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Economic behavior of small-farm households: credit recipients in Olancho Region, Honduras

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households: Credit recipients
in Olancho Region, Honduras

by

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INTRODUCTION

Statement of the Problem

Massive poverty, arising from income inequality and increasing underemployment, generally has been recognized as a major characteristic of many less developed countries (LDCs). Since the agricultural sector contains the majority of these countries' population, and represents the largest area of economic activity, rural poverty has become one of the most important targets for public development policies.

The World Bank estimates that in 1969 there were approximately 695 million rural poor in the LDCs [36]. The World Bank defines the rural poor as including: small-scale farmers, tenants, share croppers, and landless workers, "with a per capita income of $50 or less, plus others with per capita incomes that are less than one-third of the national average" [36, p.4].

The variety of target groups for rural development policies leads governments in LDCs to define a wide range of programs and projects designed to reduce poverty.

Even though a rural development program should simultaneously deal with several aspects of the rural poverty problem, one of its most important components is the generation of projects oriented toward raising agricultural output. These projects must be formulated both to remove constraints and to support those forces prevalent within the target group which are favorable to change.

One kind of policy that has been widely implemented in most LDCs has been that of providing credit for agricultural production. Many of these credit programs have been supposedly directed to relaxing financial constraints of small farmers as a means to increase production.

Nevertheless, experience shows that institutional credit has not been generally successful as a means of raising agricultural output. As the World Bank puts it [35, p.31]:

> In most developing countries, growth rates in agricultural output have been the lowest of all major sectors: farm production, generally has been increasing by less than 3% per year.

Two main factors explain the failure of credit programs in accomplishing their objectives: (1) They have not reached small farmers who in the aggregate produce the bulk of the agricultural output, and (2) When credit has been provided to small farmers, the underlying assumption has been that, for the most part, the shortage of funds is responsible for the slow rate of investment and growth of this group.

In the first case, what happens is that credit funds are directed towards medium and large size holdings, which are considered more efficient. The World Bank, which is the major financial institution for agricultural development projects, states that [35, p.5].

> Large farmers have been the main beneficiaries of institutional credit. It is common to find 70% to 80% of small farmers in a given country with virtually no access to such credit.

Yet, even when credit is provided to small farmers, little attention is given to other limitations such as: (1) the inadequacy of some specific resources, i.e., land, irrigation facilities, etc.; (2) the degree of integration of this group into market activities; (3) the state of knowledge with respect to the implementation of new technology; and (4) the most important factor, the attitude of this group toward change.

What is apparent is that, in many LDCs, more emphasis has been placed on structuring credit programs from the institutional standpoint, and little attention has been paid to increasing knowledge of, or to understanding, the real subject of change, the small-farm household.

Objectives of the Study

The purpose of this study is to assess the micro-economic relationships present in the context of the small farmer economy. It is believed that increasing knowledge of how these economic entities operate, of what their real motives to act and make economic decisions are, as well as of the real constraints faced by small farmers in pursuing their objectives, can be of help to policy makers in designing better policies in order to foster economic development and to reduce poverty.

The four main objectives for this study are:

1. To survey the theory underlying the rationality behind the small farmers' economic behavior. In accomplishing this objective, it is assumed that the small farmer constitutes a special kind of economic entity that needs to be analyzed in a way that differs from the traditional applications of the neoclassical theories of the firm and of consumer behavior.
2. To establish the theoretical and real conditions involved in the small farmer's decision making process. This implies an assessment of the elements influencing the small farmer's decisions with regard to: (a) labor allocation; (b) land allocation and product-mix; (c) marketing and/or consumption of products; and (d) adoption of new technology.
3. To identify the structure of the small farmer economy in terms of: (a) resource endowment; (b) production patterns; (c) labor utilization patterns; (d) product disposition patterns; (e) technology used; and (f) income sources participation.

4. To investigate differences in economic performance between small farmers according to farm size. The same elements listed in objective three will be tested to establish the consistency of the small farmer group characteristics.

The first and second of these objectives will be accomplished by carrying out a survey of the relevant literature on the subject. Fulfillment of the third and fourth objectives will be done through the analysis of empirical data on small farm credit recipients in the region of Olancho in the Republic of Honduras.

CONCEPTUAL FRAMEWORK OF THE SMALL FARMERS' ECONOMY

"An economy may be defined as the total of all economic activities that are carried out within a specified spatial area or political unit" [34, p.17]. In the context of this study, the term 'small farmer's economy' is used to refer to the total economic actions that take place within a unit characterized by the following: (1) The main activity is agricultural production. (2) The product mix is generally made up of food commodities. (3) The main source of labor is family members. (4) There is a direct relationship between production and consumption of the farmers' own products. And, (5) a traditional system of production prevails.

Many agricultural researchers use the term 'small farmers' to refer to the size of land holdings, but there is no agreement among the different studies in determining a common size criteria. It may depend upon many circumstances. Another group has shown preference for the terms 'peasants', 'subsistence farmers' or 'family farms', to describe the same kind of agricultural unit. For the sake of convenience, all terms will be used interchangeably in the discussion of this part of the study. Use will be determined by the term originally used in the literature being referenced.

The Behavioral Assumptions

Under the neoclassical theory, the postulate of rationality is the customary point of departure in consumer behavior theory. This postulate of rationality implies that the consumer is capable of ranking commodity combinations consistently in order of preference. His ranking of commodities is expressed mathematically by his utility function.

The basic postulate of the theory of consumer behavior is that the consumer maximizes utility. Since his income is limited, he maximizes utility subject to a budget constraint, which expresses his income limitation in mathematical form. The consumer's rate of commodity substitution must equal the price ratio for a maximum. In diagrammatic terms, the optimum commodity combination is given by the point at which his income line is tangent to an indifference curve [16].

On the other hand, there is the theory of the firm which defines a firm as a technical unit in which commodities are produced. The entrepreneur (owner and manager) decides the quantity and method of production for one or more commodities. An entrepreneur transforms inputs into outputs, subject to the technical rules specified by his production function. The difference between his revenue from the sale of output and the cost of his inputs is his profit, if positive, or his loss, if negative.

The entrepeneur's production function gives mathematical expression to the relationship between the quantities of input he employs and the quantities of output he produces. The rational producer maximizes the quantity of his output for a given cost level [16].

The essence of this theory is that the firm pays for each of the factors of production, and operates within a market system that establishes prices for each of the factors.

Under the traditional application of the neoclassical theory, both the household as a supplier of labor and consumer of goods, and the firm as producer of goods and user of factors of production, are considered to be making their decisions independently.

If we want to analyze the behavior of the small-farm household as an economic unit, the question that arises is which theory is applicable. Can we just assume that small farmers behave as rational producers, allocating their resources to maximize profits? Or, are there some specific characteristics that lead us to presume behavioral differentiation of this group? In studying the issue, Wharton [33, p.461] states that many of the researchers studying the subsistence farmers' behavior believe that:

> The pure theory of the firm and the pure theory of the household (are) not exactly appropriate for

> the subsistence family farm because of the duality involved; i.e. the entire operation is a dual entity - farm firm plus household - where production, consumption, labor use and decision-making are intertwined.

More specifically, Krishna [17, p.185] defines the differentiation of this agricultural unit in terms of two specific characteristics which he believes have to be taken into consideration when theorizing about family farm behavior:

> First, that a part of the output goes to the household; and second, that a part of the input comes from the household. The "pure" firm "purchases" almost all its inputs and "sells" all its outputs in the market at market prices against money payments. But, the household firm simply "transfers in kind" a part of the household input potential to the firm and a part of its output to the household.

It has been mentioned before that a characteristic of small farmers is that they produce primarily food commodities. This implies that the transfer in kind of output is in fact the part of the product that is consumed by the family. And, the transfer of input refers to the proportion of the most important input used in production - labor - which is provided by the family.

The proportion of the self-produced output that is consumed by the family and the proportion of the labor used on the farm is the criteria used to differentiate between the pure subsistence farm (uses only family labor and consumes all its products) and the pure commercial farm (uses only hired labor and sells all its products) [24].

The so called family farms integrate both elements: the consumption of self-produced output, and the use of family labor in some proportions. It means that the family farm may also sell part of its products and hire in or hire out part of its labor.

Another differentiating characteristic of the family farm is that it tries to pursue collective objectives in its economic behavior. This implies that for the small farmer, the family activities, as a group, are the relevant ones, instead of the individual objectives. Related to this issue, Sen [30, p.425] points out that:

> The peasants are guided in their allocational efforts by the aim of maximizing the happiness of the family.... Each person's notion of family welfare is given by the net utility from income and effort of all members taken together, attaching the same weight to everyone's happiness.

Under the above stated set of circumstances that characterize the small farmers' economy, it is important to determine: What are the objectives that small farmers are trying to fulfill when acting as economic entities? How does this group's economy reach equilibrium? And, what are the relevant values imputed for the family labor that is used on the farm and for the production consumed by the family?

In his analysis of the family farm, Nakajima [24, p.166] states that the similarities between this economic unit and the traditional household are much greater than that between the farmer and firms. He mentions that the essence of those similarities is found in the fact that:

> Both seem to have essentially the same objectives: they seem to aim at the maximization of their utilities which are the functions of income and of the quantity of family labor used, or instead of the latter, leisure.

Therefore, the family farm can also be regarded as a utility maximizing unit. But, there still are some essential differences between the family farm and the traditional laborer's household. Those differences consist basically of their way of getting income or "mathematically in their income equation" [24, p.166]. In the case of the laborer's household, the maximization of utility is subject to a budget constraint represented by a fixed amount of income. However, in the family farm operation the income is itself a function of the production activities carried out on the farm. It means that in the latter the income equation contains the production function of the farm.

Other authors have also formulated the rational behavior of small farmers as utility maximizer units, in which their consumption depends on the income generated by their production activities [5, 17, 30].

In essence, the rationality of small farmers acting as economic units, is summarized by Nakajima [24, p.166] in the following way:

> We can say that the economic behavior of a family farm is "rational" when the family farm has achieved subjective equilibrium, i.e. when it has realized the maximizaton of its utility, subject to its income equation.

Therefore, given that the income for the family farm is variable, the assumption made is that the family farm always strives to achieve utility maximization. With regard to the utility maximization conditions, Sen [30, p.426] states that the family welfare is maximized when the marginal product of labor equals the "real cost of labor". And, he defines the real cost of labor as given by the "individual rate of indifference substitution between income and work."

Also, under the Chayanovian interpretation of the farmer's economy, the highest total returns to labor are the goal of allocation decisions of the family.

The concept of income that is assumed to be relevant for the family farm, includes both the monetary income and the in kind income.

The Subjective Equilibrium

As previously stated, the first objective pursued by the family farm in its economic behavior can be summarized as the achievement of utility maximization.

Using this premise, the set of assumptions and necessary conditions for the farmer's economy to reach an equilibrium will be formalized in the model below. It consists of the simplest model used by Nakajima [24] to demonstrate how the family farm economy reaches an equilibrium point. The set of assumptions has been simplified for this purpose. Even though this model may not be the most adaptable to the small farmers' situation described earlier, it is considered important because it allows for a better understanding of the kind of economic relationship present in the farmers' behavior. A more complete and adaptable model is developed later in this study.

Model A

The basic assumption is that the farm operates under a perfect competitive market for the farm product, but no labor market exists. Then, the family farm sells all its production and uses only family labor.

The set of assumptions regarding the utility function are:

$$U = U(A,M) \tag{1}$$

where A represents the labor hours which the whole family works in a year, and M stands for the amount of farm family income for the same period.

$$\bar{A} \geq A \geq 0 \tag{2}$$

$\bar{A}$ is used to represent the physiologically possible maximum number of labor hours for the whole family which places a constraint on the total labor used. Also:

$$U_A < 0, \; U_M > 0 \qquad (3)$$

That is, the marginal utility of labor is negative and the marginal utility of income is positive.

Because of the assumptions expressed in equation (3), the indifference curve that represents the relationship between income and quantity of family labor used, will slope upward and to the right (see Figure 1).

It is possible to remain on the same indifference curve only if a rise in (A) family labor is compensated by the corresponding rise in (M) family income. Therefore, indifference curves must slope upward and to the right.

The slope of the indifference curve, expressed by $-U_A/U_M$, represents the valuation of a marginal unit of family labor utilized by the family itself, or the "marginal valuation of labor" [24].

Regarding the production and income of the family farm, the following assumptions are made: (1) The farm produces a single product whose price, P_X, is given to the farm as determined on the market. (2) Factors of production used are land (B) and labor (A). (3) Land cannot be leased. (4) The acreage of farm land (B) owned and operated by the family farm is fixed. And (5) the technology of the farm is

FIGURE 1. Indifference curves between income and work for a "family farm"

expressed by a production function, F(A,B).

Therefore, the farm income equation is of the form:

$$M = P_X F(A,B) + E \qquad (4)$$

where E stands for other income from nonfarm assets. For the production function the assumption is that the marginal productivity of labor is nonnegative and decreasing, i.e.

$$F_A \geq 0; \; F_{AA} < 0 \qquad (5)$$

Then, maximizing (U), the utility function (1) subject to (M) the income equation (4) we have:

$$P_X F_A = -U_A/U_M \qquad (6)$$

This implies that for the family farm in equilibrium, the "marginal producitivy of labor" ($P_X F_A$) equals the "marginal valuation of family labor" ($-U_A/U_M$). The equilibrium values of (A) the family labor used and (M) the family income are determined by solving the simultaneous equations (4) and (6). Then the amount of output (F) is determined by the production function [24].

