From Tables 3.13 and 3.14, it seems reasonable to assume that operating capital is one of the factors that restrain the type and level of crop activities. Operating capital constraint and high operating capital requirements for yam activities seemed to explain why farmers in the small and medium farm groups tended to limit these (yam) activities to small areas around their homes in the survey. The average area devoted to all yam activities in the survey by farmers in the small size group was 0.09 acre while that for the medium size farmers was 0.47 acre. On the other hand, farmers in the large size group, especially those in Model C, appeared to be inclined toward yam production. The average area devoted to yam activities by this group of farmers was 3.85 acres. This inclination may be explained, in part, by "prestige" rather than by economic reasoning. Yam, throughout the Cross River State, is regarded as a "prestige" crop, cultivated and consumed mainly by the "wealthy." It is the major food item for important festivals like Christmas. The size of the farmer's yam barn is an important component of his wealth. For these and other reasons, large farmers in the area of study and in the state, as a whole, appear interested in yam activities despite the high operating capital and other input requirements.

Operating capital came from two major sources--"own" source and borrowed source. Own source comprised savings and gifts or assistance from relatives and friends. The average savings by size groups (Table 3.15) were ₦10.76, ₦27.51, and ₦137.08 for the small, medium, and large farms, respectively. Average savings were obtained by subtracting "reported" family expenditure from the average farm



Table 3.15. Average Farm Income, Expenditure, and Savings in Ika by Farm Size, 1978 (₦).

| Size group | Number of farms | Average income | Average family expenditure | Average saving | % saving |
|------------|-----------------|----------------|----------------------------|----------------|----------|
| Small      | 104             | 134.16         | 123.40                     | 10.76          | 8        |
| Medium     | 43              | 249.96         | 222.45                     | 27.51          | 11       |
| Large      | 11              | 507.71         | 370.63                     | 137.08         | 27       |

Source: Computed from survey.



income. These savings, as already indicated, ignored expenses on marriages and marriage ceremonies and therefore overstated the rate of savings.

Gifts and assistance were an important source of operating capital, especially for farmers in the small and medium size groups. They were of two kinds. The first comprised direct financial gifts from people who owed service obligations to the farmers or to the farm families. By tradition, sons and unmarried daughters are required to render some farm services to their parents as are junior members of the family to the seniors. Also, sons-in-law are required to render annual services to their parents-in-law on farms. Those who cannot meet these service obligations are required to make financial contributions to help pay for those services. Consequently, obligers who work outside the agricultural sector are increasingly using the financial contribution method to fulfill their obligations. Thus, gifts are not only a stable source of operating capital but also a source of maintenance support for the farm families.

The second kind was assistance from members of the extended family system and friends. The basic principle underlying the extended family system is that the "more economically fortunate" members of the family should aid and render economic assistance to the "less fortunate ones." However, incidence of this source of operating capital and maintenance support was rare throughout the survey area and perhaps signaled the "weakening links" of the extended family structure. But, on the whole, the average financial gift per farmer was ₦31.38, ranging from zero Naira (no gift) to ₦104.76.



The other source of operating capital was borrowing and involved short-term credit. Short-term credit was a source of operating capital for crop planting and funds for the purchase of necessary inputs or to meet other unavoidable expenditures (130:20) associated with crop production. Short-term credit for farm operation is usually required for a single growing season and needed at the beginning of the relevant farming season.

### Credit Facilities

There are usually two sources of short-term credit. These are private and institutional sources. Private credit is obtained from private individual moneylenders. The rate of interest charged by these private individuals is usually higher than that charged by institutional lenders. The average rate of interest charged in all five villages surveyed in Ika Clan by private moneylenders was 27% as compared with the 6% rate charged under the "Small Farmer Credit Guarantee Scheme Fund" jointly sponsored by the Federal Government and the Central Bank of Nigeria. The high interest rates lowered farmers' profit margins. But in the absence of a cheaper source of credit, and so long as private credit added more to revenue than to cost, its use was economically desirable. In general, private credit was easy to obtain since there were no rigid collateral requirements. The important element for credit rating appeared to have been the borrower's moral and social rating in the society as seen by the lender. The next requirement was that each party should have a witness to the deed. The borrower's witness was required to be his close relative like son, brother, or wife.



It should be pointed out, that even with this degree of ease in obtaining private credit, some farmers were reluctant to borrow. Some of them argued that borrowing would result in loss of self respect, while others relied on the traditional maxim that "debt destroys friendship." This type of mental attitude among peasant farmers toward debt, recalled Penny, had existed since the time of Shakespeare as illustrated in the advice of Polonius to his son (113:33):

Neither a borrower nor a lender be; For loan oft loses  
both itself and friend, and borrowing dulls the edge of  
husbandry.

Penny argued that, for farmers with this attitude toward debt, there may exist "profitable economic opportunities" whereas "the will to develop is absent." In general, it appears that farmers and development economists have placed too much emphasis on the adverse effects of high interest rates on private credit and neglected the potential of such credit as a source of operating capital for agricultural development in the absence of institutional credit. The basic question should be whether private credit can be available in sufficient amounts to meet the needs of the small farmers in the absence of credit from institutional sources. Assuming away risk and uncertainty, so long as private credit is available (and there is no other cheaper source of credit) and its marginal cost (rate of interest is less than its marginal revenue, the innovative small farmer will be better off by borrowing rather than doing without it.

Institutional credit--credit from commercial and agricultural banks, insurance companies, and cooperative societies and state



government--was almost nonexistent in the area of study. The Cross River State food crop farmers, like their counterparts in other parts of Nigeria, face the problem of limited institutional credit facilities. They live and operate in rural areas with no banking facilities. Institutional banking facilities, whenever available, are limited to the urban areas, particularly the local government area (LGA) headquarters. In fact, some LGA headquarters have no commercial banks at all<sup>6</sup> and no bank is located anywhere in the state outside LGA headquarters.

There are 19 commercial banks in Nigeria with 630 branches.<sup>7</sup> Among these is the Mercantile Bank of Nigeria, an indigeneous bank of the Cross River State, with 14 branches. In addition to the 19 commercial banks in the country, there are 5 Merchant Banks with 8 branches and 4 Government owned development banks (135:78). In all, there are 642 bank branches in the country, an average of 33.8 branches (5.26%) per state. Of these, 23 branches (3.58%) are located in The Cross River State. Table 3.16 shows the distribution of banks in the country by states.

At the time of the survey, there was no commercial bank in the LGA in which the study area was located. The entire LGA was served by commercial banks at Ikot Ekpene and Uyo about 25 miles and 32 miles, respectively, away from the study area. Thus, farmers had limited access to commercial bank credit.

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<sup>6</sup>At the time of writing, only 13 of the 17 LGA's had commercial banks.

<sup>7</sup>Includes the newly opened branch of the Mercantile Bank of Nigeria at Abak--opened in 1980.



Table 3.16. Distribution of Bank Branches in Nigeria by States, 1980.

| State   | No. of<br>branches | %     | State       | No. of<br>branches | %      |
|---------|--------------------|-------|-------------|--------------------|--------|
| Lagos   | 112                | 17.45 | Ogun        | 25                 | 3.89   |
| Oyo     | 67                 | 10.44 | Kwara       | 23                 | 3.58   |
| Bendel  | 54                 | 8.41  | Cross River | 23                 | 3.58   |
| Anambra | 52                 | 8.10  | Sokoto      | 18                 | 2.80   |
| Imo     | 47                 | 7.32  | Plateau     | 16                 | 2.49   |
| Ondo    | 36                 | 5.61  | Bauchi      | 15                 | 2.34   |
| Kaduna  | 35                 | 5.45  | Benue       | 14                 | 2.18   |
| Kano    | 32                 | 4.98  | Niger       | 11                 | 1.71   |
| Rivers  | 27                 | 4.21  | Gongola     | 10                 | 1.56   |
| Bornu   | 25                 | 3.89  | Total       | 642                | 100.00 |

Source: Compiled from information from West Africa, January 14, 1980, p. 78 and Oladele Olashore, "Evolution of Banking Operation in Nigeria and the System of Control," Cen Bank News: The Staff Newsletter of the Central Bank of Nigeria, Vol. 2, Nos. 2 & 3, February - March 1977, p. 5.



Like commercial bank credit, access to other forms of institutional credit was also limited. In particular, farmers in the area had little access to the much publicized state government agricultural credit, the purpose of which is to stimulate food production. As Awa correctly noted, the structure of the bureaucracy is so rigid that access to state agricultural credit is effectively restricted to those commercial farmers knowledgeable in the ways of bureaucracy. He added:

Except for cases in which kinship or friendship ties mediate access to state credit, small farmers wishing to borrow from government sources can expect to spend over one-third of the borrowed sum on graft, simply to grease the bureaucratic wheels. (11:9)

The major source of institutional credit used by farmers in the study area was the local cooperative society or local club. This credit unit was organized on village basis in the five villages. Each was organized and run by the local people. Funds for lending were contributed by individuals and members met once a week for all financial transactions--lending and repayment collection. Some farmers had access to larger cooperatives in other villages within the clan. But, on the whole, funds for lending were more limited than they were from private sources. Table 3.17 shows the average amounts of credit used by farmers from institutional sources by farm sizes, excluding all farmers in Model A. The average rate of interest charges from institutional sources was 9% as against 27% from private sources.



Table 3.17. Average Amount of Institutional Credit Available to Farmers in Models B and C by Farm Size in Ika, 1978.

| Farm size | Amount of credit available |
|-----------|----------------------------|
| Small     | 24.72                      |
| Medium    | 37.19                      |
| Large     | 56.68                      |

Source: Computed from survey.



### Forms of Operating Capital

Seeds. By far, the largest percentage of the operating capital went into the purchase of seeds and/or cassava sticks--that part of the cassava stem used for planting--where cassava crop formed part of the activity. The amounts spent on seeds, including cassava sticks for planting, are given by crop activities in Table 3.18. The names of the crops which constitute the activity groups are given under "crop activity" and the activity group names, defined in Chapter IV, are given in parentheses. Table 3.19 gives the costs of seeds and seed-related planting materials as percentages of operating capital required for the activities. The costs range from 35% for CACOMZ in Model A to 100% for CAMZ and SOLCAS in Model A and SOLCAS in B. The input requirements for CAMZ (cassava and maize) and SOLCAS (sole cassava) were relatively low especially under the traditional technique. The entire expenditure on these activities went to the purchase of cassava sticks for planting and a few cobs of local strain of maize. This low cost consideration partly explains why farmers in the small and medium size groups tended to concentrate more on activities that involved maize and cassava production than farmers in the large size groups who were interested in yam activities.

Stakes. Staking was applicable to only three activities--YAMG 1, YAMG 2, and MZCOFP. The only crops that required staking were yams and fluted pumpkins. Consequently, yam stakes and fluted pumpkin stakes were bought to supplement what the farmer could provide. In the YAMG 1 activity, expenditures on yam and fluted pumpkin stakes



Table 3.18. Expenses on Seeds and Planting Materials by Crop Activities per Acre.

| Crop activity                                      | Seeds and other planting materials bought | Value in Naira (N) |         |         |
|----------------------------------------------------|-------------------------------------------|--------------------|---------|---------|
|                                                    |                                           | Model A            | Model B | Model C |
| Yam group 1<br>(YAMG 1)                            | Seed yams                                 | 30.00              | 33.23   | 67.50   |
|                                                    | Fluted pumpkin                            | 11.76              | 10.00   | 11.30   |
|                                                    | Melon seeds                               | 0.40               | .55     | 0.50    |
|                                                    | Bean seeds                                | --                 | .26     | .40     |
|                                                    | Okra seeds                                | --                 | .25     | .25     |
|                                                    | Total YAMG 1                              | 42.16              | 44.29   | 79.95   |
| Yam group 2<br>(YAMG 2)                            | Seed yams                                 | 35.27              | 34.93   | 72.87   |
|                                                    | Cocoyam seeds                             | 12.83              | 16.95   | 34.18   |
|                                                    | Fluted pumpkin                            | 10.50              | 13.12   | 14.45   |
|                                                    | Total YAMG 2                              | 58.60              | 65.00   | 121.50  |
| Maize, coco-<br>yam, fluted<br>pumpkin<br>(MZCOFP) | Maize seeds                               | 0.50               | 0.50    | 0.65    |
|                                                    | Cocoyam seeds                             | 13.00              | 18.25   | 32.50   |
|                                                    | Fluted pumpkin                            | 7.25               | 9.70    | 15.85   |
|                                                    | Total MZCOFP                              | 20.75              | 28.45   | 49.00   |
| Cassava and<br>maize<br>(CAMZ)                     | Cassava sticks                            | 5.00               | 6.00    | 8.15    |
|                                                    | Maize seeds                               | .50                | .50     | .65     |
|                                                    | Total CAMZ                                | 5.50               | 6.50    | 8.80    |
| Cassava,<br>cocoyam,<br>and maize<br>(CACOMZ)      | Cassava sticks                            | 4.00               | 5.50    | 18.00   |
|                                                    | Cocoyam seeds                             | 7.20               | 9.60    | 26.30   |
|                                                    | Maize seeds                               | .50                | .50     | .50     |
|                                                    | Total CACOMZ                              | 11.70              | 15.60   | 44.80   |
| Sole cassava<br>(SOLCAS)                           | Cassava sticks                            | 5.00               | 7.50    | 8.00    |
|                                                    | Total SOLCAS                              | 5.00               | 7.50    | 8.00    |

Source: Computed from survey.



Table 3.19. Cost of Purchased Inputs as Percentages of Operating Capital.

| Crop activity   | Operating capital required (M) |         |        | Input values (M) |         |        | Input values as percentages of operating capital |         |       |
|-----------------|--------------------------------|---------|--------|------------------|---------|--------|--------------------------------------------------|---------|-------|
|                 | A                              | Model B | C      | A                | Model B | C      | A                                                | Model B | C     |
| <b>YANG 1</b>   | 90.41                          | 95.78   | 165.65 | 42.16            | 44.29   | 79.95  | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | 8.60             | 11.99   | 22.35  | 47                                               | 46      | 48    |
| Stakes          |                                |         |        | 22.80            | 24.00   | 30.80  | 10                                               | 13      | 13    |
| Hired labor (M) |                                |         |        | 16.85            | 15.50   | 22.55  | 25                                               | 25      | 19    |
| Hired labor (F) |                                |         |        | --               | --      | 10.00  | 18                                               | 16      | 14    |
| Fertilizer      |                                |         |        |                  |         |        | --                                               | --      | 6     |
| <b>YANG 2</b>   | 123.91                         | 142.90  | 226.89 | 58.60            | 65.00   | 121.50 | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | 14.84            | 19.85   | 31.30  | 47                                               | 45      | 54    |
| Stakes          |                                |         |        | 27.75            | 30.80   | 31.40  | 12                                               | 14      | 14    |
| Hired labor (M) |                                |         |        | 22.72            | 27.25   | 32.69  | 22                                               | 22      | 14    |
| Hired labor (F) |                                |         |        | --               | --      | 10.00  | 18                                               | 19      | 14    |
| Fertilizer      |                                |         |        |                  |         |        | --                                               | --      | 4     |
| <b>MZCOFP</b>   | 52.47                          | 71.46   | 119.81 | 20.75            | 28.45   | 49.00  | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | 8.00             | 10.40   | 14.30  | 40                                               | 40      | 41    |
| Stakes          |                                |         |        | 8.58             | 13.47   | 20.15  | 15                                               | 14      | 12    |
| Hired labor (M) |                                |         |        | 15.15            | 19.14   | 26.36  | 16                                               | 19      | 17    |
| Hired labor (F) |                                |         |        | --               | --      | 10.00  | 29                                               | 27      | 22    |
| Fertilizer      |                                |         |        |                  |         |        | --                                               | --      | 8     |
| <b>CANZ</b>     | 5.50                           | 8.00    | 23.00  | 5.50             | 6.50    | 8.00   | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | --               | --      | --     | 100                                              | 81      | 38    |
| Hired labor (M) |                                |         |        | --               | --      | --     | --                                               | --      | --    |
| Hired labor (F) |                                |         |        | --               | 1.50    | 4.20   | --                                               | 19      | 18    |
| Fertilizer      |                                |         |        | --               | --      | 10.00  | --                                               | --      | 44    |
| <b>CACOMZ</b>   | 33.90                          | 36.40   | 82.50  | 11.70            | 15.60   | 44.80  | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | 10.20            | 9.50    | 12.70  | 35                                               | 43      | 54    |
| Hired labor (M) |                                |         |        | 12.00            | 11.30   | 15.00  | 30                                               | 26      | 16    |
| Hired labor (F) |                                |         |        | --               | --      | 10.00  | 35                                               | 31      | 18    |
| Fertilizer      |                                |         |        |                  |         |        | --                                               | --      | 12    |
| <b>SOLCAS</b>   | 5.00                           | 7.50    | 22.50  | 5.00             | 7.50    | 8.00   | (100)                                            | (100)   | (100) |
| Seed            |                                |         |        | --               | --      | --     | 100                                              | 100     | 36    |
| Hired labor (M) |                                |         |        | --               | --      | --     | --                                               | --      | --    |
| Hired labor (F) |                                |         |        | --               | --      | 4.50   | --                                               | --      | 20    |
| Fertilizer      |                                |         |        | --               | --      | 10.50  | --                                               | --      | 44    |

Source: Computed from survey.



accounted for 10% of the total operating cost in Model A and 13% of the total operating cost in each of the other two models. Similarly, the ratios of total expenditures on staking operations to total operating costs in the YAMG 2 activity were higher in Models B and C (14%) than in Model A (12%). In absolute amounts, expenditures on staking operations in Model C were more than twice those in Model A except in the MZCOFP activity which involved only fluted pumpkin stakes. This may be so because the use of chemical fertilizer generally promotes the growth of yam shoots. The higher the yam shoots climb upward, the bigger tubers they yield (124:76). Thus, more and bigger stakes were needed to support yams planted with improved technology. Staking is necessary for increased yield of yam and fluted pumpkin, but it is always accompanied with high production costs.

Hiring of Labor. Reasons for labor hiring operations have already been discussed. Despite the apparent excess of male labor at all periods, hiring male labor accounted for a significant percentage of the operating capital. Also, in all activities, more money was spent on hiring female labor in Model C than in Models A or B because more weeding was required where fertilizer was used than where it was not used.

Fertilizer. Fertilizer and hybrid seeds were the only items of modern technology used. Fertilizer was used on all farms in Model C only. The average amount used per acre was four bags weighing 25 pounds (lbs) each. The market value was ₦2.50 per bag. Fertilizer application was the direct responsibility of the farmers concerned



with no indication of any advisory service. There was only one fertilizer application on each plot.