The above stated equilibrium is represented in Figure 2. The curve L_1 represents the production possibility curve. Because it starts at point E, which represents the family income for nonfarm assets, the L_1 curve could also be referred to as the "family income curve".

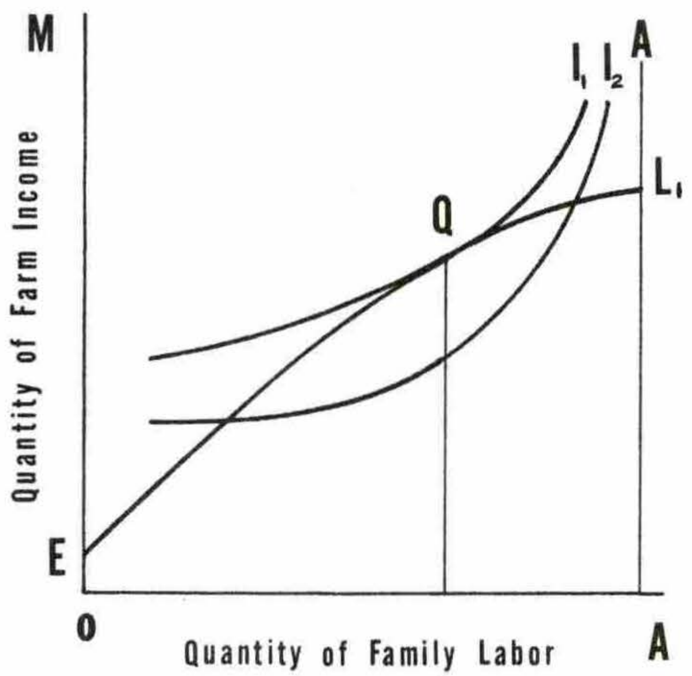

FIGURE 2. Family farm's equilibrium

The equilibrium point is represented by Q, and is given by the point where an indifference curve is tangent to the family income curve. In other words, at this point of tangency, the marginal valuation of family labor (slope of the indifference curve) equals the marginal productivity of labor (slope of the L_1 curve).

Because it is assumed in this model that the family farm does not sell its labor in the market, the equilibrium reached is considered to be independent for each family. This equilibrium will vary among families depending on: the quantities of nonlabor resources the family owns; the number of workers on the farm; and the number of dependents on the farm.

The model just presented can be brought closer to the most common behavior of farm families by allowing the family to hire in or hire out labor, and to decide between sale and consumption of its output. This situation gives rise to a second model which is considered to be more adaptable to reality. This model represents Krishna's contribution [17] to family farm analysis.

Model B

The assumptions are that the family farm uses one variable input (labor, partly family and partly hired); produces one output (partly sold and partly retained); and maximizes:

$$U = U(A, X, M) \qquad (7)$$

where A, as before, stands for the total amount of family labor used; X represents the amount of product consumed, which means "income in kind" for the family; and M is the portion of the output that is sold in the market, which is the monetary income. Then:

$$U_A < 0, \qquad U_X > 0, \qquad U_M > 0 \qquad (8)$$

which expresses that the marginal utility of labor is negative, and the marginal utility of monetary and inkind income is positive. The income equation is:

$$M = P[F(A', B) - X] + W(A - A') \qquad (9)$$

where A' stands for the labor input on the farm, whether it comes from the family itself or from off the farm. And, W stands for a given wage rate.

In this case, (A) the total quantity of family labor used could be greater, equal to, or less than (A') the labor used on the farm. When $A > A'$ then $(A-A')$ represents the amount of family labor supplied outside, and, when $A' > A$, the $(A'-A)$ stands for the labor hired from outside to work on the farm.

Maximizing (U) the utility function (7) subject to (M) the income equation (9), we have:

$$PF_{A'} = W \qquad (10)$$

$$\frac{-U_A}{U_M} = W \qquad (11)$$

$$\frac{U_X}{U_M} = P \qquad (12)$$

which implies that: (1) The labor input for the production activities of the family farm (A') is determined by the equality of the value of its marginal product ($PF_{A'}$) with the wage rate (W). (2) The total family labor that the family uses in activity on and off the farm (A) is given by the equality of the marginal valuation of family labor ($-U_A/U_M$) with the wage rate (W). And, (3) the retained output for family consumption (X) is determined by the equality of the marginal (subjective) valuation of retained output (U_X/U_M) with the price (P_X) [17].

Comments

Comparing the equilibrium conditions in Model B with the same in Model A, we see that in the former the maximization conditions for total family labor used and output consumed on the farm are determined with reference to the market wage and market output price respectively. In the latter model, the equilibrium condition for the family labor used (on the farm) is stated with regard to the subjective marginal valuation of family labor. The reason for this differentiation is based on the assumption of family participation in both markets - the factor and product markets.

In fact, the results of Model B are equivalent to the profit maximization and utility maximization conditions required by the theory of the firm and the theory of consumer choice taken independently [24]. The difference is that for the family farm, acting under the assumptions stated in Model B, profit maximization and utility maximization are reached simultaneously.

Once again, it is important to remember that Model B represents the theoretical formulation of the small farmers' economy given the set of assumptions previously made. In practice, the results of this model are equivalent to ex ante equilibrium values. They are the values which the family farm may use as references when deciding its economic activities, some time before it starts production [24]. Nevertheless, different conditions, not controllable by the farmers, may cause the ex post results to differ significantly from the expected ones.

SMALL FARMERS' DECISION MAKING PROCESS

In this part of the study, the conditions under which small farmers make their allocational decisions with regard to: (1) the use of labor; (2) the sales or the consumption of products; (3) the use of land; and (4) the adoption of new technologies, will be discussed. The appraisal will include both: (a) the theoretical formulation of the allocation conditions given specific assumptions, and (b) the more practical circumstances under which such decisions currently are made.

Labor

In the context of a competitive market for labor, the amount of labor (family and/or hired) that the family farm is willing to allocate to production activities is given by the point at which the marginal value created by the additional unit of labor ($PF_{A'}$) equals the market wage rate (W). This allocation criterion is formalized mathematically (see Model B) as follows:

$$PF_{A'} = W$$

On the other hand, the total amount of family labor that the family farm is willing to use, on its own production and/or working outside the farm, is given by the point where the marginal valuation of labor for the family

($-U_A/U_M$) equals the market wage rate (W):

$$\frac{-U_A}{U_M} = W$$

What is implied above is that, under perfect competition, a wage rate, which is the relevant point of comparison by which the small farmer makes labor allocation decisions, is observable in the market.

Nevertheless, this assumption of competitive conditions in the labor market hardly can hold for the traditional agricultural sector of the LDCs. According to the theories of economic development, in many LDCs the existence of a dual economy in which a "modern commercialized industrial sector has developed alongside a traditional subsistence sector" [18, P.125] is recognized. According to Fei and Ranis [12, p.3], this particular type of underdeveloped economy is characterized by:

> The coexistence of two sectors: a relatively large and overwhelmingly stagnant subsistence agricultural sector in which institutional forces determine the wage rate, and a relatively small but growing commercialized industrial sector in which competitive conditions obtain in the input markets. The labor surplus nature of such a dualistic economy is underlined by the fact that, given existing production conditions in the two sectors, labor is a nonscarce factor while capital is extremely scarce.

The presence of the labor surplus in the traditional agricultural sector has been explained by Fei and Ranis [12, p.15] as "the existence of a redundant agricultural sector labor force which is unable to make any contribution to the sector output." This labor surplus approach commonly has been associated with the assumption of zero marginal productivity of labor, which implies that the redundant labor can be withdrawn from the sector labor force and the sector output will not be reduced.

Sen [30] has analyzed the problem of the dualistic economy and accepts the fact that agricultural labor surplus exists in LDCs, but, he also expresses that marginal productivity of labor equal to zero is not a necessary, nor a sufficient, condition for the existence of surplus labor. He showed that surplus labor can co-exist with positive marginal productivity of labor.

The relevance of this problem of surplus labor for this study is that it provides a basis upon which to explain the imperfection in the labor market that allows for the existence of a positive wage outside the peasant economy when there is surplus labor inside.

While the surplus labor approach has been used to explain differences in wages between the agricultural and the industrial sector, Sen [30] also assumes that such differences exist within the agricultural sector between wage based farms and family-based farms when he points out that, "There is usually a substantial gap between the wage rates outside the peasant economy and the real cost of labor (and, therefore, of marginal productivity) inside it" [30, p.438].

Sen [30] expresses the "wage gap" to be that in which the wage rate (W) earned by hired labor is higher than the equilibrium real cost of labor (x) which has been defined as the individual rate of indifference between income and labor or the family valuation of its members' work. In practical terms, this concept of the wage gap is important in helping to explain the higher quantity of labor applied per acre for family farms, compared with larger farms run with hired labor. It has been proven that such a wage gap exists when family income has been calculated imputing the market wage for family labor consumed. As a result, income has become negative, which implies differences in valuation of the labor used [4, 30].

Sen [30] gives a warning about ignoring the wage gap when he says that, "If the family-based farms did have to pay the market wage rate for their labor, they would not have applied that much labor, and would certainly avoid the 'loss'."

As is mentioned by Barlett [4, p.142], according to Chayanov: "in a family farm economy, the category of wages is missing and to attribute a wage to unpaid family labor is to distort their decision process."

The above stated situation illustrates the danger of analyzing peasant equilibrium assuming a competitive market in the traditional agricultural sector. But, the question is, what, in fact, explains the existence of this market distortion expressed in the wage gap?

First of all, given the characteristics of agricultural activity, there is not a homogenous unit of labor due to the seasonality of the production tasks. The opportunity cost for a unit of labor is not always the same. A unit of labor at harvest time is not replaceable by a unit of labor at a slack period. Sen [30, p.440] mentions the fact that:

> At the harvesting time many peasants' families themselves hire outside labor. Around this busy season the labor market becomes much more perfect, and we could even assume that the wage gap disappears at this time of the year.

Therefore, for Sen [30] there exists a period in which there is no wage gap ($x = W$) and another in which the wage gap is present ($x < W$). The same concept is also found in Nakajima's work. Using his model, Nakajima [24] expresses the seasonality of agricultural production as a differentiation between the allocational condition for a busy season and that for a slack season. He points out that (in a nonlabor market economy) the amount of family labor utilized and the marginal productivity of labor in the busy season is higher than that in the slack season.

The explanation for the existence of the wage gap during some periods is that at those slack periods there are no job opportunities anywhere else. Therefore, the opportunity cost of family labor can in fact be zero during this period.

Land and Product Mix

In the earlier mentioned Model A and Model B, land has been held constant in order to work out the equilibrium conditions for the family farm economy. If the assumption of a perfect market for land is made, changes in the amount of land owned and operated by the family can be evaluated in the models. But, it only gives response to the effects on money income (positive as quantity of land is increased) and the value of the marginal product of labor (also a positive response as land is increased) [17].

According to Sen [30, p.441], if a competitive market for renting land would hold (he assumes marginal productivity of land higher for peasant farmers) "it will be in the interest of the capitalist farmer to rent his land out to the farmers." Nevertheless, as in the case of the labor market, the existence of a competitive market for renting or buying land can hardly be accepted.

In fact, Sen points out that, "The imperfection of the land market is quite a fair assumption for most underdeveloped countries" [30, p.441]. Those imperfections of the land market are reflected in: (1) the almost total impossibility for renting land because of various regulations on land operations that have become a common practice in LDCs; (2) the higher prices for land faced by the small farmers when they are interested in buying small plots (those small parcels of land are usually valued at higher prices per hectare [1 hectare equal to 2.471 acres] than large tracts of land); and (3) the higher cost of capital that small farmers must usually face when they borrow money in order to purchase land. This is the case since they have in most instances been forced to use noninstitutional sources of credit, at higher interest rates. This has been so because of the small farmer's lack of assets to offer as collateral when seeking long term credit. In the end, the results are that the real price of land for small farmers has become extremely high.

Taking into account these land market imperfections, Bardham [3, p.53] used a comparative-static approach to test a set of hypotheses about the circumstances under which land tenancy can occur and he found that:

> (a) the percentage of area under tenancy will be higher in areas where the land improvement factor is larger (i.e., soil fertility, rainfall, irrigation, etc. is better); (b) the larger the degree of imperfection in the market of inputs complementary with high-yielding variety of seeds (or in the market for credit with which to buy these inputs), the lower the percentage of area under tenancy; the larger the labor intensity of the crop harvested, the higher the percentage of

area under tenancy (alternatively if there is a labor saving technical change reducing the harvesting labor requirement - say, through the introduction of harvestors - tenancy will decline); (d) the percentage of area under tenancy will be smaller in areas with higher interest rates on credit; (e) the larger the extent of unemployment facing landless households, the higher the extent of tenancy.

If the above mentioned circumstances hold for the land market, the question arises as to how free small farmers are to consider variable quantities of land owned or under operation. Moreover, those circumstances might lead the researcher to believe that small farmers are unable to make decisions in that sense. Barlett [4] mentions that as a result of a study on family farms, Chayanov accepts that those units do make certain kinds of allocation decisions but he rejects the idea that some farms have variable allocation of land as well.

What is important then, is to determine what kind of factors influence decisions on the family farm regarding allocation of a fixed amount of land to different activities, i.e., annual or perennial crops and livestock, as well as the element influencing decisions about the product mix to be adopted. Krishna [17, p.188] says that "what the farmer decides directly is an output mix achievable with the technology familiar to him and the resources available to him." In fact, the pure profitability measure is not enough to allow the small farmers to make a decision about the kind of products they are going to farm. If it were so, there would be no reason for the small farmers to avoid shifting from the traditional crops, such as corn, to the more profitable ones such as cotton or vegetables, which will allow farmers to increase their income. The availability and quality of the resources under the control of the farmer certainly places an important constraint on the kind of activities that can be undertaken. The other factor is related to the knowledge of how to perform the activities that farmers choose to develop. Usually, the technology utilized has experienced little change over long periods of time. And, since, as we have said before, the farmers' major concern is to provide the family with basic food, the element of security influences their decisions when they choose those products that they already know how to crop. The concept of security is defined in this case as minimizing risk.

One more factor that is involved in the choice of crop combination is time. While some products such as coffee could possibly be cropped by small farmers, giving them high returns, it takes several years for these products to mature and produce and the farmers may not be able to afford to wait until they can market the product. If all these factors place limitations on the decision marking process regarding production activities, the result is that the alternatives are also limited. As Berry [8, p.327] mentions:

> When actual costs and returns to alternative agricultural activities are fully and accurately measured, it often turns out that poor farmers prefer, for example, subsistence to commercial production, or mixed to mono-cropping, or existing cultivation methods to new ones, because it pays them to do so. Such choices frequently lead to higher income than would the supposedly more productive alternatives, given the constraints under which poor farmers produce, sell and consume.

Market Participation

In the context of the small farmers' economy, output is allocated primarily between family consumption and sales. In Model B, described earlier in this paper (equation 12), the quantity of output retained for the family's own consumption is given by the equality of the marginal (subjective) valuation of the retained output (U_X/U_M) with the output price (P_X):

$$\frac{U_X}{U_M} = P_X$$

This suggests that the family make a subjective appraisal of the utility obtained from the consumption of a unit of product, compared with the alternative of getting monetary income to obtain other products in the market. And, the decision is made only when these two elements are equal for the family farm unit.

The same conclusion is reached by Sen [30, p.428] when he says that:

> The product should be divided in such a matter between direct consumption and exchange in the market that the relevant marginal rate of indifference substitution between the two commodities equals their price ratio.

What is implied in these allocating conditions is that farmers face a competitive market for the product, This is, in fact, a tenable assumption in most LDCs. The fact that they produce food commodities which are staple for the bulk of the population in each country contributes to the occurrence of the competitive market. Nevertheless, the same fact influences the decisions about the amount of product retained. In practice, the subjective valuation of such product depends on many factors: the conditions of existing transportation and marketing facilities; the seasonality of the production; and the existence of storage facilities [4]. In many rural communities in which transportation facilities are poor, farmers who sell their product and rely on the market for their own comsumption needs may eventually pay higher prices for staple foodstuffs than they receive for selling the same commodities.

Seasonal fluctuations in food prices may also raise the cost of meeting household consumption needs by purchase, especially in years of poor harvests. Therefore, the decision of keeping part of their output gives them the security of family survival. But, at the same time, high storage costs or nonexistent or inappropriate storage facilities may prevent poor farmers from accumulating their own buffer stock in good years to cover household needs in years of poor harvests [8].

Technology

In the models described earlier, production is assumed to use two inputs: land, which is fixed, and labor. If another input is introduced to the model, for example fertilizer, the price of which is given or can be determined by its market, then, the equation for the farm family's income will be:

$$M = P_X[F(A',C;B) - X] + W(A-A') - P_C C$$

where (C) is the amount of fertilizers used and (P_C) is its given price. The equilibrium condition for the new input is:

$$P_X F_C = P_C$$

which means that the marginal productivity of that input ($P_X F_C$) equals the input price (P_C) [24].

Theoretically, this implies that the small farmer decides whether or not to use a new input in the production process, based on the contribution that such an input makes to income. If this were so, then what stops small farmers from adopting new technology? What are the practical circumstances under which these decisions are made?

It has been recognized that traditional methods of cultivation are still in use in most LDCs among small farmers [28, 32, 34]. Knowledge of traditional technology has been carried down through generations orally or by demonstration. These traditional methods of production have experienced so little change over time that it is considered that all available agricultural technology is being used by farmers. Hence, no new technology that would increase production is known to them. This does not imply that such technology does not exist. But, any interest to switch methods will require a learning process and many adjustments for the farmers.

Therefore, in order for farmers to make their decisions about introducing new methods of production or using new inputs, the considerations they make cannot only be evaluated with respect to the additional expenditure in buying the new input or investing in new tools. An additional cost is automatically charged by farmers to the input due to risk and other implications that the adoption of new technology means to them. Technical opportunities, even where they exist, may not be economical to implement, and it would be misleading to assume that all new technologies made available to the small farmer will be profitable to him.

Provided that the necessary funds for purchasing these inputs exist, the adoption of new practices may be restricted by the lack of availability of the new inputs at the right time and/or at the right place. Usually, the success of new technology depends on a balanced application of several inputs, and the absence of any one may adversely affect the benefit to be gained from using the others. New technology also requires, on many occasions, the availability of some kind of infrastructure that is not under the control of farmers, i.e., irrigation facilities. For example, the new seed varieties are much more productive when water application can be controlled. The lack of such facilities represents in many cases a high risk that the small farmer is not willing to take.

One more factor that is taken into account by small farmers when making decisions about technological changes, corresponds to the fact that when they adopt new technology, the source of agricultural inputs shifts from within the peasant villages to external suppliers. In this way, small farmers become increasingly dependent on the rest of the economy [32].

Risk

All the aforementioned elements that bring about the imperfections of the markets in which traditional agriculture takes place, make the static-equilibrium type models unable to fully explain the small farm household behavior. The need then arises for a more dynamic and realistic model that explains small-farmer behavior under uncertainty. It has been recognized that in general, agriculture activity is highy risky and as Stevens [32, p.249] mentions, "Risk aversion is a rational and almost universal characteristic of small farmers" particularly when they are dealing with a family's subsistence food crops. Risk aversion is present in a family's decisions with regard to the adoption of new technologies, the combination of products to crop or the product-mix selected, and in many cases the use of credit.

In order to take into account this risk aversion of small farmers in traditional agriculture, the introduction of new elements in the models representing the small-farm household economy is needed. These new elements are represented by the introduction of a new cost in the income equation which stands for the additional expected return demanded by farmers as compensation for taking risk. If farmers could participate in a crop insurance program - as it is the tendency lately to induce this kind of program -

the risk term would be the marginal premium a farmer would be willing to pay to insure against risk, i.e., a certainty equivalent cost [14].

Comments

By setting out the theoretical propositions for the agricultural economy and by facing it with the set of real circumstances under which small farmers make decisions and operate, we are taking the challenge of confronting theory and reality. By doing this, we risk concluding that there is no way to analyze the small farmers' economy in a scientific systematic way. But, it is not to say that these two elements - the theoretical formulations and the real circumstances - do not provide us with useful patterns for asking the right kind of questions and seeking the relevant constituents of any economic reality.

In the process of searching for responses to these questions it has been found that some economists, when studying traditional agriculture, have come to the conclusion that small farmer operations reach an economic equilibrium but at lower levels of productivity [29, 32]. This concept represents the masterpiece of Schultz's analysis [29] of traditional agriculture. He establishes that when allocative efficiency and lower productivity are coupled with small farm size, traditional farmers can be described as "efficient but poor" [29]. That means that under the time tested traditional agricultural knowledge, small farmers are doing the best that they can do.

Stevens [32, p.10], in his analysis of low productivity and slow growth of traditional agriculture, points out that, "Economic theory of traditional agriculture and empirical studies support the hypothesis that traditional peasant farmers are 'caught in a technical and economic equilibrium trap.'"

The two major sources that have been identified as capable of increasing productivity in traditional agriculture then are: technological change and institutional innovations.

Changes in agricultural technology are obtained through the application of the whole range of modern science and technology to agricultural production processes. According to Stevens [32, p.13], "This fundamental process is the source of increased agricultural productivity, the production of more products with less resources."

Researchers have taken the challenge of developing new technology to accomplish higher productivity levels. And, at the same time, governments in many countries have undertaken institutional innovations through the implementation of different programs, i.e., credit and extension. Experience shows that in some low-income countries, those technological changes and those government programs have given the right results (Taiwan, India, Mexico). But still, these experiences have not been enough to completely overcome traditional agriculture. Even in the countries where these projects have succeeded, they have been unable to totally integrate the whole small farmer population. As a result, the largest part of the LDCs' rural population is still involved in traditional agriculture.

The problem of analyzing traditional agriculture has certainly caught the attention of many agricultural researchers. Three main groups can be identified as beig interested in explaining small farmer behavior in its struggle to operate and change:

1. Those who have formalized the economic behavior of small farmers in a systematic way, and have presented it in quantitative static-equilibrium type models, trying to give form to the theory of a peasant economy;
2. The group which recognizes the need for a specific theory for analyzing small farmer behavior has concentrated on the identification of circumstances under which those farmers operate; which has led to the introduction of risk variables in these models; and

3. Those who have focused exclusively on the technical relationships of small farmers' operations and have ignored their economic motives to act.

The contributions of the first and second groups have been considered to be important for the purpose of this study which primarily attempts to increase the understanding of small farmers' economic behavior. In fact, it has been considered that the second group of researchers has adequately taken into account the technical concerns of the third group in a more realistic manner.

From those who have formalized the economic behavior of small farmers, the works of Nakajima [24] and Krishna [17] are valuable contributions in terms of systematization of theory. Nevertheless, those authors failed to fully consider the real characteristics of the existent institutions in the society under study, i.e., the kind of market relationships. However, the propositions found in Sen's work and the elements identified by the second group of researchers described above [4, 8, 14, 32] can bring about the formulation of a consistent theory for the small farmers' economy.

This study does not intend to formulate such a theory, but it is certainly recognized, as Meier [18, p.59] says that, "theory is in the first and last place a logical file of our factual knowledge pertaining to a certain phenomenological domain," therefore, such knowledge can only be reached when the theoretical propositions are consistently tested against reality.

AREA OF STUDY AND SOURCE OF DATA

Description of the Area

General setting

The general setting for this study is the Republic of Honduras, which has a total area of 112,088 square kilometers, a population of 3.5 million, and a basically agricultural production structure.

The agricultural sector accounts for 33% of the gross domestic product (GDP); 75% of the exports; and 68.6% of the national population depends on the agricultural sector for its livelihood [26].

It has been estimated [1] that approximately 83% of the total land area is best suited for forest and grazing. Of the remaining land suitable for annual crops and for perennial crops, only about one-third of the former and one-fourth of the latter are being utilized.

The rural population, which is composed of approximately 346,000 families, differs in production activities and income primarily as a result of the availability of resources.

The United States Agency for International Development (AID) has classified rural families in Honduras into four major categories: commercial private farms, including the large multinational plantations; agrarian reform farms;

small traditional farms; and the landless labor force. The distinction between commercial and traditional farms has been arbitrarily made by using a land size proxy, which is related to income level. Farms from 1 to 35 hectares have been considered traditional farms; and farms over 35 hectares have been classified as commercial farms. Also, farms with less than one hectare have been included in the landless group [1].

AID estimates that: (1) the largest group is the landless labor force, 153,209 families equivalent to 44.3% of th total; (2) the following group is the traditional farmers, 149,104 families which account for 43.1% of the total; (3) the next group is the agrarian reform unit families, 32,165 or 9.3% of the total; and (4) the smallest group is composed of the commercial farmers and adds up to 11,512 families and represents 3.3% of the total rural families.

The average annual income per capita estimated for the traditional sector is U.S. $135 (ranging from $83 to $260 depending on the farm size); for the land reform units the estimation is $106; and for the landless group it is $50 to $63 [1]. No estimation of the income earned on the commercial farms has been found.

The traditional farmers group represents 76.3% of the total farm units (excluding landless workers) and has control of over 36% of the farm land; the agrarian reform group farms represent 0.5% of all farms and controls 6.0% of total farm land; and the commercial farm units constitute 5.9% and control 57.2% of all farm land [1].

Characteristics of the region of study

For the analysis of the agricultural sector and the implementation of sector programs, Honduras has been geographically divided into seven regions (see Figure 3). In order to carry out this study, region No. 5, the Nor-Oriental region, has been selected. This region is defined by or covers the entire departamento of Olancho ('departamento' refers to the form of political division in Honduras). And, in this work, we will refer to it as the region of Olancho.

Olancho was chosen as the specific setting for this study due to the importance that the government of Honduras is giving to this area in the implementation of agricultural programs and projects. It was expected that, given such interest in developing the area, adequate information that could increase the knowledge and understanding of the behavior of small farmers could be very useful.

The total area of the region of Olancho is 24,350 square kilometers, which accounts for one-fifth of the area of Honduras. Its population is estimated at 151,436 inhabitants, representing 4% of the country's total

FIGURE 3. Agricultural regions in Honduras and representation of area of study

population. According to the 1975 Honduran population census, the rural people of Olancho account for 84% of the total population in the region [21].