Fertilizer availability was a major problem in the study area. Farmers had to travel long distances in order to buy fertilizer. Farmers in the area appeared to be aware of the yield benefits of fertilizer, but the scarcity of the resource appeared to have been the major reason for its limited use.<sup>8</sup> The few farmers who applied fertilizer to their crops were known to have substantially improved their output and incomes. Wierer and Abbott (136:10) have noted that farmers in traditional agricultural systems live close together in large villages so that innovations are heard of and are easily accepted. Reasons for exceptional crop performances are easy to trace. In the area of study, there seemed to have been a close relationship between crop output per acre and the technique of farming employed--traditional or improved. Table 3.20 outlines the average outputs of the various crops per acre in the mixed cropping system according to the technique employed. The traditional Models A and B had lower yields of all crops than the improved model--Model C. Yam output in Model C was 76% higher than in Model A and the outputs of cassava and maize were 87% and 68% higher, respectively, in Model C than in Model A. It was only with the minor crops (okra, melon and beans) that the increase in output due to modern technology was below 50%. This was because fertilizer was usually not applied to minor crops. Minor

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<sup>8</sup>One of the major reasons given for not using fertilizer was that they could not find it to buy. But the most frequent reason was "lack of money."



Table 3.20. Average Crop Yields per Acre in Ika Mixed Cropping Pattern by Models, 1978.

| Crop                      | Unit         | Model A         | Model B         | Model C         |
|---------------------------|--------------|-----------------|-----------------|-----------------|
| Yam                       | Pounds (lbs) | 1766.6          | 1911            | 3108            |
| Maize                     | lbs          | 586             | 613             | 982             |
| Cassava                   | lbs          | 2935            | 3479            | 5486            |
| Cocoyam                   | lbs          | 3575            | 3864            | 6762            |
| Fluted pumpkin:<br>Leaves | Bundles      | 768             | 773             | 1349            |
| Fruits                    | Pods         | 58              | 51              | 126             |
| Okra                      | lbs          | 280             | 290.3           | 402.6           |
| Melon                     | lbs          | 118             | 116             | 168             |
| Pepper                    | lbs          | na <sup>1</sup> | na <sup>1</sup> | na <sup>1</sup> |
| Beans                     | lbs          | 910             | 947             | 1140            |

Source: Computed from survey.

<sup>1</sup>na = not available.



crops benefited indirectly from fertilizer application to major crops with which they were planted together. In YAMG 1 activity, for example, fertilizer was applied only to yam and fluted pumpkin even though melon, okra, pepper, and beans were also planted simultaneously.

It is often argued that yield comparison is not an appropriate measure for determining the advantage of improved technology since cost increase may be higher than output increase attributed to improved technology. Despite the fact that technology was associated with higher input requirements, a comparison of the net returns from all the activities, as shown on pages 97-100, confirms that the application of improved practices to traditional agriculture can increase net farm income.



## CHAPTER IV

### THE LINEAR PROGRAMMING MODELS FOR THE STUDY AREA

The Linear Programming (LP) model is a mathematical technique which seeks to maximize (or minimize) a linear objective function subject to some linear constraints including the requirement that the values of all variables be nonnegative. In this study, the model is used as a farm planning tool with the objective of maximizing the farmer's net income subject to restrictions imposed by the availability of resources--land, male and female labor by periods, operating capital and borrowed funds.

In its general form, the LP problem is mathematically stated as:

$$\text{Maximize } Z = \sum_{j=1}^n C_j X_j \quad (j=1, 2, \dots, n) \quad (4.1)$$

$$\text{Subject to } \sum_{j=1}^n a_{ij} X_j \leq b_i \quad (i=1, 2, \dots, m) \quad (4.2)$$

and  $X_j \geq 0$ ,

where:

$Z$  = the total farm gross margin to be maximized, defined as the total farm income minus the total variable cost of production.

$C_j$  = the increase in  $Z$  that is attributable to each unit increase in  $X_j$ .



$X_j$  = the decision variable under the farmer's control, e.g.,  
number of acres of cassava to be produced.

$a_{ij}$  = the input-output coefficient which measures the amount of  
resource  $i$  consumed by each unit of activity  $j$ .

$b_i$  = resource restriction--a measure of the total amount of  
resource  $i$  available.

In its standard form (as used in this study), the LP problem  
is stated as:

$$\text{Maximize } Z = C_1X_1 + C_2X_2 + \dots + C_nX_n \quad (4.1')$$

Subject to:

$$\begin{aligned} a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n &\leq b_1 \\ a_{21}X_1 + a_{22}X_2 + \dots + a_{2n}X_n &\leq b_2 \\ &\vdots \\ a_{m1}X_1 + a_{m2}X_2 + \dots + a_{mn}X_n &\leq b_m \end{aligned} \quad (4.2')$$

and  $X_j \geq 0$ ;

where  $Z$ ,  $C_j$ ,  $X_j$ ,  $a_{ij}$  and  $b_i$  remain as defined above. In either of  
these forms, the LP problem calls for maximization of the objective  
function and specifies that the amount of the constraining resources  
should not be exceeded. In addition, the nonnegativity requirement  
restricts the use of decision variables to nonnegative values.

#### A. ASSUMPTIONS OF THE LP MODEL

Some basic assumptions are required in the formulation of a  
linear programming problem. They include linearity, continuity,  
certainty and nonnegativity.



### Linearity

The linearity assumption requires that all variables chosen by linear in the objective function and that all constraints have exponents of unity (88:144). This assumption has two components--proportionality and additivity (65:127).

Proportionality. This assumption requires that the amounts of inputs used per unit of output be constant over all levels of output. Thus, when inputs in a certain production technique vary, output should vary in the same proportion as the variation in inputs.

Additivity. By this assumption, total resource used is obtained by adding the amounts used by the individual activities together. Thus, if Yam Group 1 (YAMG 1) activity uses 34.50 mandays of labor in Period 1 and Yam Group 2 (YAMG 2) uses 32.70 mandays, then together they account for 67.20 mandays of male labor in Period 1.

Brigham and Pappas have argued that the relationships involved in LP problems revolve around revenue functions, cost functions, and the accompanying profit function. In their view, each of these functions must be linear, meaning that as output increases, revenues, costs, and profits will increase linearly (23:174). The linearity assumption requires that product price be constant and that both returns to scale and input prices be constant also--a competitive situation which is closely approximated by the small farm condition under study.



### Continuity

By the continuity assumption, all variables chosen must be capable of taking any numerical value. Activity units can be divided into fractional levels because positive non-integer values are permissible for the decision variables (59:23). In the present study, it was possible to use fractions of mandays of labor, of pounds (lbs) of fertilizer, of acres of land, of Naira of operating capital and borrowed funds.

### Certainty

By this assumption, all values are known with certainty implying that they are deterministic. The known values include the input-output values as well as factor and product prices and the constraints.

### Nonnegativity

This assumption, generally referred to as the nonnegativity constraint, requires that the values of all decision variables be equal to or greater than zero. This assumption is further explained under "Constraints" below.

## B. COMPONENTS OF THE LP MODEL

An economic problem that is suitable for solution by LP involves an objective that is a linear combination of variables and constraints that are also linear in the variables and stated as inequalities (88: 143). Basically, a linear programming problem consists of three components:



- i. the objective function which is a linear function of a set of activities which (in this study) is to be maximized.
- ii. the alternative activities determined by the farm manager of the planner; and
- iii. the constraints which limit the amount and number of activities to be used. (65:127)

### The Objective Function

Equations (4.1) and (4.1') above define the objective function of the model. The  $C_j$ 's in the objective function are a measure of the marginal contribution of each decision variable: the revenue associated with one unit of the  $j$ th activity. The value of the program is the difference between total gross sales from all production activities included in the final plan and their variable costs. It is usually referred to as the total gross margin (TGM). Net farm income is obtained by subtracting all fixed costs from the value of the program. The plan that maximizes the value of the program (TGM) also maximizes net farm income. Etuk has noted, however, that in northern Nigeria where the fixed cost item of smallholder agriculture is minimal or zero, the total gross margin is equivalent to net farm income (38:80). This seems to be true of the five villages under study judging from the low level of fixed capital given in Table 3.12, page 61. As already noted, the major fixed costs involved simple tools with low market values and expected useful life of over 2 years. The fixed cost component in this case was fairly negligible.

The computation of the parameters of the objectives functions for Model A, B, and C is shown in Tables 4.1, 4.2, and 4.3 respectively. The revenue, variable cost, and net returns information given in the three tables for field crops (row 1 through 6) were based on



Table 4.1. Computation of the Objective Function Parameters (Cj's) for Model A/Acre in Ika, 1978.

| Activity                                         | Total<br>revenue<br>(₦) | Total<br>variable<br>cost (₦) | Net<br>returns<br>(₦) (Cj) |
|--------------------------------------------------|-------------------------|-------------------------------|----------------------------|
| 1 Yam group 1 (YAMG 1)                           | 170.53                  | 90.41                         | 80.12                      |
| 2 Yam group 2 (YAMG 2)                           | 176.59                  | 123.91                        | 52.68                      |
| 3 Maize, cocoyam, and fluted<br>pumpkin (MZCOFP) | 124.04                  | 52.47                         | 71.57                      |
| 4 Cassava and maize (CAMZ)                       | 69.67                   | 5.50                          | 64.17                      |
| 5 Cassava, cocoyam, and<br>maize (CACOMZ)        | 110.59                  | 33.90                         | 76.69                      |
| 6 Sole cassava (Slocas)                          | 64.77                   | 5.50                          | 59.27                      |
| 7 Hire male labor 1 (HMLAB 1)                    |                         |                               | -1.40                      |
| 8 Hire female labor 1 (HFLAB 1)                  |                         |                               | -1.00                      |
| 9 Sell male labor 2 (SMLAB 2)                    |                         |                               | 1.25                       |
| 10 Sell male labor 3 (SMLAB 3)                   |                         |                               | 1.10                       |
| 11 Sell female labor 2 (SFLAB 2)                 |                         |                               | 1.00                       |
| 12 Sell female labor 3 (SFLAB 3)                 |                         |                               | 0.85                       |

Source: Computed from survey.



Table 4.2. Computation of Objective Function Parameters (Cj's) for Model B/Acre in Ika, 1978.

| Activity                                      | Total revenue (₦) | Total variable cost (₦) | Net returns (₦) (Cj) |
|-----------------------------------------------|-------------------|-------------------------|----------------------|
| 1 Yam group 1 (YAMG 1)                        | 177.99            | 95.78                   | 82.21                |
| 2 Yam group 2 (YAMG 2)                        | 194.19            | 142.90                  | 51.29                |
| 3 Maize, cocoyam, and fluted pumpkin (MZCOFP) | 141.47            | 71.46                   | 70.01                |
| 4 Cassava and maize (CAMZ)                    | 76.18             | 8.00                    | 68.18                |
| 5 Cassava, cocoyam, and maize (CACOMZ)        | 114.97            | 36.40                   | 78.57                |
| 6 Sole cassava (SOLCAS)                       | 78.54             | 7.50                    | 71.04                |
| 7 Hire male labor 1 (HMLAB 1)                 |                   |                         | -1.40                |
| 8 Hire female labor 1 (HFLAB 1)               |                   |                         | -1.00                |
| 9 Sell male labor 2 (SMLAB 2)                 |                   |                         | 1.25                 |
| 10 Sell male labor 3 (SMLAB 3)                |                   |                         | 1.10                 |
| 11 Sell female labor 2 (SFLAB 2)              |                   |                         | 1.00                 |
| 12 Sell female labor 3 (SFLAB 3)              |                   |                         | 0.85                 |
| 13 Private credit (PRCRED)                    |                   |                         | -0.27                |
| 14 Institutional credit (INCRED)              |                   |                         | -0.09                |

Source: Computed from survey.



Table 4.3. Computation of Objection Function Parameters (Cj's) for Model C/Acre in Ika, 1978.

| Activity                                         | Total<br>revenue<br>(₦) | Total<br>variable<br>cost (₦) | Net<br>returns<br>(₦) (Cj) |
|--------------------------------------------------|-------------------------|-------------------------------|----------------------------|
| 1 Yam group 1 (YAMG 1)                           | 285.48                  | 165.65                        | 119.83                     |
| 2 Yam group 2 (YAMG 2)                           | 329.11                  | 226.89                        | 102.22                     |
| 3 Maize, cocoyam, and fluted<br>pumpkin (MZCOFP) | 229.92                  | 119.81                        | 110.11                     |
| 4 Cassava and maize (CAMZ)                       | 93.14                   | 23.00                         | 70.14                      |
| 5 Cassava, cocoyam, and<br>maize (CACOMZ)        | 181.14                  | 82.50                         | 98.64                      |
| 6 Sole cassava (SOLCAS)                          | 106.22                  | 22.50                         | 83.72                      |
| 7 Hire male labor 1 (HMLAB 1)                    |                         |                               | -1.40                      |
| 8 Hire female labor 1 (HFLAB 1)                  |                         |                               | -1.00                      |
| 9 Sell male labor 2 (SMLAB 2)                    |                         |                               | 1.25                       |
| 10 Sell male labor 3 (SMLAB 3)                   |                         |                               | 1.10                       |
| 11 Sell female labor 2 (SFLAB 2)                 |                         |                               | 1.00                       |
| 12 Sell female labor 3 (SFLAB 3)                 |                         |                               | 0.85                       |
| 13 Private credit (PRCRED)                       |                         |                               | -0.27                      |
| 14 Institutional credit (INCRED)                 |                         |                               | -0.09                      |

Source: Computed from survey.



1 acre of land. Total revenue from each activity was obtained by multiplying total output of all crops in the activity group by their respective average market prices (Appendix D) and summing up the products. Similarly, total variable cost was the sum of the total variable cost of each crop in the activity group. The difference between the total revenue and total cost of each activity constituted the "net returns" figures used as the parameters of the objective functions to be maximized (Tables 4.1, 4.2, and 4.3) and were the returns to the farmer's bundle of fixed resources--land, family labor, and capital (138:222-23). Product prices used were averages of the local market prices of the crops for 1978 and were obtained from the three local markets--Urua Inyang, Urua Nyieke Iso, and Urua Asukpong--that serve the area. Crop prices were fairly stable in all three markets throughout the year. For example, the average annual price of raw cassava in each of the three markets was ₦0.015 per pound (1b).

### Constraints

Constraints in a linear programming problem are fixed conditions imposed by a system of linear inequalities. As stated by (4.2) and (4.2'), the linear constraints imply that:

- i. the quantity of each resource used in the solution does not exceed the quantity available, and
- ii. the levels of output are consistent with the levels of inputs.

The constraints are given as a set of inequalities. Boulding has defined a "linear inequality" as a special case of boundary condition that divides the field of conceivable position into a feasible set



consistent with the condition and an infeasible set that is inconsistent with the condition (21:17).

The constraints used in this study were averages from the survey. They were mostly of the "equal to" or "less than" ( $\leq$ ) type and were associated with limited supplies of land, seasonal male and female labor, operating capital, and institutional credit as well as limited opportunities for seasonal sales of male and female labor outside the family farm. They all defined the upper limits to which the resources could be used and were applicable to Models  $A_1$ ,  $B_1$ ,  $C_1$ ,  $A_2$ ,  $B_2$ , and  $C_2$ .<sup>1</sup> However, there were three cases in which inequalities of the "equal to" or "greater than" ( $\geq$ ) type were used. They were associated with those farms defined as "large" to portray 5 acres of land as the lower limit. Tables 4.4, 4.5, and 4.6 show the restrictions used in the models and submodels of this study. The words or abbreviations in parentheses after each resource are the names assigned to these restrictions in the computer printouts and are used in subsequent LP models in this study. For example, Operating Capital is referred to as "OPECAP" and male labor in Period 1 is given as "MLABI."

The restriction on land in the small size group stated that the amount used may be less than or exactly equal to 2 acres. In other words, the program was not bound to utilize all 2 acres of land, but could not be expanded to a point where it required more than 2 acres. The same kind of land restriction held for the medium farm.

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<sup>1</sup>Models  $A_1$ ,  $B_1$ , and  $C_1$  were associated with small size farms and  $A_2$ ,  $B_2$ , and  $C_2$  associated with medium size farms. The Models A, B, and C remain as previously defined.



Table 4.4. Restrictions on the Representative Farm in the Small Size Group in Models A, B, and C in Ika, 1978.

| Resources                                     | Sign   | Amount | Unit    |
|-----------------------------------------------|--------|--------|---------|
| Land (LAND)                                   | $\leq$ | 2.00   | Acres   |
| Operating capital <sup>1</sup> (OPECAP)       | $\leq$ | 39.00  | Naira   |
| Male labor 1 (MLAB 1)                         | $\leq$ | 95.90  | Mandays |
| Male labor 2 (MLAB 2)                         | $\leq$ | 130.50 | Mandays |
| Male labor 3 (MLAB 3)                         | $\leq$ | 104.30 | Mandays |
| Female labor 1 (FLAB 1)                       | $\leq$ | 121.30 | Mandays |
| Female labor 2 (FLAB 2)                       | $\leq$ | 146.40 | Mandays |
| Female labor 3 (FLAB 3)                       | $\leq$ | 134.40 | Mandays |
| Male labor sales 2 (MLABS 2)                  | $\leq$ | 14.00  | Mandays |
| Male labor sales 3 (MLABS 3)                  | $\leq$ | 17.79  | Mandays |
| Female labor sales 2 (FLABS 2)                | $\leq$ | 43.10  | Mandays |
| Female labor sales 3 (FLABS 3)                | $\leq$ | 26.80  | Mandays |
| Institutional borrowing <sup>2</sup> (BORRIN) | $\leq$ | 24.72  | Naira   |

Source: Computed from survey.

<sup>1</sup>Operating capital for Model C was ₦43.00 instead of ₦39.00.

<sup>2</sup>This constraint was applicable only to Models B and C. No borrowed funds were used in Model A.



Table 4.5. Restrictions on the Representative Farm in the Medium Size Group in Models A, B, and C in Ika, 1978.

| Resources                                     | Sign   | Amount | Unit    |
|-----------------------------------------------|--------|--------|---------|
| Land (LAND)                                   | $\leq$ | 5.00   | Acres   |
| Operating capital (OPECAP)                    | $\leq$ | 58.00  | Naira   |
| Male labor 1 (MLAB 1)                         | $\leq$ | 99.46  | Mandays |
| Male labor 2 (MLAB 2)                         | $\leq$ | 132.53 | Mandays |
| Male labor 3 (MLAB 3)                         | $\leq$ | 98.74  | Mandays |
| Female labor 1 (FLAB 1)                       | $\leq$ | 129.90 | Mandays |
| Female labor 2 (FLAB 2)                       | $\leq$ | 154.85 | Mandays |
| Female labor 3 (FLAB 3)                       | $\leq$ | 118.27 | Mandays |
| Male labor sales 2 (MLABS 2)                  | $\leq$ | 14.00  | Mandays |
| Male labor sales 3 (MLABS 3)                  | $\leq$ | 17.79  | Mandays |
| Female labor sales 2 (FLABS 2)                | $\leq$ | 43.10  | Mandays |
| Female labor sales 3 (FLABS 3)                | $\leq$ | 26.80  | Mandays |
| Institutional borrowing <sup>1</sup> (BORRIN) | $\leq$ | 37.19  | Naira   |

Source: Computed from survey.