In 1974, the number of families operating agricultural units in Olancho totaled 13,716; this figure does not include the rural landless labor force in the region. The total area owned or operated by those families running farms in Olancho is estimated at 232,614 hectares [20].

The data provided by the publication of the 1974 Honduran agricultural census [20] does not use the same divisions as does AID; instead, it allows for an isolation of this group from the range of 20 to 50 hectares. Therefore, the range of up to 20 hectares is used in this study to characterize the group of traditional farms. The group accounts for 11,676 families, and represents 85.1% of the total farms in Olancho. The area operated by the traditional farmers adds up to 58,226 hectares which is 25.0% of the total area under operation. The second group, farmers with farm size of from 20 to 50 hectares, is made up of 1,290 families or 9.4% of the total. And, it makes use of 39,368 hectares representative of 16.9% of the total area in the region. The last group, according to the AID classification, the commercial farms, includes 750 farms, representing 135,020 hectares or 58.1% of the total farm land (see Table 1). In the remainder of this part of the study the second and third groups just described will be combined into a single group. This is due to the interest in isolating the characteristics of the first group (farms with less than 20 hectares) which includes the range of farm sizes for which the empirical analysis will be carried out. And then, those characteristics will be contrasted with the rest of the farmers in the region.

As is shown in Table 2 use of land in the region of Olancho is represented by the following figures: 22.8% of the area is cropped; 54.8% is maintained in pasture; and 19% is covered by forest or bush, or is used for other nonagricultural activities.

The group of traditional farms, operating on less than 20 hectares, actually crops 55.4% of its land; it maintains 21.6% in pasture; and forest and other uses represent 16.8%. In the group of farms larger than 20 hectares, only 11.9% of the land is cropped; 65.9% is used for pastures; and the area with forest and other uses represents 19.7% of the total land in the group.

Another interesting feature of the region of Olancho is given by the land tenancy pattern. According to the 1974 agricultural census, only 29.9% of the land under operation was under private ownership in the entire region; 48.4% of the total land was public land being operated by individual farmers; 15.5% was under the sharecropping form of land

TABLE 1. Distribution of farms and farmland by farm size in Olancho, 1974[1]

Farm Size (hectares)	Number of Farms	% of total Farms	Total Land (hectares)	% of total Land
Less than 5	7,560	55.1	17,491	7.5
5 - 9.9	2,480	18.1	17,870	7.7
10 - 19.9	1,636	11.9	22,865	9.8
	11,676	85.1	58,226	25.0
20 - 49.9	1,290	9.4	39,368	16.9
50 and over	750	5.5	135,020	58.1
Total Region	13,716	100.0	232,614	100.0

[1] Source: [20].

TABLE 2. Use of land in Olancho, 1974[1]

Use	Total Region (hectares)	%	Less than 20 hectare-farms (hectares)	%	20 hectare and over-farms (hectares)	%
Annual Crops	36,846	15.9	22,424	38.5	14,422	8.3
Perennial Crops	16,158	6.9	9,872	16.9	6,286	3.6
Fallow land	7,978	3.4	3,577	6.2	4,401	2.5
Pasture	127,448	54.8	12,597	21.6	114,851	65.9
Brush, Forest and other uses	44,184	19.0	9,756	16.8	34,428	19.7
Total Region	232,614	100.0	58,226	100.0	174,388	100.0

[1] Source: [20].

exploitation; the rented land in the total region represented 3.1%; and other nonspecified forms of tenancy make up the remaining 3.1%. With regard to the two groups described in this study, it was found that the form of tenancy differs substantially between them. The amount of land being held in private and state ownership represents 19.1% and 63.1% respectively for the group of traditional farms; while for the larger farms these figures are 33.5% and 43.4% respectively. This means that smaller farms have been dependent on public land to a greater degree than larger farms. On the other hand, sharecropping represents a higher proportion of the land in the latter group, 17.1%, compared with 10.9% in the former group of farms. The proportion of rented land is higher in the group of smaller farms, 6.1%, than in the large farm group, only 2.1% of the total land (see Table 3).

The bulk of the agricultural production in Olancho consists of six main crops and livestock. In 1974, corn was the most important crop in terms of area planted. It accounted for 28,199 hectares. Small farms produced 62.6% of the corn in the region and larger farms produced the other 37.4%. The next most important annual crop was beans which used a total of 8,396 hectares in the whole region during the year of 1974. Of the total bean production, 79.4% came from the traditional farms and the difference,

TABLE 3. Land tenancy in Olancho, 1974[1]

Form of Tenancy	Total Region (hectares)	%	Less than 20 hectare-farms (hectares)	%	20 hectare and over-farms (hectares)	%
Private Ownership	69,548	29.9	11,098	19.1	58,450	33.5
State Ownership	112,511	48.4	36,742	63.1	75,769	43.4
Rented	7,215	3.1	3,557	6.1	3,658	2.1
Share cropped	36,085	15.5	6,343	10.9	29,742	17.1
Other Forms	7,255	3.1	486	0.8	6,769	3.9
Total Region	232,614	100.0	58,226	100.0	174,388	100.0

[1] Source: [20].

20.6%, was produced by the larger farm group. This product is followed by cotton, in terms of area planted. Cotton represents a cash crop for the farmers and a total of 2,681 hectares was planted in this product in 1974. A total of 85.6% of the production of cotton came from the commercial farms; the traditonal farms cropped the 14.4% difference. The fourth most important annual crop in Olancho was rice which together with corn and beans represents the staple food for the general Honduran population. The area planted with rice in 1974 was 1,523 hectares. Traditional farms cropped 53.5% of the total rice production.

Two other important crops in the region of Olancho are the perennial crops, coffee and sugarcane. Coffee itself accounts for 9,905 hectares in production. Of the coffee produced, 56.9% was provided by the group of small farms. The group of large farms provided 43.1%. Sugarcane was planted on a total of 1,367 hectares; a higher proportion, 74.9%, of the production came from the small farms (see Table 4).

Livestock production in Olancho in 1974 was as follows: cattle -- 195,701 head; hogs -- 68,505 head. Of the cattle, 33.0% along with 76.7% of the hogs belonged to the group of small farms. The rest, 67.0% of the cattle and 23.3% of the total hogs were the production of the larger farms [20].

TABLE 4. Production of crops in Olancho, 1974[1]

Product	Total Region: Area Cultivated (hectares)	Total Region: Production (m.t.)	Less than 20 hectare-farms (m.t.)	%	20 hectare and over-farms (m.t.)	%
Annual Crops[2]						
Corn	28,199	51,114	32,011	62.6	19,103	37.4
Beans	8,396	5,561	4,413	79.4	1,148	20.6
Rice	1,523	2,229	1,192	53.5	1,037	46.5
Cotton	2,681	4,222	609	14.4	3,613	85.6
Perennial Crops						
Coffee	9,905	2,549	1,451	56.9	1,098	43.1
Sugar Cane	1,367	24,580	18,414	74.9	6,166	25.1

[1] Source: [20].

[2] The number of hectares in annual crops is higher than the number shown in table 3 because some farmers reported two crops of corn and beans on the same land.

Source of Data

The data used in this study come from a sample from a more extensive farm level survey carried out in 1976 by the American Technical Assistance Corporation (ATAC) for the government of Honduras (GOH) and the Agency for International Development (AID).

The survey included small farms and land reform unit operators; it covered four agricultural regions of Honduras; and it was in reference to the agricultural year of 1975.

With regard to the small farmers, two main sources were used to select interviewers for the survey: (1) the population of customers of the Banco Nacional de Fomento (BNF) which is the governmental agricultural credit institution in Honduras; and (2) the closest neighbors to those who had received the institutional credit.

In the first case, the selection was made by taking a random sample of the BNF clients who were provided with credit in 1975. Then a process of elimination of cases was carried out in order to limit the sample to those farmers who have owned or operated a maximum of 14 hectares of land. The second group of potential interviewees was chosen in the field at the time of the survey. For each BNF client there was selected a BNF nonclient whose characteristics in terms of size of the land owned or operated, and the geographic location of the farm were similar to those of the former

[2]. This second group of farmers was treated as a control group for those farmers who operated with credit.

The survey covered a total of 1,086 small farms in the four regions. One year later, and as an activity of the Agricultural Sector Assessment for Honduras [1], AID carried out a replication of that survey covering 987 small farms in the remaining three agricultural regions of Honduras. The total data, 2,073 observations, represent the basic farm level data to be used in the micro-analysis component of the sectoral assessment.

For the purpose of this study, a sample of 135 observations was taken from that larger survey. Those observations represent the credit recipients in the region of Olancho.

Farmers included in this sample owned or operated agricultural units ranging between 1 and 14 hectares. The reason for selecting only one region and only small farmers with credit was the impossibility of accessing information directly from the computerized files. Errors in handling those files caused damage to the data storage, such that for this study it was necessary to collect the information directly from the questionnaires.

A total of 196 original variables was coded from the original questionnaires. These variables deal with: (1) use of land; (2) composition of the capital; (3) the set of production activities carried out during the period; (4) distribution of production; (5) indirect costs incurred during the period; and (6) information regarding the amount of credit received and the amount owed at the end of the year.

Even though the sample is not representative of the total population of small farmers in Honduras, and even though it is not representative of all small farmers using credit in the country, it is suitable to analyze the group of credit users in the region of Olancho within the range of farm sizes of the sample.

The analysis carried out in this study is considered to be demonstrative in the sense that the same set of hypotheses listed in this study could, at a later date, be applied to the more extensive data covering all regions of Honduras.

Comments

The set of figures characterizing the rural population in the Republic of Honduras in general, and that in the Olancho region in particular, gives insight into the importance of the role of the small farm group in the context of the economy of the country. It is clear from the numbers stated that, even though small farms may face many constraints in their daily operation, they certainly are contributing to the production process. This is especially true for the production of food consumed in the region. With the exception of cotton, small farmers contribute the largest share of the total output in the Olancho region. However, the real condition under which these farmers operate will be assessed carrying out an empirical analysis of a group of credit recipients in the region.

EMPIRICAL ANALYSIS OF ECONOMIC BEHAVIOR OF CREDIT RECIPIENTS IN OLANCHO

Hypotheses of Study and Methodology

Hypotheses tested

Three major hypotheses are tested in the present study:

Hypothesis I: The elements that structure the economy of the group of farmers being studied are characteristic of traditional agriculture. This implies that for the group of farmers in the Olancho region: (a) the production activities are geared toward the production of food commodities; (b) the production activities are carried out in collective form by the members of the family; (c) the main source of labor is the group of family members; (d) a part of the production is self-consumed by the family; (e) the system of production is still traditional, i.e. no modern technology has been incorporated.

Hypothesis II: There are no differences in economic structure between farmers according to the size of their holdings. This hypothesis assume that (a) all farms in the range of 1 to 14 hectares present the characteristics tested in hypothesis I. Therefore, all can be classified as traditional small farms; (b) there are differences in the total values observed for the variables representing the elements of the farmers' economy, but there are no significant differences with regard to those values when land differences are taken into account.

Hypothesis III: As in all other countries or regions where traditional agriculture prevails, low productivity of resources is observed in the Olancho region. This hypothesis directs particular focus on establishing the average and marginal products of resources in the region - land, labor and capital.

Methodology used

The methodology used to test the hypotheses consisted on: (a) to create a set of new variables in the sample data in order to estimate other measures of the performance of the small-farmer behavior; (b) to calculate the frequency, mean, and standard deviation for all the variables in the sample data; (c) to set arbitrarily a criterion to group farmers within the sample data in order to test hypotheses related to farm-size differences; (d) to adopt a system for the classification of variables such that the economic relationship of the farmers' operations could be shown; (e) to apply the one-way analysis of variance method of statistical analysis in order to test whether the means of subsamples are significantly different from each other; and (f) to estimate production functions for the farmers in the sample using multi-regression analysis as a means to analyze productivity levels.

The one-way analysis of variance statistical method used consists of testing the null hypothesis.

$$H_0 : \mu_i = \mu$$

against

$$H_A : \mu_i \neq \mu \qquad \text{or at least one} \neq$$

where

i = 1 .... 4, the farm size subgroups.

If the means of the subsamples were not found significantly different, the null hypothesis that the true subpopulation means are equal and that deviations were the result of sampling errors was not rejected. The testing of this hypothesis was done comparing the computed F ratio (F = between-groups mean square/within groups mean square) to the known sampling distribution of the F ratio (values on F distribution tables).

Along with the analysis of variance procedures, a test of linearity between the variable farm size and the other variables was carried out. The Pearson r and the r^2 statistics were obtained. The Pearson r was used to measure the goodness of fit of the regression line to the data. And, r^2 accounted for the proportion of variation of the dependent variable that is linearly explained by the independent variable (farm size).

The multi-regression analysis for the production functions was performed by means of the least squares method of estimation of regression parameters.

In addition to estimating the parameters of the regression models two tests of significance were performed. First was the test of significance of the regression, the purpose of which is to assess the overall significance of fitting the regression equation. The hypothesis consists of:

$$H_0 : B_i = 0$$

against

$$H_A : \text{at least one } B_i \neq 0$$

This hypothesis testing was carried out by calculating the F ratio, regression mean square divided by error mean square. If the F value is larger than the tabled value of F at the desired probability level, the null hypothesis is probably not true. This procedure provides a test of the null hypothesis that all the regression coefficients are equal to zero.