<sup>1</sup>This constraint was not applicable to Model A.



Table 4.6. Restrictions on the Representative Farm in the Large Size Group in Models A, B, and C in Ika, 1978.

| Resources                                     | Sign   | Amount | Unit    |
|-----------------------------------------------|--------|--------|---------|
| Land (LAND)                                   | $\geq$ | 5.00   | Acres   |
| Operating capital (OPECAP)                    | $\leq$ | 93.30  | Naira   |
| Male labor 1 (MLAB 1)                         | $\leq$ | 132.45 | Mandays |
| Male labor 2 (MLAB 2)                         | $\leq$ | 173.10 | Mandays |
| Male labor 3 (MLAB 3)                         | $\leq$ | 140.45 | Mandays |
| Female labor 1 (FLAB 1)                       | $\leq$ | 195.75 | Mandays |
| Female labor 2 (FLAB 2)                       | $\leq$ | 213.84 | Mandays |
| Female labor 3 (FLAB 3)                       | $\leq$ | 168.21 | Mandays |
| Male labor sales 2 (MLABS 2)                  | $\leq$ | 14.00  | Mandays |
| Male labor sales 3 (MLABS 3)                  | $\leq$ | 17.79  | Mandays |
| Female labor sales 2 (FLABS 2)                | $\leq$ | 43.10  | Mandays |
| Female labor sales 3 (FLABS 3)                | $\leq$ | 26.80  | Mandays |
| Institutional borrowing <sup>1</sup> (BORRIN) | $\leq$ | 56.68  | Naira   |

Source: Computed from survey.

<sup>1</sup>This constraint was not applicable to Model A.



In both cases, the restrictions defined the upper limits. About 93% of the sample were affected by this type of constraint. As already indicated, small size of farm holdings is due, in part, to the agricultural technique employed. Some parcels of land are left idle for some years before they are cultivated. The provision of improved inputs, like chemical fertilizers made possible through the use of credit, can induce changes in the wasteful technique employed and cause a relaxation of the upper limits of the land restrictions. But how far can we expand?

The restriction on land in the large size farm was designed to provide an answer to the above question. It was of the "equal to" or "greater than" ( $\geq$ ) type and defined the lower limit of land. It stated that the program could expand the use of land in excess of 5 acres consistent with the availability of other resources with which land must be combined. Only a few farmers in Ika (7% of the sample) had farms in crops in excess of 5 acres. But the size of farm in crops was not a true measure of the total land holdings of the farmers (Table 3.3, page 44). However, modern technology was needed to bring idle land into cultivation in order to expand output of food crops and raise farm income.

Operating capital is, in general, a limiting resource in Nigerian agriculture. Consequently, its constraint in each of the models was of the "equal to" or "less than" type and defined the upper limit of the resource use. For this study, cash expenses on variable factors were used as an indication of the amount of operating capital available in each of the size groups. The restriction on own funds



available for variable expenses was set equal to the actual average amount spent on those variable input purchases and hired labor during the 1978 farming season by each size group. A summary of the operating capital used by size group was given in Table 3.13, page 63.

Restrictions on other resources are shown in Tables 4.4, page 91 through 4.6 and all define the upper limits of the resources. In addition to the functional constraints described above, there is also the nonnegativity constraint stated as:

$$X_j \geq 0.$$

This constraint states that all variables in the problem must be equal to or greater than zero and is designed to prevent the occurrence of any "nonsense results" like negative activity or output which makes no economic sense (23:184).

### Activities

The number and structure of activities included in a particular LP model depend on the objective of the study. For the purpose of this study (defined above), three models were formulated to represent traditional farming technique without borrowed funds, traditional technique with borrowed funds, and "modern" technique with borrowed funds. Consequently, activities differed according to these models. In general, the activities included were crop production activities, labor hiring and labor selling activities, and cash borrowing activities.

Crop activities. There were six crop activities in each of the models. Since this was an area of mixed cropping, crops planted



simultaneously on the same plots were grouped under a single activity.

The crop activities included were as follows:

1. YAMG 1 or YAM Group 1 consisted of yam as the major crop and fluted pumpkin, melon, okra, pepper and beans as minor crops.<sup>2</sup>

The sum of the net returns (differences between total revenues and total variable costs) from each crop in the activity group constituted the YAMG 1 column coefficient in the objective function. The values were ₦80.12, ₦82.21, and ₦119.83 for Models A, B, and C, respectively (Table 4.7).

2. YAMG 2 or Yam Group 2 comprised three crops yam, cocoyam, and fluted pumpkin<sup>3</sup> (Table 4.8).

3. MZCOFP<sup>4</sup> was made up of maize, cocoyam, and fluted pumpkin (Table 4.9).

4. CAMZ<sup>5</sup> comprised cassava and maize (Table 4.10).

5. CACOMZ<sup>6</sup> was made up of cassava, cocoyam, and maize (Table 4.11).

<sup>2</sup>The planting distances between crops which defined the plant population of each crop were as follows: Yam was planted 8 feet by 6 feet apart or (8' by 6'); fluted pumpkin and melon (13' by 12'); okra (8' by 8'); pepper (4' by 5').

<sup>3</sup>Same plant population for yam and fluted pumpkin as in YAMG 1. The average planting distance for cocoyam was (3' by 2').

<sup>4</sup>Plant population for maize was 681 stands per acre. The spacing distances for cocoyam and fluted pumpkin were the same as those in YAMG 2.

<sup>5</sup>Plant population per acre for both cassava and maize was about 2720.

<sup>6</sup>Maize and cassava were planted 8' by 8' apart and cocoyam, 3' by 2' apart.



Table 4.7. Net Income from Crops under YAMG 1 Activity per Acre by Models (₦).

| Crop           | Net income |         |         |
|----------------|------------|---------|---------|
|                | Model A    | Model B | Model C |
| Yam            | 16.89      | 18.74   | 30.97   |
| Fluted pumpkin | 20.93      | 21.49   | 39.53   |
| Melon          | 17.30      | 16.80   | 19.60   |
| Okra           | 8.40       | 8.71    | 12.08   |
| Pepper         | 7.50       | 7.00    | 6.25    |
| Beans          | 9.10       | 9.47    | 11.40   |
| Total          | 80.12      | 82.21   | 119.83  |

Source: Computed from survey.

Table 4.8. Net Income from Crops under YAMG 2 Activity per Acre by Models (₦).

| Crop           | Net income |         |         |
|----------------|------------|---------|---------|
|                | Model A    | Model B | Model C |
| Yam            | 14.53      | 17.34   | 29.49   |
| Cocoyam        | 15.34      | 10.46   | 30.70   |
| Fluted pumpkin | 22.81      | 23.49   | 42.03   |
| Total          | 52.68      | 51.29   | 102.22  |

Source: Computed from survey.



Table 4.9. Net Income from Crops under MZCOFP Activity per Acre by Models (₦).

| Crop           | Net income |         |         |
|----------------|------------|---------|---------|
|                | Model A    | Model B | Model C |
| Maize          | 28.68      | 35.57   | 33.71   |
| Cocoyam        | 20.70      | 13.64   | 34.83   |
| Fluted pumpkin | 21.19      | 22.80   | 41.57   |
| Total          | 71.57      | 70.01   | 110.11  |

Source: Computed from survey.

Table 4.10. Net Income from Crops under CAMZ Activity per Acre by Models (₦).

| Crop    | Net income |         |         |
|---------|------------|---------|---------|
|         | Model A    | Model B | Model C |
| Maize   | 31.05      | 34.89   | 35.28   |
| Cassava | 33.12      | 33.29   | 34.86   |
| Total   | 64.17      | 68.18   | 70.14   |

Source: Computed from survey.



Table 4.11. Net Income from Crops under CACOMZ Activity per Acre by Models (₦).

| Crop    | Net income |         |         |
|---------|------------|---------|---------|
|         | Model A    | Model B | Model C |
| Maize   | 30.61      | 33.92   | 34.17   |
| Cassava | 29.35      | 32.80   | 32.03   |
| Cocoyam | 16.73      | 11.85   | 32.44   |
| Total   | 76.69      | 78.57   | 98.64   |

Source: Computed from survey.



6. SOLCAS<sup>7</sup> was the sole cassava crop and its net income by models is given in (Table 4.12).

Labor activities. Labor activities were divided into labor hiring and labor selling activities. Labor hiring activities involved hiring of specialized male labor and hiring of male labor to meet date-lines in Period 1. Female labor was also hired during this period because this was the season of peak labor demand. The two labor hiring activities were designated as:

7. HMLAB 1--hiring of male labor in Period 1 at a wage rate of ₦1.40 per manday.

8. HFLAB 1--hiring of female labor in Period 1 at a wage rate of ₦1.00 per manday.

Labor selling activities for male and female were for Periods 2 and 3 and were designated as:

Table 4.12. Net Income from Sole Cassava (SOLCAS) Activity per Acre by Models (₦).

| Model | Net farm income |
|-------|-----------------|
| A     | 59.27           |
| B     | 71.04           |
| C     | 83.72           |

<sup>7</sup>Plant population was 3630 per acre.



9. SMLAB 2--sale of male labor in Period 2 at ₦1.25 per manday.
10. SMLAB 3--sale of male labor in Period 3 at ₦1.10 per manday.
11. SFLAB 2--sale of female labor in Period 2 at ₦1.00 per manday.
12. SFLAB 3--sale of female labor in Period 3 at ₦0.85 per manday.

Borrowing activities. There were two borrowing activities according to the sources of credit--private or institutional.

13. PRCRED--private credit from moneylenders at an average rate of interest of 27%.
14. INCRED--institutional credit at 9% rate of interest.

The activities formulated above were designed to contribute to the objective of the program as reflected in the coefficients. The amounts of resources required by each activity are given in the relevant activity column. The amount of resources available for use by the activities made up the constraint vector or the right hand side, RHS.

Tables 4.13 through 4.15 are the resource allocation matrices of the three models of this study. These three models were each broken into three submodels--small, medium, and large size farms. The electronic IBM computer was used in finding the optimal solution to each of the problems. The results were printed on computer printouts and used for the analysis of this study.



Table 4.13. Resource Allocation Matrix for Model A.

| Row No. | Resources | Units   | Activities               |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            |                            | Sign | RHS <sup>1</sup> |
|---------|-----------|---------|--------------------------|--------------------------|--------------------------|------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|------|------------------|
|         |           |         | X <sub>1</sub><br>YANG 1 | X <sub>2</sub><br>YANG 2 | X <sub>3</sub><br>MZCOFP | X <sub>4</sub><br>CAMZ | X <sub>5</sub><br>CACOMZ | X <sub>6</sub><br>SOLCAS | X <sub>7</sub><br>HMLAB 1 | X <sub>8</sub><br>HFLAB 1 | X <sub>9</sub><br>SMLAB 2 | X <sub>10</sub><br>SMLAB 3 | H <sub>11</sub><br>SFLAB 2 | H <sub>12</sub><br>SFLAB 3 |      |                  |
| 1       | LAND      | Acre    | 1                        | 1                        | 1                        | 1                      | 1                        | 1                        |                           |                           |                           |                            |                            |                            | <    | 2.00             |
| 2       | OPECAP    | N       | 90.41                    | 123.91                   | 52.47                    | 5.50                   | 33.90                    | 5.50                     |                           |                           |                           |                            |                            |                            | <    | 39.00            |
| 3       | MLAB 1    | Mandays | 34.50                    | 32.70                    | 4.80                     | 5.80                   | 9.70                     | 3.60                     | -1.00                     |                           |                           |                            |                            |                            | <    | 95.90            |
| 4       | MLAB 2    | Mandays | 12.70                    | 19.50                    | 16.30                    | 4.60                   | 15.80                    | 3.20                     |                           |                           | 1.00                      |                            |                            |                            | <    | 130.50           |
| 5       | MLAB 3    | Mandays | 8.70                     | 12.80                    | 6.90                     | 1.50                   | 7.80                     | 1.50                     |                           |                           |                           | 1.00                       |                            |                            | <    | 104.30           |
| 6       | FLAB 1    | Mandays | 22.20                    | 18.60                    | 11.50                    | 14.20                  | 12.00                    | 11.90                    | -1.00                     |                           |                           |                            |                            |                            | <    | 121.30           |
| 7       | FLAB 2    | Mandays | 45.80                    | 30.00                    | 25.60                    | 14.30                  | 28.10                    | 10.40                    |                           |                           |                           |                            | 1.00                       |                            | <    | 146.40           |
| 8       | FLAB 3    | Mandays | 38.00                    | 18.80                    | 13.10                    | 4.50                   | 14.70                    | 4.50                     |                           |                           |                           |                            |                            | 1.00                       | <    | 134.40           |
| 9       | MLABS 2   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           | 1.00                      |                            |                            |                            | <    | 14.00            |
| 10      | MLABS 3   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           | 1.00                       |                            |                            | <    | 17.79            |
| 11      | FLABS 2   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            | 1.00                       |                            | <    | 43.10            |
| 12      | FLABS 3   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            | 1.00                       | <    | 26.80            |

<sup>1</sup>This RHS applies only to sub-model A<sub>1</sub>. For RHS for sub-models A<sub>2</sub> and A<sub>3</sub>, see Tables 4.5 and 4.6, respectively.



Table 4.14. Resource Allocation Matrix for Model B.

| Row No. | Resources | Units   | Activities               |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            |                            |                           |                           | Sign | RHS <sup>1</sup> |
|---------|-----------|---------|--------------------------|--------------------------|--------------------------|------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|------|------------------|
|         |           |         | X <sub>1</sub><br>YANG 1 | X <sub>2</sub><br>YANG 2 | X <sub>3</sub><br>MZCOFF | X <sub>4</sub><br>CAMZ | X <sub>5</sub><br>CACOWZ | X <sub>6</sub><br>SOLCAS | X <sub>7</sub><br>HMLAB 1 | X <sub>8</sub><br>HFLAB 1 | X <sub>9</sub><br>SMLAB 1 | X <sub>10</sub><br>SMLAB 2 | X <sub>11</sub><br>SFLAB 2 | X <sub>12</sub><br>SFLAB 3 | X <sub>13</sub><br>PACRED | X <sub>14</sub><br>INCRED |      |                  |
|         |           |         | C <sub>j</sub>           | 51.29                    | 70.01                    | 68.18                  | 78.57                    | 71.04                    | -1.40                     | -1.00                     | 1.25                      | 1.10                       | 1.00                       | 0.85                       | -0.27                     | -0.09                     |      |                  |
| 1       | LAND      | Acre    | 1.00                     | 1.00                     | 1.00                     | 1.00                   | 1.00                     | 1.00                     |                           |                           |                           |                            |                            |                            | -1.00                     | -1.00                     | <    | 2.00             |
| 2       | OPECAP    | N       | 95.78                    | 142.90                   | 71.46                    | 8.00                   | 36.40                    | 7.50                     |                           |                           |                           |                            |                            |                            |                           |                           | <    | 39.00            |
| 3       | MLAB 1    | Mandays | 33.80                    | 34.10                    | 4.60                     | 5.30                   | 10.20                    | 3.90                     | -1.00                     |                           |                           |                            |                            |                            |                           |                           | <    | 95.00            |
| 4       | MLAB 2    | Mandays | 13.40                    | 18.70                    | 16.90                    | 4.80                   | 14.70                    | 3.80                     |                           |                           | 1.00                      |                            |                            |                            |                           |                           | <    | 130.00           |
| 5       | MLAB 3    | Mandays | 8.40                     | 13.20                    | 7.30                     | 1.80                   | 7.30                     | 1.60                     |                           |                           | 1.00                      |                            |                            |                            |                           |                           | <    | 104.30           |
| 6       | FLAB 1    | Mandays | 23.00                    | 17.80                    | 11.80                    | 14.10                  | 12.30                    | 11.70                    |                           | -1.00                     |                           |                            |                            |                            |                           |                           | <    | 121.30           |
| 7       | FLAB 2    | Mandays | 45.30                    | 28.60                    | 26.90                    | 14.90                  | 29.50                    | 10.60                    |                           |                           |                           | 1.00                       |                            |                            |                           |                           | <    | 146.40           |
| 8       | FLAB 3    | Mandays | 38.20                    | 18.40                    | 18.40                    | 4.30                   | 14.60                    | 4.50                     |                           |                           |                           |                            | 1.00                       |                            |                           |                           | <    | 134.40           |
| 9       | MLABS 2   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           | 1.00                      |                            |                            |                            |                           |                           | <    | 14.00            |
| 10      | MLABS 3   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           | 1.00                       |                            |                            |                           |                           | <    | 17.79            |
| 11      | FLABS 2   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            | 1.00                       |                            |                           |                           | <    | 43.00            |
| 12      | FLABS 3   | Mandays |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            | 1.00                       |                           |                           | <    | 26.80            |
| 13      | BORRIN    | N       |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            |                            |                           | 1.00                      | <    | 24.72            |

<sup>1</sup>This RHS applies to sub-model B<sub>1</sub> only. For RHS for sub-models B<sub>2</sub> and B<sub>3</sub>, see Tables 4.5 and 4.6, respectively.



Table 4.15. Resource Allocation Matrix for Model C.

| Row No. | Resource | Units <sup>c</sup> <sub>j</sub> | Activities               |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            |                            |                           |                          | Sign | RHS <sup>1</sup> |
|---------|----------|---------------------------------|--------------------------|--------------------------|--------------------------|------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|---------------------------|--------------------------|------|------------------|
|         |          |                                 | x <sub>1</sub><br>YAMG 1 | x <sub>2</sub><br>YAMG 2 | x <sub>3</sub><br>MZCOFP | x <sub>4</sub><br>CAMZ | x <sub>5</sub><br>CACOMZ | x <sub>6</sub><br>SOLCAS | x <sub>7</sub><br>HMLAB 1 | x <sub>8</sub><br>HFLAB 1 | x <sub>9</sub><br>SMLAB 2 | x <sub>10</sub><br>SFLAB 3 | x <sub>11</sub><br>SFLAB 2 | x <sub>12</sub><br>SFLAB 3 | x <sub>13</sub><br>PRCRED | x <sub>14</sub><br>INCRD |      |                  |
| 1       | LAND     | Acre                            | 119.83                   | 102.22                   | 110.11                   | 70.14                  | 98.64                    | 83.72                    | -1.40                     | -1.00                     | 1.25                      | 1.10                       | 1.00                       | 0.85                       | -0.27                     | -0.09                    | <    | 2.00             |
| 2       | OPECAP   | N                               | 165.65                   | 226.89                   | 119.81                   | 23.00                  | 82.50                    | 22.50                    |                           |                           |                           |                            |                            |                            | -1.00                     | -1.00                    | <    | 43.00            |
| 3       | MLAB 1   | Mandays                         | 35.90                    | 37.10                    | 6.10                     | 7.30                   | 12.70                    | 6.40                     | -1.00                     |                           |                           |                            |                            |                            |                           |                          | <    | 95.90            |
| 4       | MLAB 2   | Mandays                         | 13.90                    | 19.10                    | 16.90                    | 5.30                   | 15.00                    | 4.30                     |                           |                           | 1.00                      |                            |                            |                            |                           |                          | <    | 130.50           |
| 5       | MLAB 3   | Mandays                         | 9.30                     | 14.30                    | 7.70                     | 1.80                   | 7.40                     | 1.90                     |                           |                           |                           | 1.00                       |                            |                            |                           |                          | <    | 104.30           |
| 6       | FLAB 1   | Mandays                         | 24.20                    | 19.20                    | 12.30                    | 16.60                  | 14.80                    | 14.20                    |                           | -1.00                     |                           |                            |                            |                            |                           |                          | <    | 121.30           |
| 7       | FLAB 2   | Mandays                         | 48.00                    | 30.70                    | 29.10                    | 16.90                  | 31.30                    | 12.80                    |                           |                           |                           | 1.00                       |                            |                            |                           |                          | <    | 146.40           |
| 8       | FLAB 3   | Mandays                         | 39.50                    | 19.30                    | 14.70                    | 5.80                   | 15.70                    | 5.80                     |                           |                           |                           |                            | 1.00                       |                            |                           |                          | <    | 134.40           |
| 9       | MLABS 2  | Mandays                         |                          |                          |                          |                        |                          |                          |                           |                           | 1.00                      |                            |                            |                            |                           |                          | <    | 14.00            |
| 10      | MLABS 3  | Mandays                         |                          |                          |                          |                        |                          |                          |                           |                           |                           | 1.00                       |                            |                            |                           |                          | <    | 17.79            |
| 11      | FLABS 3  | Mandays                         |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            | 1.00                       |                            |                           |                          | <    | 43.00            |
| 12      | FLABS 3  | Mandays                         |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            | 1.00                       |                           |                          | <    | 26.80            |
| 13      | BORRIN   | N                               |                          |                          |                          |                        |                          |                          |                           |                           |                           |                            |                            |                            |                           | 1.00                     | <    | 24.72            |

<sup>1</sup> This RHS applies to sub-model C<sub>1</sub> only. For RHS for sub-models C<sub>2</sub> and C<sub>3</sub>, see Tables 4.5 and 4.6, respectively.



## CHAPTER V

### RESULTS OF THE LP MODELS

The purpose of this chapter is to analyze the results of the models presented in the last chapter in terms of the objectives of this research. Three models, A, B, and C representing traditional technology with funds limited to the farmer's own operating capital (without borrowing), traditional technology with borrowing introduced, and improved technology with borrowing, respectively, were formulated. Each model was divided into three submodels representing small, medium, and large farms as defined in the study. The submodels were solved by the MPSX (Mathematical Programming System Extended) routine with an IBM Computer after the appropriate slack and/or surplus variables had been introduced.

In analyzing the results, emphasis is placed on the optimal cropping patterns of the LP solutions as compared to traditional cropping patterns, levels of resource use along with the shadow prices of resources, changes in net farm incomes resulting from improved technology made possible through the use of credit, and the optimum credit needs of the farmers by farm size. Also, information is provided about the stability of the optimal solution relative to changes in the objective function values of column activities included in the optimal solution.



### A. LP OPTIMAL CROPPING PATTERN

Actual observation of the cropping pattern in Ika Clan revealed that each farmer tried to produce all crops with the result that output and the accompanying farm income, in general, were low. The cropping pattern suggested by the LP solutions did not seem to support this practice. Table 5.1 shows the cropping pattern suggested by the LP solution of this study. The solution suggested that the farmer would increase his income by specializing in the production of a few crops according to the production technique employed and the size of the farm. For example, a small farmer with only 2 acres of land would be better off if he used 1.01 acres to produce a combination of cassava and maize (CAMZ) and 0.99 acre for a combination of cassava, cocoyam, and maize (COCOMZ). In the same way, a small farmer in the same size group using traditional technology with borrowed funds to augment his operating capital would improve his income by specializing in two activities, CACOMZ (1.69 acres) and SOLCAS (0.31 acres). For a farmer in the small size group, who applied improved technique of cultivation and used borrowed funds, specialization in the MZCOFP (maize, cocoyam, and fluted pumpkin) activity would be the best alternative. The same interpretation follows for farms under the medium size group. However, the optimal cropping pattern for a farmer in the medium size group (who applied improved technology) was the combination of MZCOFP with SOLCAS rather than MZCOFP alone as in the small size group.

An interesting feature of this optimal cropping pattern occurred with the large size group. In all three models, the SOLCAS (Sole cassava) activity was the only one that entered the basis. However,



### 5.1 Optimal Cropping Pattern for Food Crop Farmers in Ika Clan.

| Model | Farm size       |              |                 |              |                 |              |
|-------|-----------------|--------------|-----------------|--------------|-----------------|--------------|
|       | Small           |              | Medium          |              | Large           |              |
|       | Crop activities | Area (acres) | Crop activities | Area (acres) | Crop activities | Area (acres) |
| A     | CAMZ            | 1.01         | CAMZ            | 3.93         | SOLCAS          | 18.66        |
|       | CACOMZ          | 0.99         | CACOMZ          | 1.07         |                 |              |
| B     | CACOMZ          | 1.69         | CACOMZ          | 2.00         | SOLCAS          | 20.17        |
|       | SOLCAS          | 0.31         | SOLCAS          | 3.00         |                 |              |
| C     | MZCOFP          | 2.00         | MZCOFP          | 2.90         | SOLCAS          | 16.71        |
|       |                 |              | SOLCAS          | 2.10         |                 |              |



optimum solution for each model occurred at different farm acreage-- 18.66 acres in Model A, 20.17 acres in Model B, and 16.70 acres in Model C. This pattern was in direct contrast to actual practice. It was stated earlier that, as the farmer becomes "wealthier," he tends to concentrate more on yam production because of the prestige usually attached to yam cultivation and consumption. Farmers themselves are aware of the high cost associated with yam production in the area of study due to staking, care, and storage requirements. But they also need to know that they would be better off by producing those crops in which they have comparative production advantage and only buying those in which they have comparative disadvantage in production. The opportunity costs associated with the foregone alternatives are given later in this chapter.

#### B. NET FARM INCOME

Net farm income in a linear programming model is defined as total gross margin (TGM) less all fixed costs. Since very little fixed cost is involved in traditional agriculture as seen above, we assume that total gross margin is equal to net farm income. Accordingly, Table 5.2 sets out the "net farm income" by farm size as given by the optimal solutions of the LP models. As set out in Table 5.2, it is easy to compare the net farm incomes of farms of similar size in the different models. For example, a farmer in the small size group in Model A, limited to his own funds for operating capital and using the existing traditional technology, had a lower net farm income than his counterpart in Model B who used the same traditional technology but



Table 5.2. Net Farm Income by Model and by Farm Size given by the Optimal Solutions of the LP Models (₱).

| Model | Net income |        |         |
|-------|------------|--------|---------|
|       | Small      | Medium | Large   |
| A     | 243.53     | 437.24 | 1159.30 |
| B     | 255.40     | 469.83 | 1447.24 |
| C     | 274.43     | 513.87 | 1350.92 |

Source: Computed from survey.



introduced borrowed funds into the system. This implies that personal funds for operating capital available to the farmer in the small size group were inadequate to execute an optimal plan even under traditional technology.

Net farm income in the small size group was highest in Model C in which both borrowed funds and improved technology were used. The difference in net farm income between Models A and C (N30.90) was a measure of the effect of improved technology made possible through the use of credit. The higher net farm income in Model C over Model B showed the superiority of improved technology over traditional practices even with the same level of operating capital used. Modern technology raised the efficiency of other resources, especially labor. Comparison of net farm incomes in the medium size farms showed similar results to those of the small size farms.

However, contrary to the results of the small and medium size farms and contrary to expectation, total net farm income of the large farm in Model B exceeded that of Model C in the optimal solution. This discrepancy may be explained in terms of the number of acres of land that was in the final solution. Model B utilized about 3.5 more acres of land than Model C (Table 5.3). However, per acre contribution of the SOLCAS activity which entered the final solution of both models was higher in Model C (N83.72) than in Model B (N71.04). Consequently, comparison of total net figures tends to underestimate the importance of improved technology. But part of the explanation seems to be found in higher input requirements associated with the introduction of improved technology. For example, the operating capital



Table 5.3. Components of the Optimal Solution in Models B and C (Large).

| Activity        | Model B |                |                       | Model C                |                |                       |
|-----------------|---------|----------------|-----------------------|------------------------|----------------|-----------------------|
|                 | Unit    | Activity level | Unit contribution (N) | Total contribution (N) | Activity level | Unit contribution (N) |
| SOLCAS          | Acres   | 20.17          | 71.04                 | 1433.13                | 16.71          | 83.72                 |
| HFLAB 1         | Mandays | 40.28          | -1.00                 | -40.28                 | 41.48          | -1.00                 |
| SMLAB 2         | Mandays | 14.00          | 1.25                  | 17.50                  | 14.00          | 1.25                  |
| SMLAB 3         | Mandays | 17.79          | 1.10                  | 19.57                  | 17.79          | 1.10                  |
| SFLAB 3         | Mandays | 26.80          | 0.85                  | 22.78                  | 26.80          | 0.85                  |
| PRCRED          | (N)     | 1.32           | 0.27                  | -0.36                  | 225.91         | -0.27                 |
| INCRED          | (N)     | 56.68          | -0.09                 | -5.10                  | 56.68          | -0.09                 |
| Net farm income |         |                |                       | N1447.24               |                | N1350.92              |

Source: Computed from survey.



requirement for the (SOLCAS) activity in Model C was 3 times that in Model B (Table 3.5, page 51). The total amount of operating capital available to the farmer in this farm size group was ₦93.30. He could augment his own funds with institutional credit up to ₦56.68 at 9% interest rate and with private credit at 27% rate of interest. In addition, modern technology required increased use of labor resources, particularly, female labor in Periods 1 and 2 (FLAB 1 and FLAB 2). Thus, as farm size increased FLAB 1 and FLAB 2 became limiting resources and restricted the scope of operation to 16.71 acres. It was noted that the same amounts of FLAB 1 and FLAB 2 needed to operate 20.17 acres of SOLCAS in Model B were required to operate 16.71 acres of the same activity in Model C. (See Tables 5.4 and 5.5)

From Model C solution, institutional credit (INCRED) entered the basis at an activity level of ₦56.68 while private credit (PRCRED) entered at ₦225.91 level. The objective function value entered for PRCRED in the problem was -₦0.27. The solution level for this activity, according to the "sensitivity of solutions with range" was stable between objective function value of -₦2.52 and -₦0.09 with lower and upper activity limits of ₦160.19 and ₦282.59, respectively. This implied that if the objective function value of PRCRED was reduced to -₦2.52, the use of PRCRED would fall to ₦160.19 and sale of female labor in Period 2 (SFLAB 2) would come into the solution. On the other hand, if the interest rate fell to 9% (or the objective function value of PRCRED was increased from -₦0.27 to -₦0.09), the activity level would be increased to ₦282.59.

From the above, analysis, the amount of funds needed to execute an optimal farm plan in Model C was ₦375.89 comprising ₦93.30 from



Table 5.4. Components of the Optimal Solution in Models B and<sup>O</sup>C (Small).

| Model B         |         |                |                       | Model C                |                 |         |                |                       |                        |
|-----------------|---------|----------------|-----------------------|------------------------|-----------------|---------|----------------|-----------------------|------------------------|
| Activity        | Unit    | Activity level | Unit contribution (N) | Total contribution (N) | Activity        | Unit    | Activity level | Unit contribution (N) | Total contribution (N) |
| CACOMZ          | ACRES   | 1.69           | 78.57                 | 132.45                 | MZCOFP          | ACRES   | 2.00           | 110.11                | 220.22                 |
| SOLCAS          | ACRES   | 0.31           | 71.04                 | 22.32                  | SMLAB 2         | MANDAYS | 14.00          | 1.25                  | 17.50                  |
| SMLAB 2         | MANDAYS | 14.00          | 1.25                  | 17.50                  | SMLAB 3         | MANDAYS | 17.79          | 1.10                  | 19.57                  |
| SMLAB 3         | MANDAYS | 17.79          | 1.10                  | 19.57                  | SFLAB 2         | MANDAYS | 43.00          | 1.00                  | 43.00                  |
| SFLAB 2         | MANDAYS | 43.00          | 1.00                  | 43.00                  | SFLAB 3         | N       | 26.80          | 0.85                  | 22.78                  |
| SFLAB 3         | MANDAYS | 26.80          | 0.85                  | 22.78                  | PRCRED          | N       | 171.90         | -0.27                 | -46.42                 |
| INCRED          | N       | 24.72          | -0.09                 | -2.22                  | INCRED          | N       | 24.72          | -0.09                 | -2.22                  |
| Net farm income |         |                |                       | 255.40                 | Net farm income |         |                |                       | 274.43                 |

Source: Computed from survey.



Table 5.5. Components of the Optimal Solution in Models B and C (Medium).

| Model B         |                |                       |                        | Model C         |                |                       |                        |
|-----------------|----------------|-----------------------|------------------------|-----------------|----------------|-----------------------|------------------------|
| Activity unit   | Activity level | Unit contribution (N) | Total contribution (N) | Activity unit   | Activity level | Unit contribution (N) | Total contribution (N) |
| CACOMZ ACRES    | 1.99619        | 78.57                 | 156.84                 | MZCOFP ACRES    | 2.92945        | 110.11                | 322.56                 |
| SOLCAS ACRES    | 3.00381        | 71.04                 | 213.49                 | SOLCAS ACRES    | 2.07055        | 83.72                 | 173.45                 |
| SMLAB 2 MANDAYS | 14.00          | 1.25                  | 17.50                  | SMLAB 2 MANDAYS | 14.00          | 1.25                  | 17.50                  |
| SMLAB 3 MANDAYS | 17.79          | 1.10                  | 19.57                  | SMLAB 3 MANDAYS | 17.79          | 1.10                  | 19.57                  |
| SFLAB 2 MANDAYS | 43.00          | 1.00                  | 43.00                  | SFLAB 2 MANDAYS | 43.00          | 1.00                  | 43.00                  |
| SFLAB 3 MANDAYS | 26.80          | 0.85                  | 22.78                  | SFLAB 3 MANDAYS | 26.80          | 0.85                  | 22.78                  |
| INCRED N        | 37.19          | -0.09                 | -3.35                  | PRCRED N        | 302.37         | -0.27                 | -81.64                 |
|                 |                |                       |                        | INCRED N        | 37.19          | -0.09                 | -3.35                  |
| Net farm income |                |                       | 469.83                 | Net farm income |                |                       | 513.87                 |

Source: Computed from survey.



"own" operating capital (OPECAP), ₦56.68 from institutional credit sources (INCRED) and ₦225.91 from private credit sources (PRCRED).

This was the amount required as operating capital to cultivate 16.70625 acres of SOLCAS at ₦22.50 per acre and explained the lower level of economic activity in Model C than in Model B. Therefore it would be reasonable to assume that higher input cost requirements also contributed to the lower net farm income for the large size farm in Model C than in Model B.

The result here should be interpreted with caution. On per acre basis, the net farm income from the large farm in Model C was higher than that in Model B. An examination of the components of the optimal solution in each of the models shows that the difference in net farm income between the two models was due to the high cost of improved technology which limited the size of operation in Model C more than in Model B (Table 5.3). From Table 5.3, there were no major differences in activity level and total contribution between Models B and C except in SOLCAS and PRCRED activities. The activity levels and total contribution of SOLCAS in the two models have already been defined above. Also, of some importance were the activity levels and total contributions of PRCRED in both models. The actual amount of PRCRED needed in Model C was over 171 times that needed in Model B and further explained the limitation on the level of operation in Model C.

It may be reemphasized that the net farm income in Model B was higher than that in A in all farm sizes. The implication for agricultural policy was that the amount of personal funds available to



farmers in the area was inadequate for executing an optimal farm plan under existing technology in any of the size groups. Additional funds were needed to supplement the farmer's operating capital if efficiency of other sources was to be raised. Thus, credit was economically beneficial within the range of existing interest rate even under traditional technology.

Finally, the net farm income from the LP solutions of the models widely diverged from what farmers reported. Although information on this subject was scarce, actual figures ranged from ₦19.17 to ₦46.09 per acre across the board after accounting for household needs. But in the LP solution, these extreme figures were much higher, ranging from ₦62.13 in the large size farm of Model A to ₦137.22 in the small farm of Model C. This was a result of including nonoptimal activities in the enterprise combinations of the actual situations. As already noted, many farmers in the study area usually attempt to be self-sufficient in the production of all crops. To them, "family needs satisfaction" rather than profit maximization appears to be the major objective and to influence the types and number of crops included in the activities. While this objective is rational, it undermines the principle and advantages of specialization and reduces efficiency with which resources are employed. In particular, specialization and exchange can expand the limits of choice available to farmers and help them and the society to achieve production and consumption combinations that would otherwise be impossible. Specialization results in shifting each input to the production of crops in which it has the highest marginal value productivity. Under the assumption that the LP models



employed in this study have been able to capture the major features of agriculture in Ika Clan, the superiority of the LP results over actual situations signaled the need for farm plans if net farm income is to be maximized after household needs are met.

### C. LEVELS OF RESOURCE USE

Differences in technology of production with the accompanying differences in technical coefficients influence the level of resource use. Table 5.6 gives information on the amount of resources available for the small size representative farm in each model and compares the amounts and percentages of unused resources in the three models. Tables 5.7 and 5.8 convey similar information for the medium and large farms, respectively, in all the models.

According to Table 5.6, only 2 acres of land were available in each of the models and all were in the basis in the optimal solution. The same was true of operating capital. Thus, land and operating capital were limiting resources in each of the models. There was no excess capacity in either case. On the other hand, there were large amounts of unused male labor in all the models and in all 3 periods. For example, Male Labor 1 (MLAB 1) has surpluses of over 80% in each of the models in the small size group. In the same way, there were large amounts of unused female labor in all 3 periods in each model. Labor resources for sale (male and female) and institutional borrowing were fully utilized in this size group in all the models.