The second test performed is for evaluating the significance of the individual regression coefficients. In this case, the F value calculated for each coefficient was evaluated at the probability level desired.

The adequacy of the overall function or its equivalent, the accuracy of the prediction equation, is assessed through the analysis of the R^2 coefficient of determination. This coefficient indicates the proportion of variation of the dependent variable that is explained by variations of the independent variables.

Characteristics of Credit Recipients in Olancho

In order to characterize the small-farm credit recipient in the Olancho region, the variables contained in the sample data that are common to more than 60% of the farmers are assessed as representative of the whole group. Nevertheless, the contrast with those variables that are not observable with such frequency is also pointed out.

Means of production

As shown in table 5, the most important means of production for these small farmers is land. On the average they operated 5.2 hectares. Only 62.2% of the farmers owned land for which the average value is Lps 1,298.6 (U.S.$649.3) [1 Lps equal to 0.50 US$]. The lower mean value of tools and equipment owned (Lps 64.7) explains the prevalence of traditional man-power tools within those farms. Even though in general in Honduras it is a common practice to use animal power to plow the land, the ownership of oxen was not commonly observed among small farmers in Olancho. Also, it has been found that less than half of the farmers, 41.5%, had inventories of cattle and only 58.5% of them reported hog inventories.

In order to carry out household farming activities these physical means of production are complemented by the family labor force. It has been estimated [22] that the average size of the family in Honduras is 6.3 members, from which a figure of 1.9 members has been given as the estimation of available labor force per family.

Since there is no reason to assume differences between the national figures and those for the region under study, a total of 456 man-days per family per year can be estimated as the family's total supply of labor per year (this estimation is based on a total of 240 working days per year).

Land and labor allocation

The allocation of resources - land and labor - within the small-farm household is as follows: an average 3.6 hectares of land have been allocated to annual crops, no land has been used for perennial crops among those farmers; and, only 15.5% of the farms reported the allocation of 4.7 hectares to pastures. Considering that, as was mentioned in chapter IV, in general terms for Honduras the proportion of land suitable for annual and perennial crops is about 17% of the total, the use made of the land by the farmers in the Olancho region is fairly intensive. A proportion of 69.2% of the total amount of land on the farm has been utilized.

TABLE 5. Olancho, characteristics of the small-farm household, 1975

Concept	Number of Observations	% of total Farms	Mean	Standard Deviation
Means of Production (Lps)				
Farm Land Operated	135	100.0	5.2	3.2
Value Land Owned	84	62.2	1,298.6	1,150.7
Tools and Equipment	132	97.8	64.7	94.0
Animals of Work-oxen	47	34.8	2.2	0.9
Cattle Inventory	56	41.5	1,137.5	974.9
Hogs Inventory	79	58.5	91.1	96.7
Land Allocation (Has)				
Annual Crops	133	98.5	3.6	1.9
Pastures	21	15.5	4.7	2.6
Family Labor Allocation (man-days)				
On-Farm Crops	134	99.3	70.0	54.1
On-Farm Livestock	121	89.6	28.6	26.7
Off-Farm Work	46	34.1	68.8	64.1
Production Activities (Quintales)				
Corn	116	85.9	92.8	103.4
Beans	96	71.1	22.2	22.3
Rice	18	13.3	31.9	24.4
Product Allocation (%)				
Consumption	133	98.5	38.1	57.9
Sales	123	91.1	66.9	18.4
Seed	58	43.0	5.9	11.7

Technology Used				
Labor (man-days)				
Family Labor	134	99.3	70.0	54.1
Hired Labor	128	94.8	82.9	75.1
Other Inputs (Lps)				
Fertilizers	8	5.9	83.6	41.2
Pesticides	31	23.0	38.1	28.0
Purchased Seed	115	85.2	51.6	41.3
Farm-Grown Seed	58	43.0	28.9	28.8
Rented Machinery	84	62.2	128.6	113.3
Indirect Costs (Lps)				
Land Rental	13	9.6	55.9	40.9
Purchase of Tools	116	85.9	11.4	12.3
Interests on Credit	37	27.4	37.6	56.2
Income Sources (Lps)				
Gross Income	134	99.3	1,312.8	1,243.2
Crops	134	99.3	1,256.1	1,203.2
Livestock	15	11.1	240.7	157.0
Others	40	29.6	308.9	240.8
Net Income	134	99.3	819.6	925.2
Credit (Lps)				
Received	132	97.8	493.4	450.1
Balance	119	88.1	467.7	424.8

The allocation of labor was mainly to on-farm activities -- crop production and livestock husbandry. A total of 70.0 man-days were used on cropping activities and 28.6 man-days on livestock care. Cropping is found to be a male adult's activity while livestock care involves the participation of women's labor. Farms on which men's work on animal care was reported, represented 64.4% of the total number of farms and they worked on average 22.2 days. Women's work in the same activity was observed on 71.8% of the farms and added up to 14.8 days per year. Children's labor was only reported in 7.4% of the farms. With regard to the allocation of labor to off-farm activities, i.e. farming activities on other people's farms, it is found that this kind of job is not a common practice among small farmers in the region of Olancho. Only 34.8% of the farms reported work done outside the farm by the family members. The total allocation of labor per family per year observed was 118.6 man-days which represented 26.0% of the total availability of labor in the family. Therefore, considering these figures alone a strong underemployment of the rural labor force is likely to exist in the region.

Production activities and allocation of final product

The kind of production activities carried out by the group under study in the Olancho region, follows the pattern of traditional agriculture in many developing countries.

The product-mix implemented is made up of the two basic food products for the Honduran population - corn and beans. Rice cropping was only observed on 13.3% of the farms. The production of corn and beans is sometimes made through cropping the same product during two seasons within the agricultural year. The number of farms that reported production of corn in the first season reached 80.0% of the total. And, farms producing corn in the second season represented 14.1% of the total farms. Farms that have produced beans in the first season accounted for 21.2% of the total and in the second season the figure observed is 57.0%. It should be noted that corn is the main crop in the first season (from May to August) and beans prevails in the second season (October to January). Very often it is the same plot that is alternately being cropped with both products. On the average small farms in Olancho produced 92.8 quintales of corn which is equivalent to 4.2 metric tons. (One quintal is equal to 100 pounds.) The production of beans reached an average amount of 22.2 quintales or 1.0 metric tons.

The allocation of that production was basically between consumption and sales. And, only 43% of the farms left part of the production to be used as seeds for the next crop. Family consumption averaged 38.1% of the total production for the total number of farms but a large variation (152.0%)

was observed in the share of this variable of the total farm production (coefficient of variation = standard deviation/mean). Sales represented 66.9% of the total production of the 91.1% of the farms which marketed their product. Even though most of these farms marketed part of their product, they can still be considered as responding to the basic principle of security characteristic of traditional agriculture. This element of security is expressed through the production of basic food products with self-consumption of a portion of them.

Technology used

As it is expected in this kind of traditional agriculture, labor represented the most important input used in production, although the use of some labor-saving kind of technology is observed in the region. From the total number of farms, 62.2% made use of rented machinery, which is pressumed to be tractors used to plow the land. This fact is related to the lack of oxen ownership observed between most of the small farmers in Olancho.

The labor used on production was partly family labor and partly hired labor. The former represented 45.8% of the total labor used on crop production and the latter the difference, 54.2%. The use of inputs indicated that use of technological innovations was not commonly observed among farmers in Olancho. Only 5.9% of them made use of fertilizers and 23.0% used pesticides. Even though 85.2% of the farmers have purchased seed this does not automatically imply that they have used improved seed in their cropping activities. And, only 43.0% of the farmers saved farm grown seed for future crops.

Indirect costs

Other costs incurred by farmers in carrying out their production activities were assigned to the purchase of tools. Land rental was observed only among 9.6% of the farmers and credit repayment was reported by only 27.4% of them.

Sources of income

The main source of income for the farmers in the Olancho region was from cropping activities. An average of Lps 1,256.1 (U.S.$628.05) represented the gross income per family generated from these activities. Income generated by livestock sales was only found on 11.1% of the farms and other sources of income, dairy products sales and/or forestry by-products sales, were reported by 29.6% of the farms. The total gross income estimated was Lps 1,312.8 (U.S.$656.4) per family per year. Net family income, reached by subtracting all cash expenses was, Lps 819.6 (U.S.$409.8). This figure includes the family's self-consumed product income. Therefore, it represents the in kind and monetary income.

Credit

The value of borrowed capital that was reported by those farmers in the Olancho region averaged Lps 493.4 (U.S.$246.7). And, 88.1% of them still had on average a Lps 467.7 (U.S.$233.8) balance at the end of the year.

Farm-Size Differentiation

It is one of the objectives of this study to establish if structural differences exist between farmers in the sample according to the size of their holdings. The interest in doing this particular analysis comes from the different studies on small-farm agriculture that have been reviewed in the process of carrying out this work. The term "small farm" has been applied mostly referring to the particular characteristics of the group under study in each country. This means that different farm-size criteria have been used in different studies, i.e. farmland averaging 24 hectares in Brazil [28], 3.5 hectares in Cajamarca, Peru [11], and for the World Bank [35, p.3] small farmers "include families farming less than five hectares or, in countries where all farms are small in absolute size, farmers comprising the poorer half of the countries population." Factors that influence these criteria are generally related to the availability and distribution of land, and to the kind of agricultural products under exploitation.

By carrying out the analysis of farm-size differentiation for the credit recipients in Olancho, the characteristics of this group which have been described in the last section of this study, are further investigated. This is done as a means to establish if those farmers, whose farm size ranges from 1 to 14 hectares, can homogeneously be classified as small farms.

The first step in determining such farm-size differentiation consisted of deciding on a grouping disaggregation system to be used throughout the analysis. Even though no valid criterion can be called upon to explain the convention adopted, the sample was broken down into four groups: Group 1, which includes farms with farm size from 1 to 3 hectares; Group 2, which includes farms from more than 3 up to 5 hectares; Group 3, which represents farms from more than 5 up to 10 hectares; and Group 4, which accounts for farms from more than 10 up to 14 hectares.

The analytical tool to assess meaningfull differences in farm size consisted of a one-way analysis of variance and tests of linear relationships between variables. The hypotheses tested were addressed to assess whether the differences between means in farms of different sizes are statistically significant.

For the appraisal of those groups' economic structure, a system of classification of the variables similar to that adopted in the last section of this study was followed. In this part of the study, even the variables that are not observed for more than 60% of the farm are assessed. This is so, due to the interest in establishing differences in performance of the groups. To determine such differences the F-values significant at 5% level or less were accepted to reject the hypothesis of equal means.

In table 6 the distribution of farms per groups is presented. As it is shown group 1 accounts for 34.1% of the total number of farms in the sample, group 2 for 31.8%, group 3 for 21.5% and group 4 for 12.6%. Since the sample of credit recipients was a random sample from the population of total number of farmers operating with credit, the distribution of farms in Olancho represents the true distribution of credit recipients in this range of farm size.

Endowment and use of means of production

The components that make up the set of means of production for the credit recipients in Olancho which have been disaggregated by group are presented in table 7.

With the exception of the oxen-ownership variable, the test of hypotheses that the means of the variables representing the total endowment of resources per group were

TABLE 6. Distribution of farms and average farm size per group in the sample

	Distribution of Farms		Average Farm Size
	Frequency	%	(hectares)
Group 1 (1.0 - 3 has)	46	34.1	2.4
Group 2 (3.1 - 5 has)	43	31.8	4.0
Group 3 (5.1 - 10 has)	29	21.5	7.4
Group 4 (10.1 - 14 has)	17	12.6	11.8
Total Sample	135	100.0	5.2

TABLE 7. Average value of stocks of means of production per group in Lempiras

	Land Owned	Tools and Equipment	Work Animals (oxen)	Livestock Inventories Cattle	Hogs
		(Lempiras)			
Group 1 (1.0 - 3 has)	552.0	30.5	550.0	615.6	65.1
Group 2 (3.1 - 5 has)	878.9	44.9	529.5	838.2	63.2
Group 3 (5.1 - 10 has)	1,467.3	108.3	592.3	1,135.9	117.8
Group 4 (10.1 - 14 has)	2,341.2	137.4	688.9	2,012.3	141.0
Total	1,298.6**	64.7**	584.2	1,137.5**	91.1*
n[1]	84	132	46	56	79
r[2]	.53	.41	-	.50	.30
R[3]	.28	.16	-	.25	.09

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
*F test significant at .05 level.
**F test significant at .01 level.

equal, led to the rejection of such hypotheses. These results are in accordance with what generally is expected: that the larger the farm size, the larger the total amount of means of production available. The value of owned land for group 4 represented 4.2 times that of group 1; 2.7 times the one of group 2; and 1.6 times the land value of group 3. This is consistent with the relationship observed for the farm size variable when analyzed in the same way. The variable total value of land owned keeps a positive linear relationship with the variable farm size. The latter variable alone accounts for 28% of the variation on land ownership value. Also, it was found that the size of the farm explained 16% of the differences in the value of tools and equipment owned; and 25% of the differences in the value of livestock inventories for those farmers who kept them. However, the hog inventories variable turned out to be related to the farm size variable in a smaller proportion - only 9% of the variation on hog inventories was explained by farm size variations. This is certainly as could be expected since for hog production small farmers do not have special infrastructure facilities nor must they have a certain amount of land. The test performed for the variable oxen ownership concluded in failure to reject the hypothesis of equal means between groups. This result goes against the expectations that the larger the farm the higher the value of animal power observed. This hypothesis could also have resulted in a negative relationship in the sense that the larger the farm the lower the value of oxen due to the prevalence of different technologies on the larger farms. But, the fact is that in this study no significant differences were observed.