The information in Table 5.7 followed the same pattern as that in Table 5.6. But in the case of medium farm group depicted by



Table 5.6. Comparison of Resources Available and Unused by Models in the Small Size Group.

| 1        | 2       | 3                            |        |        | 4                         |       |       | 5                             |      |      |
|----------|---------|------------------------------|--------|--------|---------------------------|-------|-------|-------------------------------|------|------|
|          |         | Amount available<br>in model |        |        | Amount unused in<br>model |       |       | Percentage unused<br>in model |      |      |
| Resource | Unit    | A                            | B      | C      | A                         | B     | C     | A                             | B    | C    |
| LAND     | Acres   | 2.00                         | 2.00   | 2.00   | 0                         | 0     | 0     | 0                             | 0    | 0    |
| OPECAP   | N       | 39.00                        | 39.00  | 43.00  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| MLAB 1   | Mandays | 95.90                        | 95.90  | 95.90  | 80.45                     | 77.48 | 83.70 | 83.9                          | 80.8 | 87.3 |
| MLAB 2   | Mandays | 130.50                       | 130.50 | 130.50 | 96.26                     | 90.52 | 82.70 | 73.8                          | 69.4 | 63.4 |
| MLAB 3   | Mandays | 104.30                       | 104.30 | 104.30 | 77.30                     | 73.70 | 71.11 | 74.1                          | 70.7 | 68.2 |
| FLAB 1   | Mandays | 121.30                       | 121.30 | 121.30 | 95.70                     | 96.89 | 96.70 | 78.4                          | 79.9 | 79.7 |
| FLAB 2   | Mandays | 146.40                       | 146.40 | 146.40 | 61.09                     | 50.34 | 45.20 | 41.7                          | 34.4 | 30.9 |
| FLAB 3   | Mandays | 134.40                       | 134.40 | 134.40 | 88.54                     | 81.57 | 78.20 | 65.9                          | 60.7 | 58.2 |
| MLABS 2  | Mandays | 14.00                        | 14.00  | 14.00  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| MLABS 3  | Mandays | 17.79                        | 17.79  | 17.79  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| FLABS 2  | Mandays | 43.10                        | 43.10  | 43.10  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| FLABS 3  | Mandays | 26.80                        | 26.80  | 0      | 0                         | 0     | 0     | 0                             | 0    | 0    |
| BORRIN   | N       | --                           | 24.72  | 24.72  | --                        | 0     | 0     | --                            | 0    | 0    |

Source: Computed from survey.



Table 5.7. Comparison of Resources Available and Unused by Models in the Medium Size Group.

| 1        | 2       | 3                            |        |        | 4                         |       |       | 5                             |      |      |
|----------|---------|------------------------------|--------|--------|---------------------------|-------|-------|-------------------------------|------|------|
|          |         | Amount available<br>in model |        |        | Amount unused in<br>model |       |       | Percentage unused<br>in model |      |      |
| Resource | Unit    | A                            | B      | C      | A                         | B     | C     | A                             | B    | C    |
| LAND     | Acres   | 5.00                         | 5.00   | 5.00   | 0                         | 0     | 0     | 0                             | 0    | 0    |
| OPECAP   | N       | 58.00                        | 58.00  | 58.00  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| MLAB 1   | Mandays | 99.46                        | 99.46  | 99.46  | 66.27                     | 67.38 | 68.34 | 66.6                          | 67.7 | 68.7 |
| MLAB 2   | Mandays | 132.53                       | 132.53 | 132.53 | 83.50                     | 77.77 | 60.11 | 63.0                          | 58.7 | 45.4 |
| MLAB 3   | Mandays | 98.74                        | 98.74  | 98.74  | 66.68                     | 61.57 | 54.46 | 67.5                          | 62.3 | 55.2 |
| FLAB 1   | Mandays | 129.90                       | 129.90 | 129.90 | 61.26                     | 70.20 | 64.67 | 47.2                          | 54.0 | 49.8 |
| FLAB 2   | Mandays | 154.85                       | 154.85 | 154.85 | 25.43                     | 21.02 | 0     | 16.4                          | 13.5 | 0    |
| FLAB 3   | Mandays | 118.27                       | 118.27 | 118.27 | 58.12                     | 48.81 | 36.40 | 49.1                          | 41.3 | 30.8 |
| MLABS 2  | Mandays | 14.00                        | 14.00  | 14.00  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| MLABS 3  | Mandays | 17.79                        | 17.79  | 17.79  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| FLABS 2  | Mandays | 43.10                        | 43.10  | 43.10  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| FLABS 3  | Mandays | 26.80                        | 26.80  | 26.80  | 0                         | 0     | 0     | 0                             | 0    | 0    |
| BORRIN   | N       | --                           | 37.19  | 37.19  | --                        | 0     | 0     | --                            | 0    | 0    |

Source: Computed from survey.



Table 5.8. Comparison of Resources Available and Unused by Models in the Large Size Group.

| 1        | 2       | 3                            |                   |                   | 4                         |        |        | 5                             |         |         |
|----------|---------|------------------------------|-------------------|-------------------|---------------------------|--------|--------|-------------------------------|---------|---------|
|          |         | Amount available<br>in model |                   |                   | Amount unused in<br>model |        |        | Percentage unused<br>in model |         |         |
| Resource | Unit    | A                            | B                 | C                 | A                         | B      | C      | A                             | B       | C       |
| LAND     | Acres   | 5.00 <sup>+</sup>            | 5.00 <sup>+</sup> | 5.00 <sup>+</sup> | 13.66*                    | 15.17* | 11.71* | 273.2**                       | 303.4** | 234.2** |
| OPECAP   | N       | 93.30                        | 93.30             | 93.30             | 0                         | 0      | 0      | 0                             | 0       | 0       |
| MLAB 1   | Mandays | 132.45                       | 132.45            | 132.45            | 65.27                     | 53.77  | 25.53  | 49.3                          | 40.6    | 19.3    |
| MLAB 2   | Mandays | 173.10                       | 173.10            | 173.10            | 99.38                     | 82.44  | 87.26  | 57.4                          | 46.6    | 50.4    |
| MLAB 3   | Mandays | 140.45                       | 140.45            | 140.45            | 94.67                     | 90.38  | 90.92  | 67.4                          | 64.4    | 64.7    |
| FLAB 1   | Mandays | 195.75                       | 195.75            | 195.75            | 0                         | 0      | 0      | 0                             | 0       | 0       |
| FLAB 2   | Mandays | 213.84                       | 213.84            | 213.84            | 0                         | 0      | 0      | 0                             | 0       | 0       |
| FLAB 3   | Mandays | 168.21                       | 168.21            | 168.21            | 57.44                     | 50.63  | 44.51  | 34.1                          | 30.1    | 26.5    |
| MLABS 2  | Mandays | 14.00                        | 14.00             | 14.00             | 0                         | 0      | 0      | 0                             | 0       | 0       |
| MLABS 3  | Mandays | 17.79                        | 17.79             | 17.79             | 0                         | 0      | 0      | 0                             | 0       | 0       |
| FLABS 2  | Mandays | 43.10                        | 43.10             | 42.10             | 23.32                     | 43.10  | 43.10  | 54.1                          | 100.00  | 100.00  |
| FLABS 3  | Mandays | 26.80                        | 26.80             | 26.80             | 0                         | 0      | 0      | 0                             | 0       | 0       |
| BORRIN   | N       | --                           | 56.68             | 56.68             | --                        | 0      | 0      | --                            | 0       | 0       |

<sup>+</sup> Minimum level at which resource is allowed.

\*Amount used in excess of minimum allowed.

\*\*Percentage of excess over minimum allowed.



Table 5.7, Model C had, in general, higher percentages of labor utilization than A and B. For female labor in Period 2 (FLAB 3) in Model C, excess capacity was zero. Also, for the medium size representative farms, the percentages of unused female labor in all periods were much lower than those of unused male labor. FLAB 2, in particular, was much more highly utilized than others because this period included the peak of the weeding season, cocoyam planting and maize harvesting.

The minimum area of land allowed in the large size group was 5 acres (Table 5.8). The idea was to determine the maximum amount of land that could be efficiently combined with other available resources to maximize net farm income. In the area of study, few farmers often own and operate farm plots that are larger than the average. Eleven such farms were observed in the sample. Land was no more a limiting resource for farms in this size group. Rather, operating capital constituted the main limiting resource with zero unused capacity in each model. Male labor in each period in the three models still had excess capacities. Female labor was fully utilized in Periods 1 and 2. Because of this, sale of female labor in Period 2 (SFLAB 2) in Models B and C could not be met at all; but it could be met, in part, in Model A.

The LP solutions in the large size group indicated the extent to which farm size in each model could be economically expanded within the limits imposed by the availability of other resources. For example, land in Model A could expand up to 18.66 acres before any change could occur in the value of the objective function. The optimal level of land use in Model B was 20.17 acres. Thus, even in the traditional models, large farms yielded higher net farm incomes than small and



medium farms. The LP solution indicates that if farm size could be expanded beyond the limits defined in this study for small and medium size farms, net farm incomes would improve within the range given by the model.

On the whole, and particularly on the small and medium representative farms, there was significant under-utilization of the available supply of agricultural labor. The larger the scale of operation, the less significant this under-utilization became. This suggests that if the scale of operation could be increased, greater efficiency in labor use could be attained and net income per farm unit would increase. It will be recalled that land is a limiting resource because of the "artificial scarcity" imposed by the shifting cultivation technique. Only a small proportion of the total land holdings of each farmer is cultivated each year. The use of improved techniques of cultivation would induce expansion in the scope of operation, particularly, for the small and medium size groups. The net farm income given by the LP solution for large farms in each model is about 5 times that of the small farms and over 2 1/2 times that of the medium farms with higher levels of resource use. But since land is limited by the traditional technology used, expansion of farm size will be facilitated by application of improved technology made possible by borrowing. Moving farmers from the small size group in Model A to the large size group in Model C would require larger amounts of all resources, including land and capital. Despite the high cost of borrowed funds, this movement would be a great advantage to both the farmer and the society. The society would benefit in terms of higher levels of employment and



higher output and farmers would benefit in terms of higher net farm incomes. It should be emphasized that the potential for increasing farm size and raising the net farm income per farm family lies only with improved technology. Technology that relies solely on nature for soil regeneration lacks this potential since it relies on rotation of land rather than of crops.

#### D. SHADOW PRICES OF RESOURCES

A resource is said to have a shadow price if it is so limited in amount that it restricts the ability of the planner to accept some projects and a choice has to be made between alternative ones (60:17). Thus, a shadow price or marginal value product in a linear programming model is associated with each constraint in the model. The shadow price is the price of the constraint and shows by how much the value of the objective function would be raised if one more unit of the scarce resource was made available or by how much it would be decreased if one unit of the resource was removed.

Shadow prices are useful in that they guide the planner in determining what resources need to be expanded to increase income. They are a measure of the productivity of scarce resources. Tables 5.9 and 5.10 give the shadow prices of the resources by models and by farm sizes.

The shadow price of land in Model A for the small and medium size groups was ₦61.75. This meant that if an additional acre of land was made available to the small or medium size group, the value of the objective function would be increased by that amount. Since land



Table 5.9 Shadow Prices of LAND, OPECAP and BORRIN by Models and Farm Sizes.

| Resource                               | Model | Small             | Medium            | Large             |
|----------------------------------------|-------|-------------------|-------------------|-------------------|
| LAND                                   | A     | 61.75             | 61.75             | 0                 |
|                                        | B     | 69.09             | 69.09             | 0                 |
|                                        | C     | 77.76             | 77.55             | 0                 |
| OPECAP<br>(operating<br>capital)       | A     | 0.44              | 0.44              | 7.39              |
|                                        | B     | 0.26              | 0.26              | 0.27              |
|                                        | C     | 0.27              | 0.27              | 0.27              |
| BORRIN<br>(institutional<br>borrowing) | A     | NONE <sup>1</sup> | NONE <sup>1</sup> | NONE <sup>1</sup> |
|                                        | B     | 0.18              | 0.17              | 0.18              |
|                                        | C     | 0.18              | 0.18              | 0.18              |

<sup>1</sup>"NONE" means that this constraint was not used in the model.



Table 5.10. Shadow Prices for Labor Constraints by Models and Farm Size.

| Labor category | Model A |        |       | Model B |        |       | Model C |        |       |
|----------------|---------|--------|-------|---------|--------|-------|---------|--------|-------|
|                | Small   | Medium | Large | Small   | Medium | Large | Small   | Medium | Large |
| MLAB 1         | 0       | 0      | 0     | 0       | 0      | 0     | 0       | 0      | 0     |
| MLAB 2         | 0       | 0      | 0     | 0       | 0      | 0     | 0       | 0      | 0     |
| MLAB 3         | 0       | 0      | 0     | 0       | 0      | 0     | 0       | 0      | 0     |
| FLAB 1         | 0       | 0      | 1.00  | 0       | 0      | 1.00  | 0       | 0      | 1.00  |
| FLAB 2         | 0       | 0      | 1.00  | 0       | 0      | 5.41  | 0       | .01    | 4.96  |
| FLAB 3         | 0       | 0      | 0     | 0       | 0      | 0     | 0       | 0      | 0     |
| MLABS 2        | 1.25    | 1.25   | 1.25  | 1.25    | 1.25   | 1.25  | 1.25    | 1.25   | 1.25  |
| MLABS 3        | 1.10    | 1.10   | 1.10  | 1.10    | 1.10   | 1.10  | 1.10    | 1.10   | 1.10  |
| FLABS 2        | 1.00    | 1.00   | 0     | 1.00    | 1.00   | 0     | 1.00    | 1.00   | 0     |
| FLABS 3        | 0.85    | 0.85   | 0.85  | 0.85    | 0.85   | 0.85  | 0.85    | 0.85   | 0.85  |

Source: Computed from survey.



in the large size group was not a limiting resource, its marginal value product was zero. The marginal value product of land for Model B (small and medium) was ₦69.06 and zero for the large farm. Model C had marginal value products of ₦77.76 and ₦77.55 for the small and medium farms, respectively. In other words land productivity was highest with Model C in which improved technology was introduced.

The marginal value product of operating capital was highest in Model A where operating capital was limited to the farmer's own funds. This value ranged from ₦0.44 in the small and medium farms to ₦7.39 in the large farm of Model A and implied that net farm income of the relevant submodel would increase by that value if an additional unit of operating capital was made available. The high marginal value product of operating capital reflected the magnitude of the scarcity of this resource. When this value is compared with the marginal factor cost of operating capital (the rate of interest at which operating capital can be borrowed), then one can appreciate the need for borrowed funds to execute an optimal farm plan. Expansion of the use of operating capital in this model would be consistent with economic theory since marginal value product far exceeded the going rate of interest on private credit (₦0.27).

The marginal value product of operating capital for the small and medium farms in Model B (₦0.26) was less than the marginal factor cost of capital from private sources (₦0.27). This implied that while capital was still a limiting resource, it would be unprofitable to use borrowed funds from private sources since cost would exceed return. Consequently, private credit (PRCRED) did not enter the basis in any of



these submodels. However, if the cost of borrowed funds was less than ₦0.26, it would be desirable to borrow since the use of such funds would add more to total revenue than to total cost. Marginal value product in the large farm of Model B and in all farm sizes in Model C was equal to the marginal factor cost of borrowed funds from private sources and explains why PRCRED was in the basis in each of these cases. The same interpretation of marginal value product of capital holds for borrowed funds from institutional sources (BORRIN) in Table 5.9. But it should be noted that in the two models in which credit was used, the marginal value product exceeded the institutional rate of interest--the marginal factor cost (₦0.09). This implied that, other things being equal, institutional credit was still a limiting resource. The provision of an additional Naira (₦) of credit would raise the value of the program by an amount equal to the marginal value product of capital.

The marginal value products of the different categories of labor are given in Table 5.10. The marginal value product of a resource with positive slack activity (or unused resources) is zero. It was seen in Table 5.8, page 120, that there were large amounts of unused labor. Consequently, male labor in all 3 periods had zero shadow prices in all the models and submodels. FLAB 1 in the large farm of all the models had a shadow price equal to the wage rate for female labor in Period 1 (₦1.00). FLAB 2 was highly limiting in the large farms of Models B and C with shadow prices of ₦5.41 and ₦4.96, respectively. MLABS 2, MLABS 3, FLABS 2, and FLABS 3 had shadow prices equal to their respective wages. It is to be noted that where the



shadow price is higher than the wage rate of labor as in the large farms of Models B and C, it would be profitable to hire additional units of labor because each additional unit would add the indicated amount to the value of the program within the given range.

#### E. OPTIMUM CREDIT NEEDS

The LP solution in each of the models and submodels showed that operating capital was a limiting resource as illustrated by the positive shadow price of capital at each level of operation. It also revealed that the farmer, at each level of operation could increase his income by obtaining loans to augment his operating capital. The shadow prices of borrowed funds for all size groups in Models B and C were positive, reflecting the scarcity of the resource. For example, in the small and medium farms of Model B, the shadow price was ₦0.17 and in the large farm, it had the same value (₦0.18) as it had at all levels in Model C. These values defined the amounts by which the farmers' incomes would rise if an additional Naira of credit were made available. The question then arises as to how much credit the farmer would need at different interest rates in order to execute an optimal farm plan. Table 5.11 contains information on the optimum credit needs of the farmers by model and by farm size.

The actual credit used in the representative farms has been divided into institutional and private credit in Table 5.11. These two sources of credit were different in terms of cost (interest rate) and availability. Private credit was relatively easy to obtain but at a high interest rate of 27%. Institutional credit was more



TABLE 5.11. Optimum Credit Needs and Actual Credit Used in Models B and C by Credit Sources and by Farm Sizes (N).

| Model and farm size | Optimum credit need (upper activity) | Actual credit used in plan |               | Upper limit of interest rate (%) | Optimum credit need satisfied? |
|---------------------|--------------------------------------|----------------------------|---------------|----------------------------------|--------------------------------|
|                     |                                      | Private                    | Institutional |                                  |                                |
| B--small            | 33.80                                | 0                          | 24.72         | 26                               | no                             |
| B--medium           | 69.34                                | 0                          | 37.19         | 26                               | no                             |
| B--large            | 58.00                                | 1.32                       | 56.68         | 27                               | yes                            |
| C--small            | 196.62                               | 171.90                     | 24.72         | 27                               | yes                            |
| C--medium           | 339.58                               | 302.37                     | 37.19         | 27                               | yes                            |
| C--large            | 282.59                               | 225.91                     | 56.68         | 27                               | yes                            |

Source: Computed from survey.



difficult to obtain and constituted a constraint as already defined. At a 9% interest rate, it was more profitable than private credit. Consequently, in the small and medium farms of Model B, only institutional credit entered the basis at limit level. Private credit was excluded from the basis. Forcing in a unit of private credit would reduce the value of the objective function by ₦0.01. Stability limits given by sensitivity analysis of the LP solution showed that private credit would enter the basis without changing its solution only if private rate of interest fell to 26% (Appendix E). This was why the total credit used in the basis diverged from the optimum amount desirable (₦33.80). At the existing level of institutional funds available, credit (and therefore, operating capital) was still a limiting resource in the small and medium farms of Model B. In both cases, the actual credit used in the LP solution was less than the optimum credit need. Actual credit used was limited to that from institutional sources because the cost of private credit was higher than the expected rate of return from its use. Forcing any unit of private credit into the basis would reduce the value of the program by ₦0.01. The solution of the LP problem in Model B for the small and medium farms was optimal within the range of interest rate from infinity to 26%. Beyond this range, other inputs would become limiting resources and a new optimal solution would emerge. At the new optimal point, the shadow prices of resources would change.