In order to test for the real differences in structure between groups, in the sample the calculation of some indices that have taken into account the differences in land with which farmers operated, has been undertaken. As shown in table 8 the value of total land owned has been divided by the number of hectares in farms. This procedure has given a figure that represents the value of each hectare being farmed. As can be seen the value of one hectare of land in the Olancho region averaged Lps 214.8 (U.S.$107.4). No significant differences were observed between the mean value of this resource for each group.

For constructing the index for the value of tools and equipment per unit of land, it was considered more adequate to use the variable planted area instead of the total amount of land farmed. This convention gives a more meaningful expression of the relationship between this means of production and the land actually under use. The average value of tools and equipment per planted hectare in the region was Lps 17.1 (U.S.$8.5). In the case of land, the

TABLE 8. Stocks of means of production per unit of land per group

	Land value per ha. on Farm (Lps)	Tools and Eq. per planted ha. (Lps)	Number of oxen per planted ha.
Group 1 (1.0 - 3 has)	240.6	14.2	1.1
Group 2 (3.1 - 5 has)	220.2	13.6	0.7
Group 3 (5.1 - 10 has)	203.4	21.4	0.6
Group 4 (10.1 - 14 has)	201.3	27.4	0.4
Total	214.8	17.1	0.7

test procedure resulted in failure to reject the null hypothesis. This implies that no significant differences were observed between the mean of this variable between groups. In the case of oxen ownership, it is believed that the variable number of oxen per hectare of planted land instead of oxen value, is more suitable to reflect this means of production - land relationship. On average each farm has 0.7 oxen available per hectare planted.

The pattern of allocation of land between crops and pastures is presented in table 9.

As it was expected the average amount of land allocated to each one of those activities by each group turned out to be statistically significant. A meaningful positive linear relationship is observed in both variables with regard to the size of the farm. For the land area dedicated to annual crops, 40% of the variations in this variable are due to variations in farm-size variable. Land allocated to pastures was not observed for the smallest farms (1 to 3 hectares). And, 43% of the variations in area in pastures are explained by variations in farm size.

Use of family labor

Even though a strong positive linear relationship could be expected between the size of the farm and the total amount of labor applied to cropping activities, the figures presented in table 10 shown that such a relationship is

TABLE 9. Pattern of allocation of land per group

	Annual Crops (hectares)	Pastures (hectares)
Group 1 (1.0 - 3 has)	2.2	-
Group 2 (3.1 - 5 has)	3.4	0.7
Group 3 (5.1 - 10 has)	4.7	3.4
Group 4 (10.1 - 14 has)	5.6	6.3
Total	3.6**	4.7**
n[1]	133	21
r^2	.63	.65
R^3	.40	.43

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
**F test significant at .01 level.

rather weak.

The differences on the average amount of labor spent for crop production and livestock husbandry came out to be statistically significant, but only 10% of the variation on the former variable is attributable to farm size differences. Labor used in livestock husbandry, in which both cattle and hog care are included, presented a better fit to a linear relationship. Farm size variations explain 19% of the variations in total labor allocated to animal care. The F-test used when hypothesizing the equality of means of the amount of labor dedicated to off-farm activities resulted in failure to reject this hypothesis. Therefore, as a result of this test we cannot conclude that those family farms, whose members have done work outside the farm, have increased the number of days worked as laborers as less land has become available. Nevertheless, it is important to mention that from those who did report off-farm work, 48% belonged to group 1, 42% to group 2, 17% to group 3, and 12% to group 4.

Production and distribution of output

The result of the production activities carried out for the four groups of farmers in the region is assessed through the comparison of mean values obtained for the different crops and the sales of livestock. As noted corn and beans are the main crops observed between those farmers. Table 11

TABLE 10. Pattern of allocation of family labor per activities per group in man-days

	Crop Production	Livestock husbandry (man-days)	Off-farm work	Total
Group 1 (1.0 - 3 has)	56.7	20.6	74.8	108.0
Group 2 (3.1 - 5 has)	59.9	18.6	76.0	107.7
Group 3 (5.1 - 10 has)	82.5	39.1	33.6	124.7
Group 4 (10.1 - 14 has)	109.8	54.4	29.5	164.5
Total	70.0**	28.6**	68.8	118.6*
n^1	134	121	46	135
r^2	.31	.43	-	.22
R^3	.10	.19	-	.05

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
*F test significant .05 level.
**F test significant .01 level.

contains the distribution of the farm's activities per group.

The average value of the total production of corn for each group turned out to be significantly different. Nevertheless, such differences were not observed for the average value of production of the other crops - beans and rice - and livestock sales. In the case of corn production, there is not a strong linear relationship between this variable and farm size. The average value of production of beans per farms was Lps 471.5 (U.S.$235.7) and 13.3% of the farms which have cropped rice report an average value of that crop of Lps 695.5 (U.S.$347.7). Cattle sales were not observed by the first and second groups of farms and those who marketed cattle (2.9% of the total farms) got Lps 295.0 (U.S.$147.5). Hog sales were found in 8.1% of the farms and the average value generated by this activity was Lps 220.9 (U.S.$110.4).

In the analysis of the use of land, it has been pointed out that significant differences exist between the average amount of farm land under cultivation per group. If this is so, the result just described above with regard to the total production of crops, could lead to hypothesize that differences in output yields exist between those groups. In

TABLE 11. Total value of output from cropping activities carried out in farm and livestock sales per group in Lempiras

	Corn	Beans	Rice	Cattle	Hogs
		(Lempiras)			
Group 1 . (1.0 - 3 has)	603.8	512.1	450.0	-	186.7
Group 2 (3.1 - 5 has)	627.4	423.3	560.0	-	257.5
Group 3 (5.1 - 10 has)	1,279.1	451.5	1,103.4	140.0	213.7
Group 4 (10.1 - 14 has)	1,785.4	525.0	390.2	450.0	250.0
Total	934.7**	471.5	695.5	295.0	220.9
n^1	116	96	18	4	11
r^2	.34	-	-	-	-
R^3	.11	-	-	-	-

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
**F test significant at .01 level.

order to test these hypotheses, the output yields for each crop were calculated and the analysis of variance method applied. The results are shown in table 12.

Statistically there was no evidence to reject the hypothesis that the output per hectare under cultivation for each one of the three crops - corn, beans and rice - was equal among the groups. The corn yield averaged 30.9 quintales (1.4 metric tons) per hectare, the beans yield averaged 12.9 quintales (0.6 metric tons) and the average yield for rice was 33.5 quintales (1.5 metric tons) per hectare.

An index representing the proportion of the final product allocated between family consumption and sales was calculated for the assessment of the distribution of output. As a result, it was found that there was no statistical evidence that the proportion of output that farmers allocate to each use varies along with the variations in the size of the farm. One hundred percent of the farmers who produced corn saved on average 59.2% of their production for family consumption. Sales of corn were observed between 73.3% of the producers of this product and those sales averaged 70.0% of their total corn production. With regard to bean production, it is found that also one hundred percent of those who cropped this product saved 50.2% for family consumption and 66.7% of the bean producers reported sales

TABLE 12. Output per unit of land obtained from crop production per group in quintales per hectare

	Corn Yield	Beans Yield	Rice Yield
Group 1 (1.0 - 3 has)	32.5	13.3	33.7
Group 2 (3.1 - 5 has)	26.2	10.3	35.8
Group 3 (5.1 - 10 has)	33.0	11.8	41.5
Group 4 (10.1 - 14 has)	34.9	18.1	17.9
Total	30.9	12.9	33.5

that averaged 67.5% of their production. The proportion of rice saved was lower, 33.5% of the total production, and sales reached an average proportion of 64.0%. These figures are presented in table 13.

Technological levels

When the variables representing the inputs used in production are disaggregated by groups according to farm size, the expectations that the larger the farm size the higher the total amount of inputs used are fulfilled. This is true except for those high-cost inputs -- fertilizers and pesticides, the use of which is not observed with enough frequency to become part of the common technology applied by farmers in the region (See table 14). The average number of man-days of family labor applied to production activities per group came out to be statistically different. But, even though a positive linear relationship exists, the proportion of variations in family labor applied to production that is explained by variations in farm size reaches only 10%. A stronger relationship is observed between the amount of hired labor and farm size. In this case, 21% of the variations in the former variable are explained by variations in the size of the farm. The amount of seed used in production, given in monetary terms, also presents a linear relationship with farm size. The variations in the amount spent on purchased seed and on the amount imputed to

TABLE 13. Pattern of allocation of final product in percentages of the total production of each crop per group

	Corn		Beans		Rice	
	Family Consumption	Sales	Family Consumption (%)	Sales	Family Consumption	Sales
Group 1 (1.0 - 3 has)	43.9	65.3	49.8	67.3	40.2	73.5
Group 2 (3.1 - 5 has)	50.0	75.0	46.0	71.8	35.6	44.0
Group 3 (5.1 - 10 has)	97.3	71.6	51.4	60.8	27.2	71.1
Group 4 (10.1 - 14 has)	47.4	67.3	58.1	68.4	34.6	57.3
Total	59.2	70.0	50.2	67.5	33.5	64.0
n[1]	116	85	96	64	18	18

[1]Number of observations.

seed used, which has been produced on the farm, were explained by the variation in farm size as 18% and 16% respectively. But, the above stated results are obviously expected since different levels of production are taking place at each farm-size group. Although, even after this analysis the question regarding the existence of significant differences in the technological levels of the different groups still remains unanswered.

In order to eliminate the effect of the total amount of land in farm operation on the quantity of inputs used, indices of amount of labor and amount of seed applied per hectare planted were constructed. The results are presented in table 15.

The findings are that there are not significant differences in the amount of labor, hired and family labor, applied per hectare when disaggregated by farm size groups. Nor was it observed that significant differences existed in the mean values of the seed used per group. Furthermore, it can be seen in table 15 how the average number of man-days hired (21.7) is almost equivalent to the average number of them coming from the family members (21.5). With regard to the value of the seed used in cropping, it is found that the value of purchased seed per planted hectare is 77% higher than the value of farm-grown seed.

TABLE 14. Pattern of technology used for crop production per group

	Labor		Other Inputs			
	Family Labor (man/days)	Hired Labor	Fertilizers	Pesticides (Lps)	Purchased Seed	Farm Grown Seed
Group 1 (1.0 - 3 has)	56.7	46.7	6.0	30.4	32.5	17.8
Group 2 (3.1 - 5 has)	60.0	66.8	90.0	39.8	53.7	28.7
Group 3 (5.1 - 10 has)	82.5	115.8	105.7	47.0	46.6	28.7
Group 4 (10.1 - 14 has)	109.8	160.2	75.0	35.1	100.8	62.0
Total	70.0**	82.9**	83.6	38.1	51.6**	28.9**
n[1]	134	128	8	31	115	58
r[2]	.31	.46	-	-	.42	.40
R[3]	.10	.21	-	-	.18	.16

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
**F test significant at .01 level.

TABLE 15. Amount of labor and quantity of seed used per unit of land per group

	Family Labor (man-days/planted ha)	Hired Labor (man-days/planted ha)	Purchased Seed (Lps/planted ha)	Farm Grown Seed (Lps/planted ha)
Group 1 (1.0 - 3 has)	26.1	20.6	14.8	8.3
Group 2 (3.1 - 5 has)	18.7	19.5	17.0	8.3
Group 3 (5.1 - 10 has)	18.3	23.7	10.8	6.6
Group 4 (10.1 - 14 has)	21.3	26.6	20.3	10.0
Total	21.5	21.7	15.4	8.7

Family income

As was stated in the production activities section, the main source of income for the farm household in Olancho was the cropping activities carried out by the family. The hypothesis that the mean values of income reached by the family from crop production are equal between groups is rejected. Therefore, as one could expect the larger the farm size, the higher the gross income that farmers get from their cropping activities. When tested for a linear relationship, the variables gross income from cropping and size of farm, were found to lack a strong linear relationship. The variations in the latter variable explain 18% of the variations in the former. No significant differences were found between the mean values of the income coming from livestock production between groups. These figures are presented in table 16.

In order to compute the net income per family, all the cash expenses that have been incurred have been subtracted from the gross income. This new concept has been used in two ways: the net income generated by farming activities, i.e. from all the on-farm activities, and the net income generated on-farm plus the income generated by hiring out the family labor for those who performed it. The test procedure for comparing means of those variables per group resulted in rejection of the hypothesis of equal means. But

TABLE 16. Mean value of gross and net family income from on-farm activities and net income including off-farm activities per group

	Gross Income from Farming			Net Income	
	Crops	Livestock (Lempiras)	Total	From Farming	From On and Off Farm activities (Lempiras)
Group 1 (1.0 - 3 has)	838.3	186.7	854.3	581.0	680.0
Group 2 (3.1 - 5 has)	918.4	257.5	930.3	508.1	602.3
Group 3 (5.1 - 10 has)	1,812.7	189.2	1,946.6	1,280.0	1,296.5
Group 4 (10.1 - 14 has)	2,266.3	350.0	2,412.4	1,453.6	1,464.0
Total	1,256.0**	240.7	1,312.8**	819.6**	887.9**
n^1	134	15	134	134	134
r^2	.42	--	.45	.36	.33
R^3	.18	--	.20	.13	.11

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
**F test significant at .01 level.

it was also found that the linear relationship of these variables with the farm-size variable is fairly weak.