In the large farm in Model B, total credit used and the optimum credit needed were equal at ₦58.00 level. The total credit that entered the basis was obtained from both institutional and private



sources. The same was true of all farms in Model C. The large farm in Model B utilized only ₦1.32 of private credit and ₦56.68 of institutional credit. Together, they constituted the "Upper Activity" of borrowed funds. Beyond this level, other resources would become limiting.

It may be added, that the actual level of credit that entered the basis in each model and the optimum credit needs of the model at the particular farm size depended on the type and level of activity (activities) that entered the optimal solution. Such was the reason for a higher level of credit in the medium than in the large farm of Model C. Also, total credit used by model and farm size plus the operating capital available for the relevant model and farm size equaled the total operating capital requirements of the activities that entered the relevant basis (Table 5.12). In the small farm of Model B, for example, total credit used (₦24.72) plus "own" capital available (₦39.00) equaled total operating capital (₦63.72). In the same farm and model, two activities, CACOMZ and SOLCAS, entered the basis at 1.69 acres and 0.31 acre levels, respectively. The sum of operating capital requirements for cultivating 1.69 acres of CACOMZ at ₦36.40/acre (₦61.36) and 0.31 acre of SOLCAS at ₦7.50/acre (₦2.36) equaled the total operating capital required in the final solution (₦63.72).

To execute an optimum farm plan, it is important to ascertain the exact credit needs of the farmer. This depends on the stability limits given by the LP solution in accordance with the range within which the rate of interest must remain. In the small farm of Model C,



Table 5.12. Comparison of Operating Capital Used with Operating Capital Required by Activities in the Final Solution.

| Model &<br>farm size | Amount of<br>credit | "Own"<br>operating<br>capital | Total<br>operating<br>capital<br>used | Activity &<br>activity<br>level in<br>acres | Operating<br>capital<br>required<br>by activity<br>per acre | Total<br>operating<br>capital<br>required |
|----------------------|---------------------|-------------------------------|---------------------------------------|---------------------------------------------|-------------------------------------------------------------|-------------------------------------------|
| A--small             | --                  | 39.00                         | 39.00                                 | CAMZ 1.01408<br>CACOMZ 0.98592              | 5.50<br>33.90                                               | (5.58)<br>(33.42)                         |
| A--medium            | --                  | 58.00                         | 58.00                                 | CAMZ 3.92606<br>CACOMZ 1.07394              | 5.50<br>33.90                                               | (21.59)<br>(36.41)                        |
| A--large             | --                  | 93.30                         | 93.30                                 | SOLCAS 18.66000                             | 5.00                                                        | 93.30                                     |
| B--small             | 24.72               | 39.00                         | 63.72                                 | CACOMZ 1.6851<br>SOLCAS 0.31419             | 36.40<br>7.50                                               | (61.36)<br>(2.36)                         |
| B--medium            | 37.19               | 58.00                         | 95.19                                 | CACOMZ 1.99619<br>SOLCAS 3.00381            | 36.40<br>7.50                                               | (72.66)<br>(22.53)                        |
| B--large             | 58.00               | 93.30                         | 151.30                                | SOLCAS 20.17358                             | 7.50                                                        | 151.30                                    |
| C--small             | 196.62              | 43.00                         | 239.62                                | MZCOFP 2.0000                               | 119.81                                                      | 239.62                                    |
| C--medium            | 339.56              | 58.00                         | 397.56                                | MZCOFP 2.92945<br>SOLCAS 2.07055            | 119.81<br>22.50                                             | (350.98)<br>(46.58)                       |
| C--large             | 282.59              | 93.30                         | 375.89                                | SOLCAS 16.70625                             | 22.50                                                       | 375.89                                    |



for example, the optimum credit need from private sources given by the LP solution was ₦171.90. This solution level for PRCRED was stable between an objective function level of -₦0.27120 and -₦0.21204. This meant that, if the interest rate rose from .27 (by .0012) to .2712, PRCRED activity would, for practical purposes, be reduced to zero and SOLCAS, with lower operating capital requirement, would come into the basis. On the other hand, if the rate of interest on private loan was reduced by .05796 to .21204, PRCRED activity level would increase to ₦263.58 level and Yam Group 1 (YAMG 1) would enter the basis (Appendix E). An understanding of these stability limits is important in farm planning if undersupply or oversupply of credit for operating capital is to be avoided.

#### F. ACTIVITIES EXCLUDED FROM OPTIMAL SOLUTION

It was stated earlier in this chapter that farmers in the study area attempted to produce all crops, perhaps for security and/or subsistence reasons. But a large number of the cropping activities have been omitted in the final solution of each LP model. An attempt to force any of them into the basis would result in a reduction in the value of the objective function. Table 5.13 lists the nonbasic variables in each model according to farm sizes along with the cost of forcing each of them into the solution. The reduction in the value of the program that would occur as a result of forcing a nonbasic activity into the solution will be termed an "opportunity cost" and defined as the value sacrificed by choosing a nonoptimal course of action.



Table 5.13. Nonbasic Variables and their Opportunity Costs by Models and Farm Sizes.

| Model | Small             |                      |  | Medium            |                      |  | Large             |                      |  |
|-------|-------------------|----------------------|--|-------------------|----------------------|--|-------------------|----------------------|--|
|       | Nonbasic variable | Opportunity cost (₦) |  | Nonbasic variable | Opportunity cost (₦) |  | Nonbasic variable | Opportunity cost (₦) |  |
| A     | YAMG 1            | 21.48                |  | YAMG 1            | 21.48                |  | YAMG 1            | 656.37               |  |
|       | YAMG 2            | 63.69                |  | YAMG 2            | 63.69                |  | YAMG 2            | 912.11               |  |
|       | MZCOFF            | 13.31                |  | MZCOFF            | 13.31                |  | MZCOFF            | 353.49               |  |
|       | SOLCAS            | 4.68                 |  | SOLCAS            | 4.68                 |  | CAMZ              | 5.00                 |  |
|       | HMLAB 1           | 1.40                 |  | HMLAB 1           | 1.40                 |  | CACOMZ            | 214.07               |  |
|       | HFLAB 1           | 1.00                 |  | HFLAB 1           | 1.00                 |  | HMLAB             | 1.40                 |  |
| B     | YAMG 1            | 11.83                |  | YAMG 1            | 11.83                |  | HAMG 1            | 211.59               |  |
|       | YAMG 2            | 55.03                |  | YAMG 2            | 55.03                |  | YAMG 2            | 159.74               |  |
|       | MZCOFF            | 17.70                |  | MZCOFF            | 17.70                |  | MZCOFF            | 106.53               |  |
|       | CAMZ              | 2.99                 |  | CAMZ              | 2.99                 |  | CAMZ              | 28.65                |  |
|       | HMLAB 1           | 1.40                 |  | HMLAB 1           | 1.40                 |  | CACOMZ            | 103.07               |  |
|       | HFLAB 1           | 1.00                 |  | HFLAB 1           | 1.00                 |  | HMLAB 1           | 1.40                 |  |
|       | PRCRED            | 0.01                 |  | PRCRED            | 0.01                 |  | SFLAB 2           | 4.41                 |  |
|       |                   |                      |  |                   |                      |  |                   |                      |  |
| C     | YAMG 1            | 2.66                 |  | YAMG 1            | 2.79                 |  | YAMG 1            | 187.01               |  |
|       | YAMG 2            | 36.80                |  | YAMG 2            | 36.79                |  | YAMG 2            | 130.41               |  |
|       | CAMZ              | 13.83                |  | CAMZ              | 13.74                |  | MZCOFF            | 78.78                |  |
|       | CACOMZ            | 1.40                 |  | CACOMZ            | 1.41                 |  | CAMZ              | 36.44                |  |
|       | SOLCAS            | 0.12                 |  | HMLAB 1           | 1.40                 |  | CACOMZ            | 93.58                |  |
|       | HMLAB 1           | 1.40                 |  | HFLAB 1           | 1.00                 |  | HMLAB 1           | 1.40                 |  |
|       | HFLAB 1           | 1.00                 |  |                   |                      |  | SFLAB 2           | 3.96                 |  |
|       |                   |                      |  |                   |                      |  |                   |                      |  |

Source: Computed from survey.



In the small size group of Model A, six variables were nonbasic and were excluded from the LP solution. YAMG 1, for example, was excluded because it had a "reduced cost" of ₦21.48. This value may be interpreted as the amount by which the value of the program would decline if 1 acre of YAMG 1 activity was forced into the solution. The optimal value of the program was ₦243.53. If YAMG 1 was forced into the solution, the value of the program would fall to ₦222.05. Alternatively, the value may be interpreted as the amount of increase required in the objective function coefficient of YAMG 1 in order to bring the activity into the optimal solution. The objective function coefficient of YAMG 1 was ₦80.12. In order to bring this activity into the basis, the coefficient must rise by ₦21.48 to ₦101.60. In other words, if the income from YAMG 1 rises above ₦101.60, the activity will become competitive and enter the basis. But before the ₦101.60 value, the basis will be unchanged and the optimal value of the objective function will remain ₦243.53. All the other nonbasic variables and their associated costs are interpreted in the same way.

It should be observed that hire of male labor did not enter the basis in any of the models and submodels. Also, the cost associated with hired labor was equal to the wage rate during the relevant period. Nonentry into the basis did not, in fact, mean that labor was not hired. As was seen earlier, hire of specialized labor for specialized farm activities is at times imperative. However, this has been accounted for under operating cost and therefore still makes the solution of the model valid. But the message conveyed here is that each



manday of HMLAB 1 reduced the value of the program by ₦1.40 since this activity was nonbasic in all the models and submodels. In the same way, each manday of HFLAB 1 in the small and medium farms of all the models reduced the value of the program by ₦1.00.

Sale of female labor in Period 2 (SFLAB 2) was nonbasic in the large farms of Models B and C. This was so because at the optimal solution, female labor in Period 2 (FLAB 2) had become a limiting resource. Disposing of any unit of it or forcing SFLAB 2 into the basis would reduce the value of the program in both models.

#### G. SUMMARY OF IMPLICATIONS OF THE RESULTS

The major implications of the results of this study may be summarized as follows:

1. Land and capital are the most limiting resources in the Cross River State agricultural system.
2. Operating capital from the farmer's own savings is inadequate for efficient operation of an optimal plan. Therefore, the farmer must borrow to supplement his savings in order to raise the efficiency of other resources with which operating capital must be combined.
3. The use of borrowed funds can facilitate the adoption of improved technology which is impossible with the limited farm savings. With improved technology, the length of the fallow period due to the shifting cultivation technique can be reduced as more land is brought into cultivation each year. Thus, borrowing can induce technological change and reduce the limitation on land.



4. There is a high degree of under-utilization of male labor throughout the farming system of the state. Some of this labor can be transferred to other sectors of the economy without reducing agricultural output. On the other hand, female labor in Periods 1 and 2 are limiting resources. Hiring female labor during these periods would raise farm income.

5. Farmers in the state have comparative advantage in the production of some crops and comparative disadvantage in the production of others. Attempting to produce all crops reduces net farm income. Therefore, all things equal, farmers should specialize in producing those goods in which they have comparative advantage in production. Specialization will rise farm (and total) output and will raise net farm income.

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## CHAPTER VI

### DESIRABLE FEATURES OF AN AGRICULTURAL CREDIT PROGRAM FOR THE CROSS RIVER STATE OF NIGERIA

In Chapter II, two opposing views about the capacity of an agricultural credit to facilitate the adoption of improved farming techniques in developing economies were presented. There was the proposition that production credit to farmers in these economies can accelerate the adoption of innovation and, therefore, increase output and farm income. But opponents of this proposition saw no economic opportunities for the traditional farmers. Some of them argued that providing credit for small farm operation was neither profitable nor desirable. The findings of this study have lent support to the theory that credit is needed for efficient farm operation in all the farm size groups. They have also revealed that the amount of operating capital available to the farmers from personal sources is inadequate to enable them to adopt improved technology. Thus, farm operating capital is a limiting factor in the Cross River State agriculture and inhibits even small and inexpensive improvements. Credit is therefore needed to supplement personal funds but institutional credit facilities, when available, are limited to export crop production. Private lenders and local credit institutions are the major sources of credit accessible to the small food crop farmers. The rate of interest charged by private lenders is relatively high and the amount of credit available from local credit sources is limited. Under these conditions, the capacity of the small farmer to adopt innovation is minimal.



## A. PREVIOUS AGRICULTURAL CREDIT PROGRAMS IN NIGERIA

Between 1936 and 1978, a number of agricultural credit programs were established by the Federal and Regional (state) governments of Nigeria (67:34-37; 26:20-22) to meet the needs of small farmers. Among these programs were the Fund for Agricultural and Industrial Development (FAID), the Western Nigeria Agricultural Credit Corporation (WNACC), the Mid-Western Nigeria Agricultural Credit Corporation (MNACC), and the credit program of Northern Nigeria in various forms like the Northern Nigeria Development Corporation (NNDC) loans to Native Authorities, "mixed farming" loans to individuals, and fertilizer loans at highly subsidized prices (67:34-47). The major Federal agricultural credit programs during the 1963-78 period were the Nigerian Agricultural Credit Bank (NAB) scheme and the Agricultural Credit Guarantee Scheme Fund (ACGSF) established in 1977 (26:20-22). Table 6.1 outlines the main features of these previous and current credit programs. The third and fourth columns of Table 6.1 show the type and level of control of the programs and the requirements for making loans, respectively. Because of their nature and structure, these programs did not seem to reach their intended clientele--the small farmers, especially food crop farmers. Rather, they were directed toward the export crop farmers. This was because administration and control of each of the programs was concentrated at the ministerial level while recommendations for loans and loans approval were left with high government officials. Consequently, small farmers, particularly food crop farmers, had limited access to the sources of



credit. It was from this experience that Ugoh (126:1-12) suggested devising credit policies that would mesh with existing local circumstances.

Since the need for credit to the Cross River State farmers has been established, and following Ugoh's suggestion, it seems reasonable to outline and define some of the "ideal features" of an agricultural credit program for the state (and Nigeria). For an agricultural credit program to reach a wider spectrum of the target group and be used to accelerate the adoption of improved techniques, it should have a decentralized administration, incorporate the services of improved input suppliers, be of proper magnitude based on an appropriate farm plan, and have a simplified repayment plan.

#### Decentralized Administration

The success of an agricultural credit program depends on the effectiveness of its administration. A centralized, bureaucratic credit administration often leads to delays in the credit delivery system. To be effective, the credit program must have the decision making process of granting loans brought to the farm level--a decentralized administration.

One way to decentralize the institutional credit administration is to use existing local financial institutions in making loans to farmers. Two major types of local financial institutions in the state are the village savings association (VSA) locally referred to as "Etibe" and the village credit union (VCU) known as "Unwam." By the VSA system, members of a village (or group of villages in a geographical



area) group themselves into a club and are bound by common bye-laws formulated by the group. Each member decides on the fixed amount he will be able to contribute at each seating, usually weekly. The lump sum collected at each seating is given to one member (or two) depending on the value of his/her weekly contribution. The process of weekly contribution by all members and lump sum assignment to one (or two) continues until all members of the association have received their shares (64:59). In other words, the VSA is an organization in which each individual is encouraged to save small sums of money weekly and to collect a large sum once to meet major needs. There are neither interest payments nor administrative charges. In most cases, these associations are licensed by the government to operate.

The VCU is also organized at the village level. But unlike the VSA, members of the VCU initially contribute funds for lending into a central fund. Jointly, these shareholders decide on the rate of interest to charge their borrowers. One date in the month is fixed for transactions during which borrowing, interest payments, loan repayments, and loan renewals are made. Also, a date is fixed on which all loans must be retired, so that capital and interest might be distributed to shareholders. This is a major source of credit to the villagers, especially farmers. But, as might be expected, funds are very limited.

One basic requirement for participation in these local financial transactions is personal character. Each member of the village is personally known by the others. Thus, people with questionable characters are not admitted to credit institutions as members or



allowed as borrowers. A second requirement is co-signature in case of advance payment by the VSA or credit from the VCU. This is a simple requirement since any member of the association/union or a close relative can co-sign (or thumb-print).

The use of these local financial channels to provide institutional production credit to the small food crop farmer<sup>1</sup> is strongly suggested and urged here. Since the officials of the banking or credit institutions have no means of determining the credit worthiness of the local farmers, it would be advisable to issue credit on village or community bases to financial committees and then allow the committees to determine the individual credit worthiness of potential borrowers. This procedure would be simple and flexible and would assist farmers with minimum delay. Repayment could be timed as the individual shares in the VSA become due (in case of utilizing the VSA channel) or in accordance with the repayment schedule of the VCU. But the use of this channel must be contingent upon the prior existence of local financial institutions with history of success and respectable committee members. The existence of local institutions must precede the infusion of institutional credit into the system.

#### Utilizing the Services of Input Suppliers

If production credit is to enhance the adoption of improved technology, then improved inputs must be made available at the right

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<sup>1</sup>Not used in the sense of the classification of farmers into three size groups in this study but includes all food crop farmers.



time and in the right place, at reasonable prices. Consequently, credit institutions need to incorporate the services of input suppliers into the production credit package. Where practicable, credit institutions could stock such inputs as fertilizers and pesticides and make loans to the local credit committees partly in cash and partly in kind (10:15-17). Millard Long (80:76) has noted that an effective production credit program requires not just the provision of funds, but also the existence of a new and modern technology which guarantees higher returns than the existing one.

The problem of fertilizer scarcity in the study area and in the state was noted earlier and its output increasing capacity acknowledged by farmers. It appears that bringing it right to the VSA or VCU office location would greatly influence its use. The same could be said of hybrid seeds and seedlings. Again, proper timing of delivery to fit in with the planting or application season is highly desirable. It is better not to give credit at all than to give it late in kind.