The same motive of further investigation for real farm-size differences, eliminating the effects of total land under operation, led to the construction of indices of gross income per planted area and gross income per hectare on the farm. These results are presented in table 17.

As can be seen there are no significant differences in the average income generated per hectare planted between groups, nor are there such differences in the average income obtained per hectare of land on the farm. Therefore, it is appropiate to say that in the Olancho region, credit recipients obtain Lps 349.8 (U.S.$174.9) per hectare under exploitation and that the gross income observed for each hectare of farmland is Lps 279.4 (U.S.$139.7).

More meaningful indicators are presented in table 18. These refer to net income obtained by the family, which is to say the disposable income for the family. The indices of net income generated by farm activities per hectare on the farm, and the same net income per hectare planted show that there are no statistical differences between the mean values of those indicators per groups. Therefore, the disposable income per family per hectare on the farm represents Lps 177.0 (U.S.$88.5) and the net income per planted hectare is Lps 235.4 (U.S.$117.7). The total net income available for

TABLE 17. Mean value of gross income per planted hectare and gross income per hectare on farm per group in Lempiras

	Gross Income per planted hectare	Gross Income per hectare on farm
Group 1 (1.0 - 3 has)	385.9	352.7
Group 2 (3.1 - 5 has)	276.1	235.3
Group 3 (5.1 - 10 has)	389.8	273.1
Group 4 (10.1 - 14 has)	374.7	207.7
Total	349.8	279.4

the family includes the income generated in off-farm activities. This concept was thought to be more appropriate if the relationship with the family members was stated. In the first case, an index of total net income per active person (individuals participating in the production activities) was constructed. In the second case, the total number of members in the family was used to obtain an indicator of per capita income. As can be seen in table 18, significant differences exist in the average income obtained by each active person per group. But, this is as expected since this result is related to the total level of production obtained per group. The average net income per family member or income per capita is also significantly different between groups. In group 1, this value was Lps 107.9 (U.S.$53.9); group 2 reported Lps 95.6 (U.S.$47.8); group 3 obtained Lps 205.8 (U.S.$102.9); and group 4 corresponding to larger farms reported Lps 232.4 (U.S.$116.2).

Use of credit

The amount of credit contracted by farmers in Olancho is shown in table 19. The test procedure showed that there are statistical differences between the means representing the total amount of credit received by farmers. But also the differences observed in the average value of credit funds that have been available to farmer per hectare planted

TABLE 18. Mean value of net income generated on farm per unit of land, and net income including off-farm earnings per family member per group in Lempiras

	Net Income On Farm Activities		Net Income On and Off Farm Activities	
	per hectare on Farm	per planted hectare	per active person[1]	per member of the family[2]
Group 1 (1.0 - 3 has)	240.2	274.4	357.9	107.9
Group 2 (3.1 - 5 has)	129.5	155.9	317.0	95.6
Group 3 (5.1 - 10 has)	179.2	288.7	682.3	205.8
Group 4 (10.1 - 14 has)	126.0	245.5	770.5	232.4
Total	177.0	235.4	467.3**	140.9**
n[3]			134	134
r[4]			.33	.33
R[5]			.11	.11

[1]A figure of 1.9 persons per family used [22].
[2]A figure of 6.3 member in the family used [22].
[3]Number of observations.
[4]Pearson r for linear trends.
[5]r^2 coefficient.
**F test significant at .01 level.

came out to be statistically different. The variable farm size turned out to not be a good prediction for linear relationships between those variables.

Farmers' Productivity Analysis

One of the most common hypotheses of researchers studying traditional agriculture in LDCs, is that small farmers in poor countries are achieving economic efficiency but at low levels of productivity.

The implication of confirming such a hypothesis is that there is little that small farmers can do to raise productivity with the technology actually in use. And also, it is assumed that such low productivity holds them back at lower levels of income.

There are two methods of measuring productivity levels: (1) partial productivity measures such as output per unit of land (yield) or production per unit of labor or in general output per unit of input used; and (2) total productivity measures including estimates of all the resources used in relation to output. Both methods were used in this study.

The fact that low levels of income are present in the region of Olancho is obvious. As can be seen in table 20 the per capita income observed in the region, Lps 140.9 (U.S.$70.4), is very close to what has been defined by the World Bank [36] as the poverty line ($50 per capita). The

TABLE 19. Mean value of borrowed capital per group in Lempiras

	Borrowed Capital	
	Total	per planted hectare
Group 1 (1.0 - 3 has)	367.3	165.5
Group 2 (3.1 - 5 has)	407.4	121.9
Group 3 (5.1 - 10 has)	590.8	118.5
Group 4 (10.1 - 14 has)	879.7	135.4
Total	493.4**	137.9*
n[1]	132	131
r[2]	.35	.18
R[3]	.12	.03

[1]Number of observations.
[2]Pearson r for linear trends.
[3]r^2 coefficient.
*F test significant at .05 level.
**F test significant at .01 level.

monetary income, i.e. the net income after deducting the value of self-consumed production, is only Lps 89.7 (U.S.$44.8) per capita. Another measure of the low income observed for small farmers in Olancho accounts for the net income generated by each hectare cultivated. This represents Lps 235.4 (U.S.$117.7). And, if the farmers would have to pay for the family labor used, the figure for the real income per cultivated hectare would be Lps 161.3 (U.S.$80.6).

Partial productivity measures

It is believed that the low levels of farmers' income expressed above are the result of the prevalence of low-value products cropped by farmers in the region - corn, beans and rice; and of the observance of low productivity levels in the region. To establish such lower levels of productivity, the output per hectare planted in corn and rice observed in the region is compared with those observed in Honduras in general, in other developing countries and in two developed countries (see table 21).

As can be seen the corn yields for the region compare very well with those observed for the other countries in which traditional agriculture prevails and it is even higher than in the latter. Nevertheless, when compared with yields obtained in modern-agriculture areas, the output per hectare cultivated which is obtained in Olancho is about one-third

TABLE 20. Different measures of farmers' income in Olancho

Concept	Average Value in Lempiras	Average Value in US$
Net income per capita[1]	140.9	70.4
Monetary income per capita[2]	89.7	44.8
Net income per planted hectare[3]	235.4	117.7
Real income per planted hectare[4]	161.3	80.6

[1] Includes on-farm and off-farm activities.
[2] Net income deducted the value of family consumption.
[3] Total net income generated by on-farm activities.
[4] Net income from on-farm and off-farm activities deducted the value of family labor used on farm.

TABLE 21. Partial productivity measures for corn and rice in traditional and modern agriculture

	Corn		Rice	
	year	metric tons per hectare	year	metric tons per hectare
Traditional Agriculture				
Brazil[1]	1960-64	1.3	1960-64	1.8
India[1]	1960-64	1.0	1960-64	1.7
Mexico[1]	1960-64	1.0		
Indonesia[1]			1960-64	2.0
Honduras[2]	1974	1.8	1974	1.4
Olancho[3]	1975	1.4	1975	1.5
Modern Agriculture[1]				
North Carolina USA	1967	4.5		
Michigan USA	1970-72	5.0		
USA				5.3
Japan				5.6

[1]Source: [32, p.10].
[2]Source: [20].
[3]Source: sample data.

of that obtained in those places.

The productivity of rice in the region of Olancho and in general in Honduras, is lower than that observed in other countries, which is mainly attributed to the lack of tradition in the country to crop this product. But again, low productivity is characteristic of all those area with traditional agriculture when compared with yields reached in countries where modern agriculture prevails.

Overall productivity of resources

The above stated partial productivity measures reflect the average productivity per unit of land. Global marginal and average productivities are measured in this study fitting Cobb-Douglas production functions of the form:

$$Y = aX^{b}$$

where Y stands for the output obtained from the production activities; a is a constant; X represents the variable resources or inputs used in production and b stands for a fraction representing the partial elasticities of inputs or the relative share of each input in the total output.

In general, the problem of fitting production functions to empirical data implies decisions such as what kind of economic unit will be represented, and what kind of algebraic form best fits the real-world relationships.

In this study, the first decision was made in terms of fitting the kind of inter-firms production functions, which is a result of the use of cross-sectional data. Such production functions were specified at an aggregate level covering all crop enterprises in each farm, and the total amount of each input used in crop production. Therefore, the economic unit for which the production functions were fitted is the representative family in the region. The output represents the total income obtained from crop production, and the inputs represented the total use of resources for cropping activities.

The decision to use the Cobb-Douglas type functions to estimate production functions in Olancho is based on the fact that this type of algebraic model has been widely utilized in farm-firm analysis. And, it has been proven to be highly efficient as a tool for diagnostic analyses reflecting marginal resource productivity at mean levels of input [15]. It is recognized that following the aggregation procedures just explained, the fitted function can tell the individual farmers little about returns for specific investments, but the results can be utilized at policy analysis levels as measures of resources' productivity with some degree of confidence.

The estimation of production functions was by means of least squares, transforming the exponential production function models into linear functions of the form

$$\log Y = \log a + b \log X$$

To test the statistical adequacy of the function the following procedures were used: (1) the assessment of the R^2 coefficient of determination; and (2) the evaluation of significance tests for the overall regression and for the individual coefficients at probability levels of 10% or less. Where such tests were significant at probability levels lower than 5%, it is noted. These statistical procedures are explained in the methodological part of this study.

In table 22 the results of fitting three production functions to the sample data from Olancho are presented. The first one represents the most simple one including only the labor inputs. Because of the importance that hired labor has been shown to have in the production activities of the farmers from Olancho, labor input has been treated as two separate resources. The second consideration made for this decision lies in the fact that in order for farmers to hire labor they have to borrow money therefore the opportunity cost of this resource is higher. The second production function fitted includes the inputs considered in function 1 plus the land resource. And, for the third one the amount spent in machinery rented has been added to the inputs included in the previous functions.

The number of observations over which each function was fitted represents the number of farms that have used all inputs in each function. This is the reason why R^2 estimated has been accepted even though for production functions they might be considered too low. In fact, what happens is that in function 1 it is known that farmers have made use of other inputs that are not included in the estimation of that particular production function. The same has been considered for the other functions. It was not possible to estimate a production function that included all inputs because as was explained before in this analysis not all producers make use of all the same inputs. As a result when the use of one input was lacking that observation did not enter into the regression. Therefore, the number of degrees of freedom for the activities was insufficient.

The sum of the b_i coefficients - the estimated input coefficients - are interpreted as indications of returns to scale. Also, individual coefficients represent the elasticities of each input. This means that for each input resource, these coefficients indicate the expected percentage increase (or decrease) in production that would occur if the amount of the input resource was increased (or decreased) by 1%, other input levels being held constant. In order to make a valid interpretation of such input

TABLE 22. Results of Cobb-Douglas type production functions fitted for the Olancho region

Item	Production Functions for Olancho Region I	II	III
Number of Observations	127	126	79
Production Elasticities:			
Land		0.40*	0.25*
Hired Labor	0.65*	0.49*	0.56
Family Labor	0.16**	0.15**	0.12
Rented Machinery			0.13
Sum of Elasticities	0.81	1.04	1.06
R^2	0.42	0.44	0.50
Sample Means			
Output (Lps)	891.20	887.97	988.55
Land (hectares)		3.27	3.57
Hired Labor (man-days)	60.20	59.94	63.44
Family Labor (man-days)	55.30	55.41	53.01
Rented Machinery (Lps)			92.98
Average Products			
Land (Lps/hectare)		271.55	276.90
Hired Labor (Lps/man-days)	14.80	14.81	15.58
Family Labor (Lps/man-days)	16.11	16.02	18.65
Rented Machinery (Lps/Lps)			10.63

Marginal Products			
Land (Lps/hectare)		108.62	69.22
Hired Labor (Lps/man-days)	9.62	7.26	8.72
Family Labor (Lps/man-days)	2.58	2.40	2.23
Rented Machinery (Lps/Lps)			1.38
Opportunity Costs:			
Hired Labor (Lps)	3.36	3.36	3.36
Farm Labor (Lps)	3.00	3.00	3.00
Capital (machinery rented)(Lps)			1.12
Marginal Return to Opportunity Costs Ratio			
Hired Labor	2.86	2.16	2.59
Family Labor	0.86	0.80	0.74
Rented Machinery			1.23

*Significant at .01 level.
**Significant at .10 level.

elasticities it is assumed that the incremental always take place at the mean input levels.

The sample means for output and inputs reported in table 22 refer to the geometrical means, i.e. calculated over the sum of the logarithm of each variable for each observation; therefore, they differ from the arithmetical means calculated in the previous analysis.

The average product of each resource results from the calculation of the output mean divided by each input mean. This calculation gives the output value generated by each unit of input.

Marginal products were obtained by taking the average product of each input at its geometrical mean and multiplying it by the elasticity coefficient.

The opportunity costs for the resources labor and capital were estimated. Hired labor was assigned as its opportunity cost the market wage plus the cost of capital since it is assumed that the only way farmers in Olancho can afford to hire labor is when they have available cash provided by credit funds. For family labor, the opportunity cost estimated reflects the market wage value which was obtained from the sample data. The opportunity cost of capital was calculated at the interest rate observed in the year of the sample. For the land resource, there is not any available estimate of its opportunity cost.

Marginal returns to opportunity cost ratios were calculated for labor and capital, the latter represented by the rented machinery input of production. These ratios provide a measure of the efficiency of resource use prevailing, on the average, throughout the population of farms, assuming that the real-world opportunity cost was used in the calculation. In the case of family labor, this ratio reflects the efficiency of this resource only if the alternative cost of this resource is properly represented by the wage rate. But, as was stated early in this study the seasonality characteristic of the agricultural activities lead to presume lack of homogeneity in the opportunity cost of this resource throughout the cropping year. Nevertheless, the ratios are used in this analysis as general indicators of the use of those resources. If the ratio is less (greater) than one, it indicates that too much (or too little) of the particular resource is being used under the existing price conditions, given the levels at which other resources are being operated.

From the results of the fitted production functions presented in table 22, it is noticeable that the number of observations (farms) is considerably reduced when the input rented machinery is added to the independent variables already in the regressions. All of these regression functions were significant at 5% probability levels or less.

The coefficients (elasticites) for hired labor, family labor and rented machinery were not significant at a 10% level in the third function, but they are included in the results because, as is explained by Heady and Dillon [15], even if the evidence against the regression coefficient being zero is slight, the best estimate of its size is still obtained from the data. And, it was observed in the other functions calculated that those coefficients were significantly different from zero.

The input that presents the largest elasticity is hired labor, with the second most important being land and the third being family labor. When rented machinery is included the elasticity of this input is slightly higher than the elasticity of the family labor input.

According to the sum of those elasticity coefficients, constant returns to scale are likely to be observed in the region. But, because of the aggregation procedure used in this analysis no stress is put on these results. Definite conclusions would be drawn if the production functions were representative of each product cropped and all inputs were included in it.

The average products of inputs indicate that (see function III) each hectare of land planted generates Lps 276.90 (U.S.$138.4); each man-day of hired labor utilized contributes Lps 15.58 (U.S.$7.8) to the gross income from cropping activities; and each man-day of family labor provides a contribution to output of Lps 18.65 (U.S.$9.3).

Nevertheless, the marginal products of inputs express that a farmer in the region of Olancho, working at the mean values of output and input use presented in table 22, will have an increase in gross income of Lps 69.22 (U.S.$34.6) if a additional unit of land is brought into operation; an increase of Lps 8.72 (U.S.$4.4) if a additional man-day is hired; an increase of Lps 2.23 (U.S.$1.1) if an additional man-day of family labor is used; and an increase of Lps 1.38 (U.S.$0.7) if the farmer decides to spend an additional Lempira in renting machinery.

The marginal return to family labor says that too much labor has been used in production if the opportunity cost of this resource is the market wage rate, but it could be lower because of the lack of demand for labor during some periods which will lower the opportunity cost and raise the marginal return for this resource. According to the results hired labor could still be used efficiently since it has a marginal return to opportunity cost ratio of 2.59, and so also could rented machinery with a ratio of 1.23. According to these results, farmers in Olancho can perfectly well borrow more capital and use it in hiring labor and renting machinery.

Risk aversion

The above stated results correspond to the static type analysis in which perfect knowledge of the future is assumed. But the fact that agricultural activities are risky and by nature farmers are risk averters should not be forgotten. In this study, the farmer's risk aversion behavior is expressed through the lack of adoption of new inputs - fertilizers, pesticides - in production. But, as a matter of demonstration some measures of the degree of the risk aversion attitude are performed for two inputs for which the availability of credit is completely necessary given the levels of income of farmers in Olancho. These risk aversion coefficients are calculated using the following equation which has been defined by Moscardi and de Janvry [23, p.711] in their analysis of peasants' attitudes toward risk:

$$K(S) = \frac{1}{\theta} \left(1 - \frac{P_i X_i}{P f_i \mu_y}\right)$$

where K(S) is defined as the risk aversion coefficient; θ is the coefficient of variation of output; P_i is the input price; X_i the amount of input used; f_i is the elasticity of production of the ith input. P is the output price; and μ is the output mean.

The coefficient of variation of output estimated is

0.1273. And the estimation of the risk aversion coefficients have been based on the figures provided in table 22 for function III. The resultant coefficient for hired labor at the mean value is 4.83 and the one for rented machinery is 2.17. These coefficients mean that the higher degree of risk aversion expressed through a larger coefficient, the higher the marginal rate of return expected by farmers in order to decide to make use of an additional unit of inputs.

SUMMARY AND CONCLUSIONS

Summary of Findings

Throughout this study an attempt has been made to isolate and analyze the behavior of small-farm households that represent their way of acting in society as economic units. In the first part of the study and by means of a survey of literature, the theoretical formulations regarding small-farm household economic behavior has been reviewed.

According to those previous studies on small-farm agriculture, farmers can be regarded as utility maximixing units, aiming at the satisfaction of the family member on an eqalitarian basis. A special characteristic of small farmer households as economic units stems from the duality involved in their entire operation, farm-firm plus household. They are producers and consumers of outputs and inputs at the same time.

The maximization of utility of the small-farm household against that of the traditional household is subject to variable income which is a consequence of their production activities. Since family labor is regarded as the most important production input, a positive relationship is implied between time spent working and income.

There has been an assessment of what conditions are necessary for the decision making process of small farmers to take place. The decisions for the allocation of resources have been analyzed under the static-equilibrium type models in which resources are allocated when their marginal values equal their opportunity cost. But, it has also been found throughout the survey of literature on the subject, that there are many reasons to expect larger deviations in farmers' behavior from such static-equilibrium type analysis. Some emphasis has been placed by researchers on the fact that agriculture is a risky activity and that imperfections in factor markets are present in most LDCs. Therefore, a more realistic analysis of small-farm household economic behavior should take these elements into account.

The existence of dualism in the labor market has been pointed out as expressed through the observance of a wage gap between the real opportunity cost of family labor and the market wage. Therefore, no single reference framework exists with which to compare efficiency of this resource.

For the land market, such imperfections are expressed through the higher cost of capital faced by small farmers, which places them at a comparative disadvantage with regard to access to land resources. Furthermore, the decisions to allocate the fixed amount of land are made following some kind of security rules in order to assure the family subsistence. These security rules have been shown to be aiming, in the first place, at providing the basic food products for family consumption, farming those products such that the risk of facing large price variations in the market can be avoided.

The decisions regarding the adoption of new technologies are also influenced by the conditions prevalent in the capital market and by the farmers' attitude toward risk. The element of security is again present in the farmers' decisions with regard to the adoption of new inputs of production. The fact that farmers have used a given technology for a long time, proves the lack of farmers' interest in undertaking the risk of trying new methods of production; unless the promised benefits were high enough to pay for taking such a risk.

In the second part of this study, the above mentioned propositions regarding small-farm household behavior were analyzed in the context of empirical data from the region of Olancho in Honduras.

The characteristics presented by the group under study reflected that as in many LDCs where traditional agriculture is observed, farmers in Olancho depend on land and labor as the main factors of production. They crop the most needed food products in Honduras - corn and beans - and, they allocate part of the production to family consumption. But, even though those characteristics are observed it is not accurate to say that the most traditional form of production is prevalent among those farmers. Some elements distort this pattern of pure traditional agriculture: First, the existence of an active labor market in the region is noticeable. Almost half of the labor used for production came from sources other than the family members, i.e. hired labor. Second, those farmers have purchased inputs in the market, such as seed and rented machinery which implies that they participate in market activities. Also, the share of product sold (overall 67%) expresses an integration into the market and the deviation from a pure subsistence economy. And third, they have had access to capital sources when contracting credit for production activities.

Also, throughout an analysis of farm-size differentiation carried out in order to establish the degree of homogeneity of the sample group, it was found that, as one would expect, as long as farmers have more land available the scale of operation grows. But in general strong evidence is not presented for the case that the increase in the availability of land will increase farm operations in the same proportion. Furthermore, when the amount of land differences were taken into account, the evidence is that there are not differences in the way that farmers operate.

From these results, it is suitable to say that the average value of each hectare of land observed in the region represents the market value of this resource. It has also been found that the productivity of farmers is homogeneous throughout the region. This productivity has been measured in terms of output per unit of land which gives each crop's yield. Also, the pattern of distribution of output between family consumption and sales, turned out to be the same no matter how much land farmers have available.

The findings with regard to input use are that there are no differences in the amount of inputs applied per unit of land planted. Therefore, the average number of days of labor used and the average value of the seed consumed per hectare for cropping, can equally be applied to a one hectare farm or to a fourteen hectare farm.

As a result of the above stated situation, there was also a homogeneous income generated by each hectare of land planted in Olancho.

It is important to notice here that such findings are an indication that constant returns to scale are observed in the region, even though where tested for linear trends strong linear relationships were not observed between most of the variables and farm size. This is due to the fact that the land unit used to construct indices when testing mean differences was in most cases the figure for land actually cultivated, and such indices, where analyzed for linear relationships with regard to the total amount of land available on the farm.

The last part of the study provides an analysis of productivity and efficiency in resource utilization.

The results here are that very low levels of income are obtained from the production activities carried out by small-farm households in Olancho. It is noted that the net income per capita is very close to what has been defined as the poverty line. These lower levels of income observed are the result of the cropping of low-value products and of the observation of low levels of productivity.

The physical productivity of land expressed as the ratio of output per hectare planted showed that the yields observed in the Olancho region are certainly low compared with the levels obtained for the same products in places where modern agriculture prevails.

When the productivity levels of input are analyzed in an interactive way, the findings are that given the levels of inputs actually used the hired labor input can still contribute to raise output using additional units of this input. The same was found with regard to rented machinery.

Even family labor productivity, where measured, was found to not represent a definite indicator of being efficiently used. Some factors related to the seasonality in the use and availability of this labor are confounded in the pattern of use of this resource throughout the agricultural year, therefore to isolate the real opportunity cost of family labor is a task that was not possible to undertake with these data.

Finally, as indicators of the real restriction in using modern methods of production, the risk aversion coefficients for hired labor and rented machinery were calculated which came out to be fairly large. It is recognized that such coefficients are even higher when the decisions are related to the adoption of new technologies such as fertilizers and other high-cost inputs. These coefficients were not calculated due to the lack of data since, in general the practice of using high-cost inputs is not observable in the region.

Policy Implications

In order to draw some policy recommendations from this study, the first element that has to be taken into account is that this group of farmers of the Olancho region, does not present a model of the behavior of the typical small farmer in Honduras. One factor makes them differentiate from the common small-farmer household. That is, they have been provided with credit for the year of the study.

Many of the characteristics of this group that have been explained are attributed to the fact that they have had additional funds available to undertake their production activities. These particular characteristics are referred to for example, in the amount of hired labor used in production and in the expenses for renting machinery. It is possible that the opportunity of having cash funds available through credit had helped farmers in Olancho to relax serious labor constraints at some specific periods of time during the cropping season. But this practice of utilizing labor saving technologies, i.e. hired labor and machinery, has shown to not be a good device for raising family income. In fact, those inputs that traditionally were supplied with family sources - in the case of labor - and with other forms of energy such as animal power - in the case of machinery - have now to be bought outside the farm, shifting the income to others. The result is that the problems of low incomes will still continue to be observed even in the instance where institutional credit is used as a policy for rural development, unless policy makers clearly see the kind of element they are trying to favor with such policies.

One recommendation of this study is that emphasis has to be placed on developing the kind of technology that is going to make more efficient use of scarce resources. For small farmers labor is an abundant resource and capital is a very scare and costly resource. Therefore, if credit is going to be provided it could be orientated to the acquisition, on the famers' part, of some devices that help them to relax those constraints but in a more efficient way. One solution could be to provide farmers with funds to purchase oxen and more adequate tools to plow the land. Even if this technology can be labeled as traditional it is obvious that it will not be keeping the family labor away from better job opportunities, since in this study no indications have been observed that this is so.

Another recommendation is to develop some kind of low cost technology that helps make farmers more effective at harvest time, which is believed to be the busiest period, in order to avoid hiring too much labor. A problem related to the development of farming activities in Honduras is that farmers depend too much on uncontrollable weather conditions. However, if farmers had available or at least had access to some devices such as grain dryers, it could help them to extend the harvest over a longer time period thus allowing the use of more family labor.

With regard to land use, it has been shown that it has been fairly intensive in the region; nevertheless the low productivity observed for this resource is still a problem. It is believed that the adoption of land saving technology - use of fertilizers and more productive seeds - has to be undertaken if it is desirable to raise productivity. The condition under which new technology would be more acceptable to farmers is that the technology in question has to be adapted to local small-farm conditions. Farmers have to assess by themselves the expected benefits they would accrue before they take the risk of adopting a new method or production input. Easy access to those inputs could also be a positive factor in encouraging farmers to try them.

But, it is difficult to expect that even if levels of productivity could be raised substantially as has been experienced in some countries, it would provide the small-farm household with an income that is high enough to satisfy family needs. Therefore, raising agricultural productivity might be a necessary but not a sufficient condition for adequately alleviating rural poverty. The consideration of new sources of income, off-farm work or other kind of nonfarm activities, should be encouraged through agricultural policies. In order to do this the development of alternative sources of employment in the rural areas is of high priority.

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