#### Magnitude of Credit

The actual amount of production credit needed by each farmer depends on the size of his farming unit, his cropping pattern, and the amount of operating capital which he can provide from his savings. To determine how much credit the farmer needs, simple farm plans are desirable. Such plans will necessarily show the total operating capital requirements for the execution of an optimal farm program. From this information, it is possible to determine how much of the operating capital the farmer can provide out of his savings and how much he needs to borrow. Failure to borrow the amount needed may result in



misallocation of resources and farm income that is less than optimal because credit is needed to provide operating capital. So long as the amount of credit available falls short of the optimum needed, operating capital becomes a limiting input which ultimately limits output. Under the assumption of linear production activities, outputs are produced in fixed proportions by the application of inputs in fixed proportions. Proportional changes in the quantities of all resources used, including operating capital of which credit is a part, will change output in the same proportion (75:151-159).

Simple plans, such as those suggested by the LP solutions of the models of this study, could be useful in determining the magnitude of credit needed by the farmers. The sum of the individual credit needs in the village/community would constitute the total credit need of the village/community. This sum, less the amount of credit available from the VCU, would then be the amount of credit needed by the local credit committee from institutional sources.

#### Repayment Plan

The final requirement of an agricultural credit program for the state is that there be a mechanism for repayment of outstanding loans on time. Voluntary repayment is basic to success. One possible factor that could impede voluntary repayment is the small size of farm holdings which may render farm operation uneconomic and repayment difficult.

To promote and sustain voluntary repayment of loans, the credit institution should lay down some minimum size requirement as a prerequisite for loans award. But in doing this, consideration should be given to the level of technological attainment. In a hoe and matchet economy, like the one under study, 2 acres of land would be a reasonable



minimum. This suggestion of 2 acre minimum size is based on the result of this study in which the introduction of improved technology through the acquisition of credit has shown an improvement in the farmer's income over the traditional farmer who used no credit at all.

The minimum size requirement may not only facilitate voluntary repayment, but may also encourage pooling the fragmented land holdings together and reallocation of the land resources into economically viable units. More importantly, the use of fertilizer associated with the credit program may induce farmers to bring more land under cultivation and reduce the numbers of years in the shifting cultivation cycle.

Nevertheless, an important function of the VSA and VCU is to collect repayment especially during the harvest season when there is money on hand. William and Miller (137:27-29) have advised that, at all times, farmers should be under informal pressure to repay their loans and be well informed that bad debts may block further loans from being available. However, with the local repayment system firmly established, as noted above, and the institutional credit program integrated into the local system, loan retirement would not pose a serious threat. In the case of the VSA, weekly (or periodic) contribution would have to continue in the normal way and the weekly (periodic) lump sum collected be used in loan repayment. In the same way, the introduction of institutional funds into the VCU would not alter the established repayment pattern.

An important point to note is that there will always be a discrepancy between the local rate of interest and the institutional rate,



with the former being slightly higher than the latter. Such discrepancy should be left to the local committees to resolve in the interest of the people they represent.

It was noted earlier in this study that food crop farmers in the Cross River State have limited access to institutional credit. Also, the various Federal and State agricultural credit programs in Nigeria seem to favor export crop farmers more than their food crop counterparts. But the results of this study revealed the desirability of credit in food crop expansion in the Cross River State. Accordingly, some measures need be taken to make institutional credit accessible to deserving food crop farmers. The above four features then, taken together, constitute the desirable features of an ideal agricultural credit program for the Cross River State. It is suggested that they be taken into account in planning future credit programs or in modifying existing ones if their purpose is to serve the small farmers and accelerate the pace of technological innovation.



## CHAPTER VII

### SUMMARY, CONCLUSIONS, AND POLICY RECOMMENDATIONS

#### A. SUMMARY

Scarcity of financial capital at the farm level in the Cross River State farming system has been a constraint to food crop expansion and agricultural development. It has not only inhibited the adoption of improved technology, but has also limited the farmer's ability to combine the other available resources in the most optimal way. Improved agricultural technology in the Cross River State context simply involves the introduction of fertilizer, hybrid seeds, and pesticides into the traditional agricultural system to improve the efficiency of existing resource. Technology change in agriculture is associated with higher farm output and higher income to farmers.

This study was based on the notion that the farmer's limited financial resources could be supplemented with borrowed funds to enable him adopt improved practices. Following this notion, Chapter II was devoted to the theoretical framework for financing agricultural development and the sources of agricultural capital. Arguments in support of, and against, the use of credit in developing agriculture as an instrument for technological change were presented and discussed.

The purpose of this study was to examine the extent to which borrowed funds could facilitate the adoption of improved agricultural practices, thereby raising output and farm incomes, and to estimate



the credit needs of farmers according to the size of their holdings. Accordingly, three representative farm plans were developed for each of the following situations:

1. Model A was based on existing traditional technology with no borrowed funds.

2. Model B was also based on existing traditional technology but incorporated borrowed funds.

3. Model C utilized modern technology and borrowed funds.

Using data from Ika Clan, Abak LGA in the Cross River State, an optimal farm plan for each model was formulated. The objective of each plan was to maximize farm income subject to resource constraints. The constraints in the models were land, operating capital, family labor--male and female by periods--and borrowed funds from institutional sources. Activities included were crop activities, labor hiring and labor selling activities by sex and by period, and borrowing activities from institutional and private sources. The analytical framework upon which each LP model was built was developed in the later part of Chapter III after a general overview of the state economy was given.

In Chapter IV, each model was broken up into three submodels representing small, medium, and large farms and a representative farm plan for each of the submodels was prepared and solved for optimal solutions. The results were presented and analyzed in Chapter V. The results confirmed the notion that scarcity of financial capital at farm level was a constraint to agricultural expansion and development. They showed that the farmer's own operating capital was insufficient to



execute an optimal farm plan, even under the traditional technique of cultivation. In each of the three submodels in which traditional technique was used without borrowing, the shadow prices of operating capital were relatively high (Table 5.9, page 124). Also, a comparison of net farm incomes from the two models using traditional technology showed that higher net farm incomes were achieved by the model in which borrowed funds were incorporated than in the farm that used no borrowed funds. More importantly, net farm income on per acre basis in each "modern" farm was higher than those of comparative traditional farms. This meant that credit became important only after new technology was introduced and that if credit was not available after the introduction of new technology, the adoption of such technology by small farmers was unlikely.

Another finding associated with credit was the important economic function performed in the society by private moneylenders. Despite the high rate of interest charged, it was profitable to adopt modern technology made possible through private credit sources within given limits. However, it was not economical to use borrowed funds from private sources to execute plans under traditional technology, even though operating capital and institutional credit were still limiting sources. Doing so would lower the value of the program in each case.

Land was a limiting resource in each of the small and medium size farms of all three models as illustrated by the high marginal productivities of land in those submodels.



The only resource whose supply exceeded demand was labor, particularly male labor in all models and submodels. But in each of the large farms in the three models, female labor in Periods 1 and 2 were limiting resources. This situation was due to the fact that men and women specialized in different tasks and that women's tasks required more mandays than men's tasks.

Finally, the results showed that the optimal cropping pattern given by the LP solution did not fit in with actual practice. The model results suggested specialization in given activities or activity groups whereas, in practice, farmers attempted to grow all crops. But the "reduced costs" associated with the nonbasic variables showed the amounts by which the farmer's income would be reduced for each acre of those non-basic activities forced into the plan. This explained why the "Jack of all trade" farmers had lower incomes than those who specialized in production of just the few crops in which they had comparative advantage.

Having established that credit was necessary for an effective and efficient farm management and realizing that past and current agricultural credit programs in Nigeria have scarcely reached the target group, Chapter VI outlined some desirable features of an effective agricultural credit program for the state. The features emphasized decentralization of credit administration and use of local financial institutions as instruments for institutional credit disbursement. Also of importance were the magnitude of credit and the provision of the improved inputs in the right amounts and at the right time and place.



## B. CONCLUSIONS

In drawing conclusions from this study, we assume that the data used were reasonably random and representative of the area and that the analytical model employed was appropriate to the subject matter of study. Under these assumptions, a few basic conclusions can be drawn.

First, the rate of saving at the farm level is inadequate to permit the execution of an optimal farm plan under technological change (and even under the existing technology). Institutional credit can be used to supplement family savings to facilitate the acquisition of improved inputs embodied in technological change. But unless these inputs are made available in the right amounts, at the right time, and at the right places, the purpose of the credit may be defeated.

Second, in addition to saving, land is also a limiting factor to expansion of agricultural output and farm income in the state. But land constraint may be viewed as short-run and surmountable with the achievement of technological change. Improved practices could induce voluntary changes in the existing shifting cultivation pattern, thereby bringing more land into annual cultivation, in the long-run. Thus, technological change is capable of simultaneously achieving expansion of the units of operation per farmer and improvement in the productivity of inputs.

Third, limitations on resources with which labor is combined--land and operating capital--have resulted in inefficient utilization of family labor resources. Coupled with scarcity of nonfarm employment,



limited resources have promoted under-employment of family labor and reduced its marginal value product to zero.

Finally, all things equal, Cross River State farmers will increase their incomes by concentrating on one or a few crop activities rather than attempting to engage in all activities. Specialization may promote efficiency of resource use in traditional agriculture.

### C. POLICY IMPLICATION AND RECOMMENDATIONS

From the results and conclusions of the study, some policy implications invariably emerge. While the models used in the study must be seen as a simplification of the complexities of reality, they are assumed to have been able to capture the crucial features of the state agricultural system. On the strength of this assumption, we may use the quantitative estimates given by the optimal solution of the models to gain insights into the future movements of the state agricultural system and as guidelines in attempting to control those movements in an effort to improve the economic welfare of the farmers.

The first policy observation of the study is the potential of technological change in raising agricultural productivity, output, and incomes. Therefore, institutions charged with the responsibility of economic and agricultural development planning should encourage the introduction of improved practices into the traditional agricultural system of the state. One way of doing this is to create incentives and provide facilities for the adoption of such innovation. In particular, since fertilizer, pesticides, and improved varieties of seeds are the basic requirements of the new technology, development planners might consider making these inputs available to the small



farmers in appropriate quantities at the right time. In addition, the small farmers should be taught how best to apply the new inputs, especially fertilizer and pesticides, through extension services. The focus of policy planners should be the small food crop farmers rather than the commercial farmers.

The second policy observation of the study is that the savings and investment capacity of small farmers in the state is so minimal that the adoption of low cost technology is impeded. Credit from informal financial institutions like the VSA and VCU is inadequate in amounts to supplement the meager savings. Credit from private money-lenders is costly. Formal institutional credit does not "go deep down enough" to reach the small farmers. Directing attention toward providing formal institutional credit for the small farmers in amounts commensurate with the requirements of their optimal farm plans may constitute an appropriate policy. Again, extension services in formulating such plans are highly desirable. At the same time, the informal (local) institutions should be encouraged to continue to maintain and expand their local credit facilities. Farmers should be made to realize that credit is not a substitute but a supplement to personal savings.

From the second implication emerges a third. Policy makers, in planning the credit programs, need to think about the clientele group--the small farmers. Since formal institutional credit facilities are detached from rural areas, credit programs designed to reach the small farmers may be integrated with existing local and informal



credit institutions. Decentralized decision making in the lending process is highly encouraged.

Finally, there is evidence of under-utilization of agricultural labor in the area which implies excess supply over demand. The agricultural labor force is generally unskilled and therefore immobile. Also, employment opportunities outside the agricultural sector are limited. A labor development program whereby labor is upgraded through training in basic nonagricultural skills is recommended as this would ease the problem of labor immobility. Where labor is under-utilized in one sector, part of it may be transferred into another sector without any decline in the output of the sector from which it was transferred. Also, development planners should take the existence of surplus labor in agriculture into consideration when formulating development plans. A program involving light industrial/manufacturing projects in rural areas would absorb the surplus agricultural labor at relatively low cost. A combination of rural nonagricultural employment opportunities and labor development programs may lead to efficient utilization of labor resources.

#### D. RECOMMENDATIONS FOR FURTHER STUDIES

This study does not claim to have found the solution to the problem of small farm finance in the low technology agriculture of the Cross River State. The validity of its results and conclusions could depend on the reliability of the data used in the models. However, because of the nature of this work and complete absence of any other existing data in the area for comparative purposes, it may be



reasonable to assume that the data used were not completely representative of the system from which they were drawn.

In addition, there were other variables that had a bearing on the problem but were not incorporated in the models. Such variables included economic and noneconomic issues like uncertainty, differences in individual performance in farm and nonfarm activities, and social and cultural factors which influence the farmer's decision. Even if the data used were accurate and the results and conclusions valid, there still would remain some problems unsolved and some questions unanswered. For example, we would want to have more precise information on the quantities of fertilizer we would require to maintain a continuous cropping system associated with new technology. Research to provide this information is highly needed. Also, the state is an economy characterized with capital shortage and reserve scarcity. Consequently, research directed toward the development, use, and allocation of credit reserves (13:129) is strongly recommended. Other areas which require investigations include consequences of alternative cropping patterns--mixed and sole--as well as the impact of technological change on shifting cultivation technique, land use pattern, and labor utilization levels.

Finally, research and education in financial management accompanied by research and education in technical agricultural production and farm management appear to be of utmost importance. Also coordinated into this package should be agronomic investigations into soil type and soil fertility, high yielding varieties of crops, and other agronomic factors which influence crop yield.



Again, this study is merely a preliminary attempt to pave the way for further investigations into the agricultural development problems of the Cross River State of Nigeria.







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## APPENDICES

CRANES  CREST



APPENDIX A

SMALL FARM PRODUCTION CREDIT QUESTIONNAIRE

FOR IKA CLAN, 1978

1. Name of farmer \_\_\_\_\_
2. Age of farmer \_\_\_\_\_
3. Sex of farmer: Male \_\_\_\_\_ Female \_\_\_\_\_
4. Village \_\_\_\_\_ Farm identification number \_\_\_\_\_
5. Formal education of farmer \_\_\_\_\_ years
6. Number of adults\* in farm household: Male \_\_\_\_\_ Female \_\_\_\_\_
7. Number of children in school: Sons \_\_\_\_\_ Daughters \_\_\_\_\_
8. How many farm plots do you own altogether? \_\_\_\_\_

Give details: \_\_\_\_\_ (Use back of this page if more space is needed.)

| Number and name of plot | Area in acres |
|-------------------------|---------------|
| i.                      |               |
| ii.                     |               |
| iii.                    |               |
| iv.                     |               |
| v.                      |               |
| vi.                     |               |
| vii.                    |               |
| viii.                   |               |
| ix                      |               |
| x.                      |               |

\_\_\_\_\_  
\*Permanent household members aged 15 and over, excluding children in school and including the farmer himself/herself.



9. Which of the above plots do you cultivate this year?

Name of plot

Area in acres

i.

ii.

iii.

(Use back of this page if more space is needed.)

10. Do you cultivate any rented farmland this year? Yes \_\_\_\_ No \_\_\_\_

If yes, give details:

Name of plot rented

Area in acres

i.

ii.

iii.

iv.

11. Is land readily available in your village:

a. for rent? \_\_\_\_ If not, why? \_\_\_\_

b. for purchase? \_\_\_\_ If not, why? \_\_\_\_

12. Which of these crops do you raise this year?

Crop

Area planted (acres)

Yam

Maize

Cassava

Fluted pumpkin

Melon

Okra

Pepper

Beans



13. Time (in mandays) spent on each operation per crop:

| Operation                   | Sex of operator | Flu. pump. Okra yam |       |         |       |  | Coco-<br>yam | Pepper |
|-----------------------------|-----------------|---------------------|-------|---------|-------|--|--------------|--------|
|                             |                 | Yam                 | Maize | Cassava | Melon |  |              |        |
| Clearing                    | M<br>F          |                     |       |         |       |  |              |        |
| Burning &<br>tidying        | M<br>F          |                     |       |         |       |  |              |        |
| Tilling                     | M<br>F          |                     |       |         |       |  |              |        |
| Planting                    | M<br>F          |                     |       |         |       |  |              |        |
| Fertil-<br>izer             | M<br>F          |                     |       |         |       |  |              |        |
| Staking/<br>support-<br>ing | M<br>F          |                     |       |         |       |  |              |        |
| Harvest-<br>ing             | M<br>F          |                     |       |         |       |  |              |        |
| Storage                     | M<br>F          |                     |       |         |       |  |              |        |

14. Give details of employment and income outside food crop production.

| Source       | Sex    | Jan.-April |   | May-August |   | Sept.-Dec. |   |
|--------------|--------|------------|---|------------|---|------------|---|
|              |        | Mandays    | ₦ | Mandays    | ₦ | Mandays    | ₦ |
| Tree crop    | M<br>F |            |   |            |   |            |   |
| Labor sale   | M<br>F |            |   |            |   |            |   |
| Market/trade | M<br>F |            |   |            |   |            |   |
| Others       | M<br>F |            |   |            |   |            |   |



15. What other time consuming activities have occupied time during this year?

| Activity | Number of days |        |            |        |            |        |
|----------|----------------|--------|------------|--------|------------|--------|
|          | Jan.-April     |        | May-August |        | Sept.-Dec. |        |
|          | Male           | Female | Male       | Female | Male       | Female |

Communal work

Religious activity

Sickness

Public holidays

Others

16. How many days of vacation have your children in school had during the year by period:

a. January-April? \_\_\_\_\_

b. May-August? \_\_\_\_\_

c. September-December? \_\_\_\_\_

17. Give the number of mandays of hired labor for farm work during the year:

| Crops | Number of mandays of labor hired |        |            |        |            |        |
|-------|----------------------------------|--------|------------|--------|------------|--------|
|       | Jan.-April                       |        | May-August |        | Sept.-Dec. |        |
|       | Male                             | Female | Male       | Female | Male       | Female |

Yam

Maize

Cassava

Cocoyam

Melon

Fluted pumpkin

Okra

Beans

Pepper



18. What daily wages did you pay?

| <u>Period</u> | <u>Male (₦)</u> | <u>Female (₦)</u> |
|---------------|-----------------|-------------------|
| January-April |                 |                   |
| May-August    |                 |                   |
| Sept.-Dec.    |                 |                   |

19. Give details of farm tools and implements you own:

| <u>Tools/implements</u> | <u>Number owned</u> | <u>Date bought</u> |             | <u>Purchase value (₦)</u> |
|-------------------------|---------------------|--------------------|-------------|---------------------------|
|                         |                     | <u>Month</u>       | <u>Year</u> |                           |
| Matchets                |                     |                    |             |                           |
| Hoes                    |                     |                    |             |                           |
| Shovels/spades          |                     |                    |             |                           |
| Forks/rakes             |                     |                    |             |                           |
| Carts/<br>wheelbarrow   |                     |                    |             |                           |
| Baskets                 |                     |                    |             |                           |
| Others (specify)        |                     |                    |             |                           |

20. Which of the above tools/implements do you lack or would you need to replace?

| <u>Tool/implement</u> | <u>Quantity needed</u> | <u>Unit value (₦)</u> |
|-----------------------|------------------------|-----------------------|
| i.                    |                        |                       |
| ii.                   |                        |                       |
| iii.                  |                        |                       |
| iv.                   |                        |                       |
| v.                    |                        |                       |

21. From what source do you get money to buy the tools/implements?

- i. farm savings \_\_\_\_\_
- ii. borrowing \_\_\_\_\_
- iii. gifts \_\_\_\_\_



22. Give details of the following input requirements for the 1978 crop year:

| Inputs                       | Quantity<br>available<br>to farmer | Additional quantity<br>needed for planting | Value<br>(₦) |
|------------------------------|------------------------------------|--------------------------------------------|--------------|
| Seed-yam                     |                                    |                                            |              |
| Maize seed                   |                                    |                                            |              |
| Cassava sticks               |                                    |                                            |              |
| Fluted pumpkin seeds         |                                    |                                            |              |
| Melon seed                   |                                    |                                            |              |
| Okra seed                    |                                    |                                            |              |
| Cocoyam seed                 |                                    |                                            |              |
| Pepper seed                  |                                    |                                            |              |
| Fertilizer                   |                                    |                                            |              |
| Yam/fluted<br>pumpkin stakes |                                    |                                            |              |
| Bean seed                    |                                    |                                            |              |

23. a. Do you apply fertilizer to your farm? Yes \_\_\_\_\_ No \_\_\_\_\_
- b. If "No," Why? \_\_\_\_\_
- c. From what source do you obtain money to buy these inputs?
- i. farm savings \_\_\_\_\_
- ii. borrowing \_\_\_\_\_
- iii. gifts \_\_\_\_\_
24. Have you received production credit from any source this year?
- Yes \_\_\_\_\_ No \_\_\_\_\_
- If "Yes," from what source?
- i. government \_\_\_\_\_
- ii. commercial bank \_\_\_\_\_
- iii. local cooperatives/clubs \_\_\_\_\_



24 (Continued)

- iv. private lenders \_\_\_\_\_
  - v. others (specify) \_\_\_\_\_
  - b. How much credit did you receive? \_\_\_\_\_
  - c. What did you use the credit for?
    - i. seed purchase (specify) \_\_\_\_\_
    - ii. labor hiring \_\_\_\_\_
    - iii. fertilizer/manure purchase \_\_\_\_\_
    - iv. yam/fluted pumpkin stakes \_\_\_\_\_
    - v. tools/implements purchase \_\_\_\_\_
    - vi. land purchase \_\_\_\_\_
    - vii. land rent \_\_\_\_\_
    - viii. debt repayment \_\_\_\_\_
    - ix. others (specify) \_\_\_\_\_
  - d. How much of the debt is outstanding? \_\_\_\_\_
25. a. Do you have any difficulties in obtaining a loan?
- Yes \_\_\_\_\_ No \_\_\_\_\_
- b. If "Yes," what are the difficulties from:
- i. government sources? \_\_\_\_\_
  - ii. commercial banks? \_\_\_\_\_
  - iii. local cooperatives? \_\_\_\_\_
  - iv. private lenders? \_\_\_\_\_
  - v. others? (specify) \_\_\_\_\_



26. What type of security is required by the lending agency for the grant of loan?

| Security | Govern-<br>ment | Commercial<br>Banks | Local<br>cooperative | Private<br>lender | Others |
|----------|-----------------|---------------------|----------------------|-------------------|--------|
|----------|-----------------|---------------------|----------------------|-------------------|--------|

No security

Simple note

Co-signature

Surety

Land  
mortgage

Property  
pledge

Others  
(specify)

27. What rate of interest was charged by each credit source?

i. government \_\_\_\_\_

ii. commercial bank \_\_\_\_\_

iii. local cooperatives \_\_\_\_\_

iv. private lenders \_\_\_\_\_

v. others \_\_\_\_\_

28. Do you have any repayment problem? Yes \_\_\_\_\_ No \_\_\_\_\_

If "Yes," what causes the problem?

i. crop failure \_\_\_\_\_

ii. low crop prices \_\_\_\_\_

iii. high rate of interest \_\_\_\_\_

iv. bad timing of repayment \_\_\_\_\_

v. other financial commitments (specify) \_\_\_\_\_



29. How far are your sources of credit from your home?

| <u>Distance</u> | <u>Govern-<br/>ment</u> | <u>Commercial<br/>bank</u> | <u>Local<br/>coops</u> | <u>Private<br/>lender</u> | <u>Others</u> |
|-----------------|-------------------------|----------------------------|------------------------|---------------------------|---------------|
|-----------------|-------------------------|----------------------------|------------------------|---------------------------|---------------|

Under 5 miles

5-10 miles

10-15 miles

15-20 miles

20-25 miles

Over 25 miles

b. By what means of transportation do you get there?

Walking \_\_\_\_\_ Own bicycle \_\_\_\_\_ Paid cyclist \_\_\_\_\_

Passenger car/lorry \_\_\_\_\_

c. How much does it cost you to get there? \_\_\_\_\_30. Farm income for the 1978 crop year:

| <u>Crop</u>     | <u>Unit</u> | <u>Quantity<br/>harvested</u> | <u>Price per<br/>unit (₦)</u> | <u>Total<br/>value (₦)</u> |
|-----------------|-------------|-------------------------------|-------------------------------|----------------------------|
| Yam             |             |                               |                               |                            |
| 1st harvest     | lb          |                               |                               |                            |
| 2nd harvest     | lb          |                               |                               |                            |
| Maize           |             |                               |                               |                            |
| Fresh           | cob         |                               |                               |                            |
| Dry             | lb          |                               |                               |                            |
| Cassava         | lb          |                               |                               |                            |
| Cocoyam         | lb          |                               |                               |                            |
| Melon           | lb          |                               |                               |                            |
| Fluted pumpkins |             |                               |                               |                            |
| Leaves          | bundle      |                               |                               |                            |
| Fruits          | pod         |                               |                               |                            |
| Okra            | lb          |                               |                               |                            |
| Beans           | lb          |                               |                               |                            |
| Pepper          | lb          |                               |                               |                            |

Name of enumerator \_\_\_\_\_





APPENDIX B

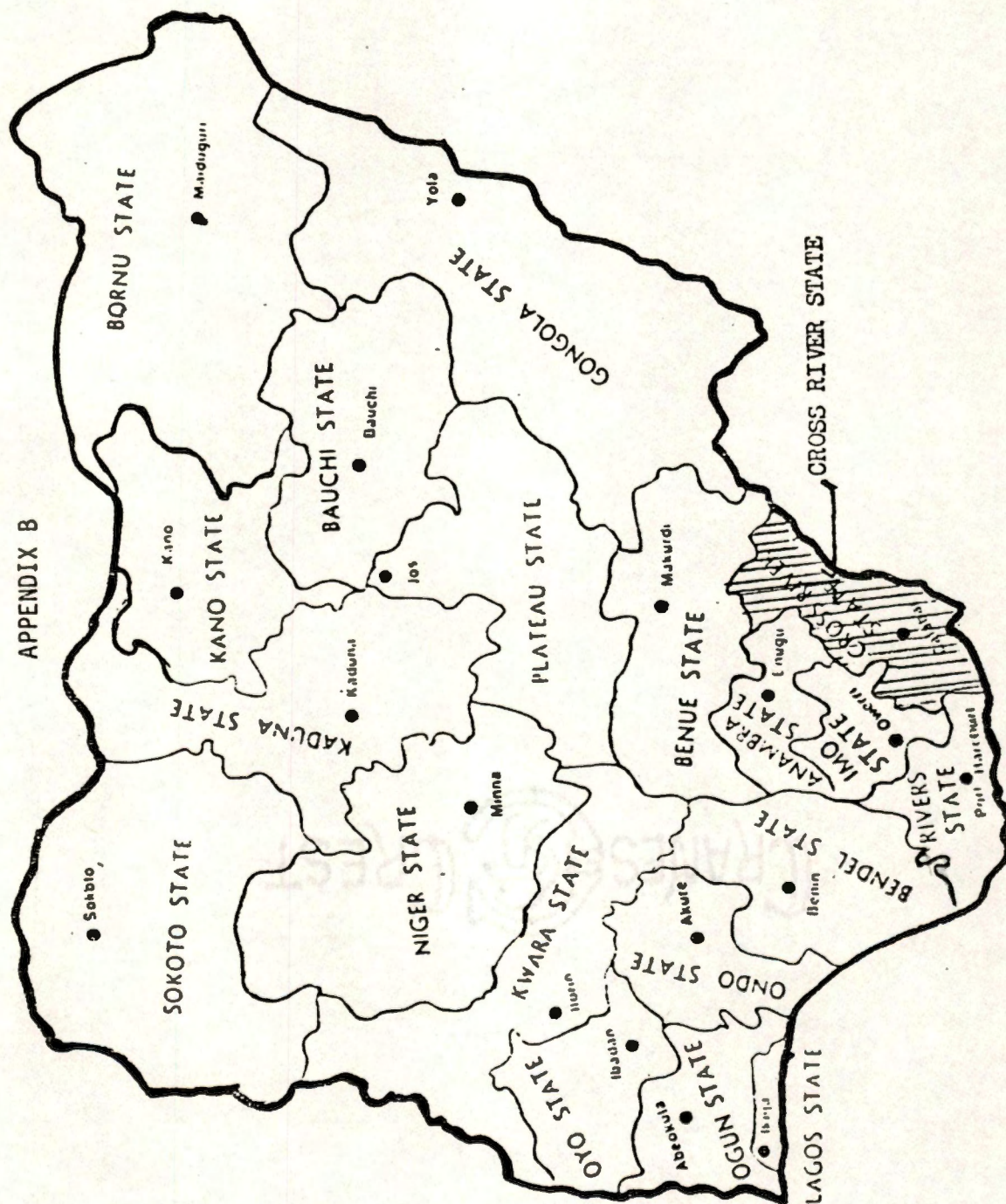


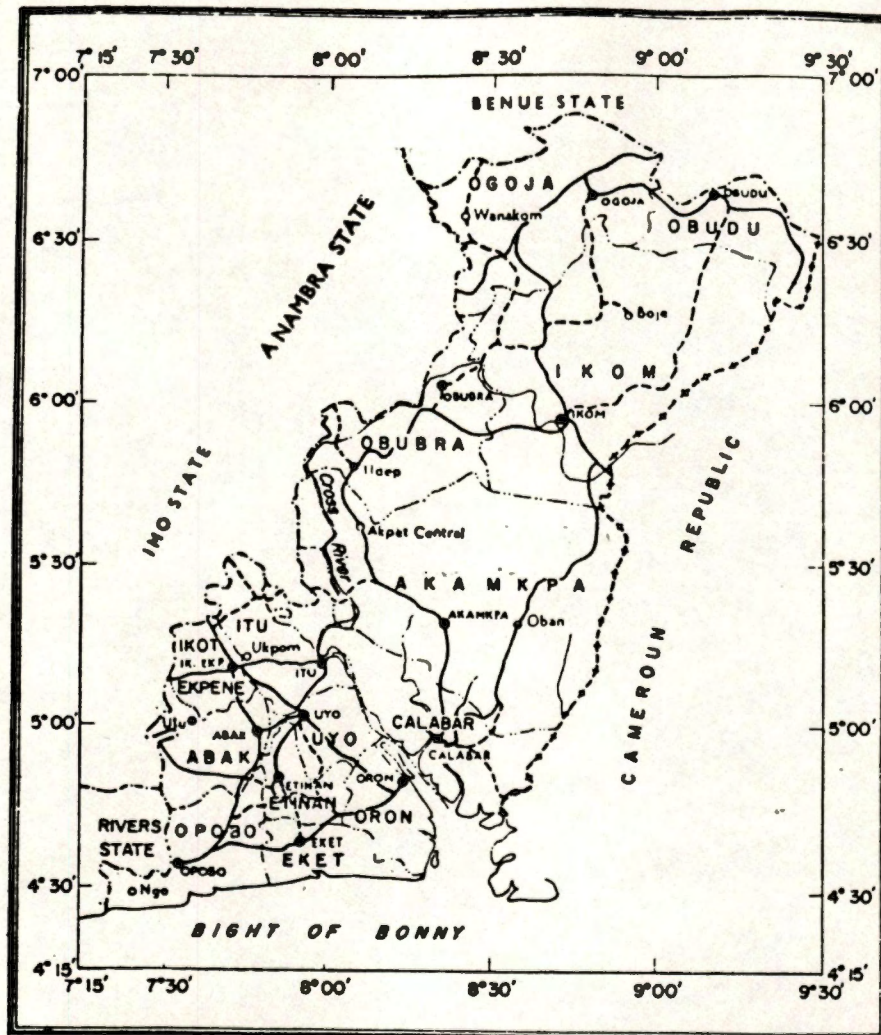
Figure B-1. Map of Nigeria Showing the 19 States.



# APPENDIX C

NIGERIA 1:2,000,000

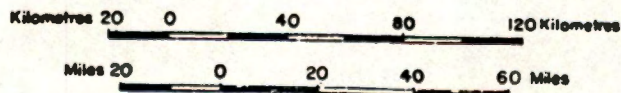
## CROSS RIVER STATE OUTLINE MAP



PROVISIONAL EDITION  
M. T. C. 58A

Drawn by S. E. S. Surveys, Calabar, Sept, 1974  
Amended March, 1975

Scale:- 1:2,000,000



### REFERENCE

|                            |                   |           |
|----------------------------|-------------------|-----------|
| Boundaries:- International | State Capital     | ● CALABAR |
| State                      | Divisional HQ.    | ● IKOMA   |
| Divisional                 | Touring Area Base | ● Nge     |
| Roads:- Main               | Rivers            | —         |
| Secondary                  |                   | ---       |

Note:- Names of Divisional HQs are identical with their respective Divisional Names

Figure C-1. Cross River State Outline Map.



# APPENDIX D

Table D.1. Average Market Prices of Food Crops in Ika Local Markets in 1978.

| Items          | Unit       | Price  |
|----------------|------------|--------|
| Yam            |            |        |
| 1st harvest    | pound (1b) | ₦0.03  |
| 2nd harvest    | pound (1b) | ₦0.05  |
| Maize          |            |        |
| Fresh          | cob        | ₦0.02  |
| Dry            | pound (1b) | ₦0.03  |
| Cassava        | pound (1b) | ₦0.01  |
| Okra           | pound (1b) | ₦0.03  |
| Cocoyam        | pound (1b) | ₦0.02  |
| Fluted pumpkin |            |        |
| Leaves         | bundle     | ₦0.10  |
| Fruits         | Pods       | ₦1.28* |
| Beans          | pound (1b) | ₦0.03  |
| Melon          | pound (1b) | ₦0.15  |

\*Actual price depended on the size of the pod and ranged from ₦0.29 for small pods to ₦3.47 for large pods.

CRANES CREST



# APPENDIX E

Table E.1. Sensitivity Analysis of Private and Institutional Credit from the LP Solutions of Ika Small Farm Survey Models, 1978.

| Model     | Column | Activity<br>N | Input Cost<br>(N) | Lower Limit<br>Upper Limit<br>(N) | Upper Activity<br>Lower Activity<br>N | Unit Cost<br>Unit Cost<br>N | Upper Cost<br>Lower Cost<br>N |
|-----------|--------|---------------|-------------------|-----------------------------------|---------------------------------------|-----------------------------|-------------------------------|
| B--small  | PRCRED | 0             | -.27              | 0<br>None                         | -48.72<br>9.08                        | 0.01<br>-0.01               | Infinity<br>-0.26             |
|           | INCRED | 24.72         | -.09              | 0<br>None                         | 24.00<br>24.72                        | -0.17<br>Infinity           | -0.26<br>Infinity             |
|           |        |               |                   |                                   |                                       |                             |                               |
| B--medium | PRCRED | 0             | -.27              | 0<br>None                         | -57.69<br>32.14                       | 0.01<br>-0.01               | Infinity<br>-0.26             |
|           | INCRED | 37.19         | -.09              | 0<br>None                         | -20.50<br>37.19                       | -0.17<br>Infinity           | -0.26<br>Infinity             |
|           |        |               |                   |                                   |                                       |                             |                               |
| B--large  | PRCRED | 1.32          | -.27              | 0<br>None                         | -24.50<br>58.00                       | -6.23<br>-0.18              | -6.50<br>-0.09                |
|           | INCRED | 56.68         | -.09              | 0<br>None                         | Infinity<br>56.68                     | -0.18<br>Infinity           | -0.27<br>Infinity             |
|           |        |               |                   |                                   |                                       |                             |                               |
| C--small  | PRCRED | 171.90        | -.27              | 0<br>None                         | -22.72<br>263.58                      | -0.001<br>-0.06             | -0.27<br>.21                  |
|           | INCRED | 24.72         | -.09              | 0<br>None                         | Infinity<br>24.72                     | -0.18<br>Infinity           | -0.27<br>Infinity             |
|           |        |               |                   |                                   |                                       |                             |                               |
| C--medium | PRCRED | 302.37        | -.27              | 0<br>None                         | 17.31<br>503.86                       | -0.001<br>-0.17             | -0.27<br>-0.10                |
|           | INCRED | 37.19         | -.09              | 0<br>None                         | Infinity<br>37.19                     | -0.18<br>Infinity           | -0.27<br>Infinity             |
|           |        |               |                   |                                   |                                       |                             |                               |
| C--large  | PRCRED | 225.91        | -.27              | 0<br>None                         | 160.19<br>282.59                      | -2.25<br>-0.18              | -2.52<br>-0.09                |
|           | INCRED | 56.68         | -.09              | 0<br>None                         | -Infinity<br>56.68                    | -0.18<br>-Infinity          | -0.27<br>-Infinity            |
|           |        |               |                   |                                   |                                       |                             |                               |



## VITA

Peter Udo Iniodu was born in Atai Otoro in Abak Local Government Area (LGA) of the Cross River State of Nigeria on June 29, 1938 as the third and last son of Obong Udo Iniodu and Nne Amankop. He has four sons and two daughters.

Peter has his primary and postprimary education within Abak LGA of his state and received the Bachelor's Degree in Economics from Cuttington College and Divinity School in Liberia in 1970. On his return to Nigeria in January 1971, he was employed as a secondary school teacher by the Cross River State School Board. In January 1972 he founded the Comprehensive Secondary School in Atai Otoro and became the first principal of the school. He held the position until he left for Virginia State University in January 1976, for the Master's program in Economics. On completion of his Master's program, he transferred to The University of Tennessee, Knoxville, to study for the Ph.D. degree in Agricultural Economics.

Peter hopes to return to Nigeria soon after completing his Ph.D. program and plans to teach in one of the Nigerian universities.

