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THE IMPACT OF THE CAGAYAN INTEGRATED AREA DEVELOPMENT PROJECT

By:

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I. INTRODUCTION

The Cagayan Integrated Area Development Project is a multi-component effort to improve in a systematic manner in the welfare of households in the major portion of Cagayan Valley. This paper reports on the initial results of ESIA/WID's effort to measure the impact of the project.

The project is primarily a rural development project introduced in a predominantly rural area. The main effects of the project will, therefore, be on the production, productivity and income as well as the ESIA/WID concerns that are most closely linked to productive activities. This paper attempts to model the agricultural household in the area in order to trace the project impact from the input (project) point to the ultimate change in household welfare. Project inputs may, of course, directly affect the other ESIA/WID concerns directly without having to go through the avenue of economic activities.

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For example, the opening of rural roads may dramatically enhance access to doctors and health clinics for some barangays. These direct impacts are tested in the study.

The conceptualization of CIADP's impact is spelled out in a few diagrams. In Figure 1, the broad overview of the intervention through CIADP is shown. The project is viewed primarily as having effects on the activities and choices of rural households. The major groups of interventions are shown as dotted lines from the project sphere to selected household activities.

The primary effect of the project is envisioned to be its influence on farm activities. (line number 1 in Figure 1). The introduction of irrigation and agricultural extension increases possibilities for farm production -- affecting household income directly through net farm income and indirectly by adjusting the farm/formal employment choice. By increasing labor productivities in the farm, the project is expected to increase incomes of farm households in the affected area and of the other households by an upward pressure in wages in the off-farm labor market.[1/] The direct

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[1/] Unless a significant amount of unemployed labor exists in which case, the increase in income will come in the form of increased employment. Or, unless fertility responds to increased incomes in the Malthusean's manner.

effect on farm activity will come in the form of increased use of inputs (including multiple cropping of land) and in more efficient use of the factors of production.

The second major effect of the project will be on non-farm activities in the area. These activities may be due to increased access to energy (electrification component) and markets (rural roads component) leading to higher employment and market wages. The impetus may also come from increasing demand from farm activities on non-farm production. In the diagram, this is shown as a direct effect of the project on household incomes. (line number 2). This kind of effect is also shown as working through the projects influence on market prices and wages. (line number 3).

Another major avenue of the project's effects is through the household consumption and saving choices on the other final ESIA/WID areas of concern: like health and nutrition, fertility, education and political participation. By providing the infrastructure, the project either directly -- through electrification and roads -- or indirectly as by-products of the irrigation and extension components -- may influence household practices in the areas of concern. (lines 4 and 5). These effects would be over and above those transmitted through the expected increase in household incomes.

The avenues of impact are shown with more detail in Figures 2, 3 and 4. Irrigation and Agricultural extension (Figure 2), for example,

are visualized to transmit their effects mainly through the changes that will ensue in farm production and productivity. Increased input use and marginal productivity are expected to increase production volumes, thereby increasing farm incomes. This increase and the changes in off-farm employment affect household income which in turn affect the other areas of concern. Increased production volume may also increase energy use and introduce changes in the environment.

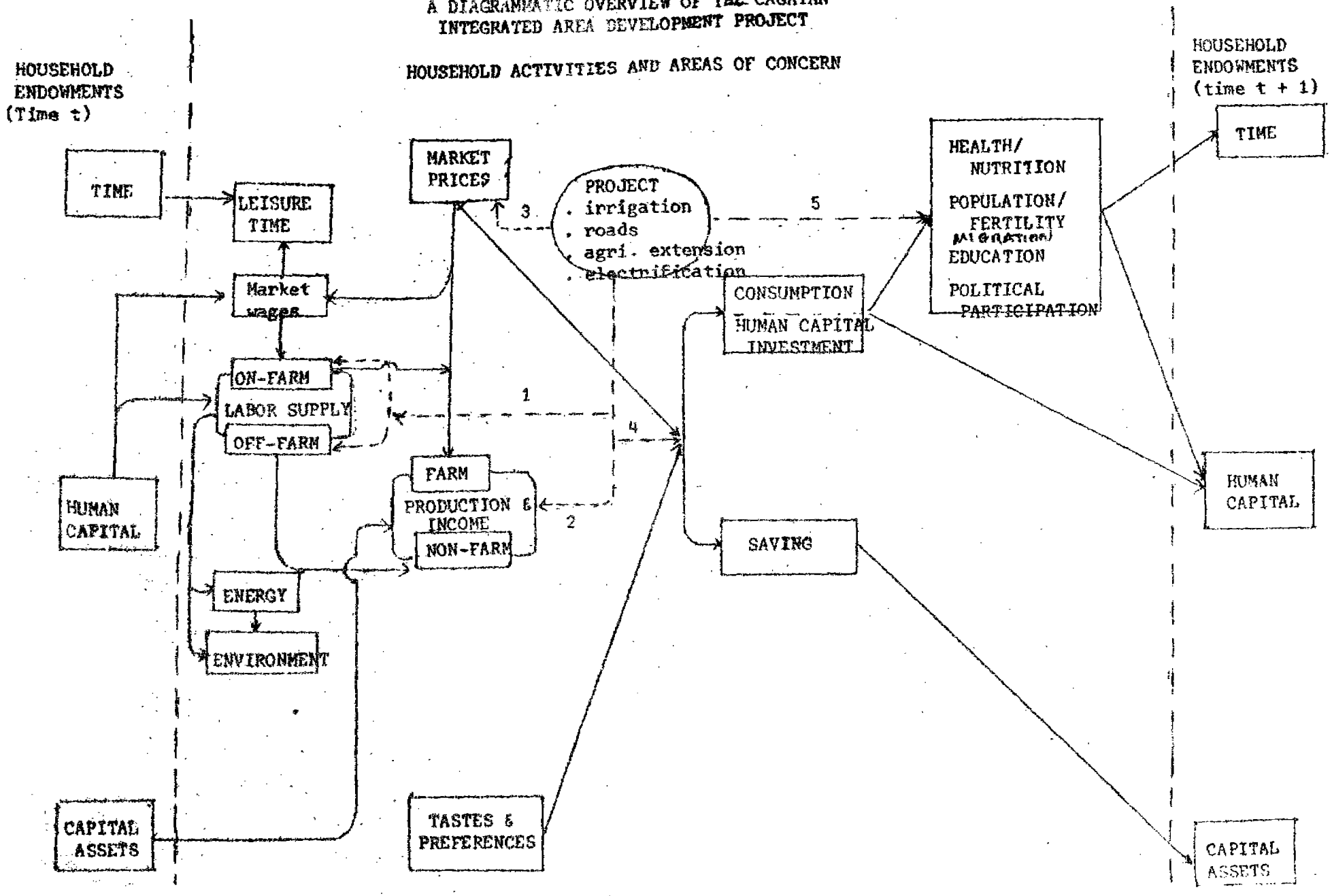
Roads expand the market. As a result, farmers are able to sell their goods for higher net prices (either higher market prices or lower transportation costs). This stimulates farm and non-farm production both of which ultimately affect household income. Household income in turn influences the other areas of concern (Figure 3). Increased production also leads to increased energy use and the consequent effect on the environment.

Aside from working through household income , roads directly affect other areas of concern. For example, this project component increases access to schools, the different clinics and to assembly halls -- aside from altering the leisure time activities of households. This all points to roads having a direct impact on different areas of concern.

Electrification is another component that has substantial impact not going through farm activities and household income.

FIGURE 1

A DIAGRAMMATIC OVERVIEW OF THE CAGAYAN INTEGRATED AREA DEVELOPMENT PROJECT



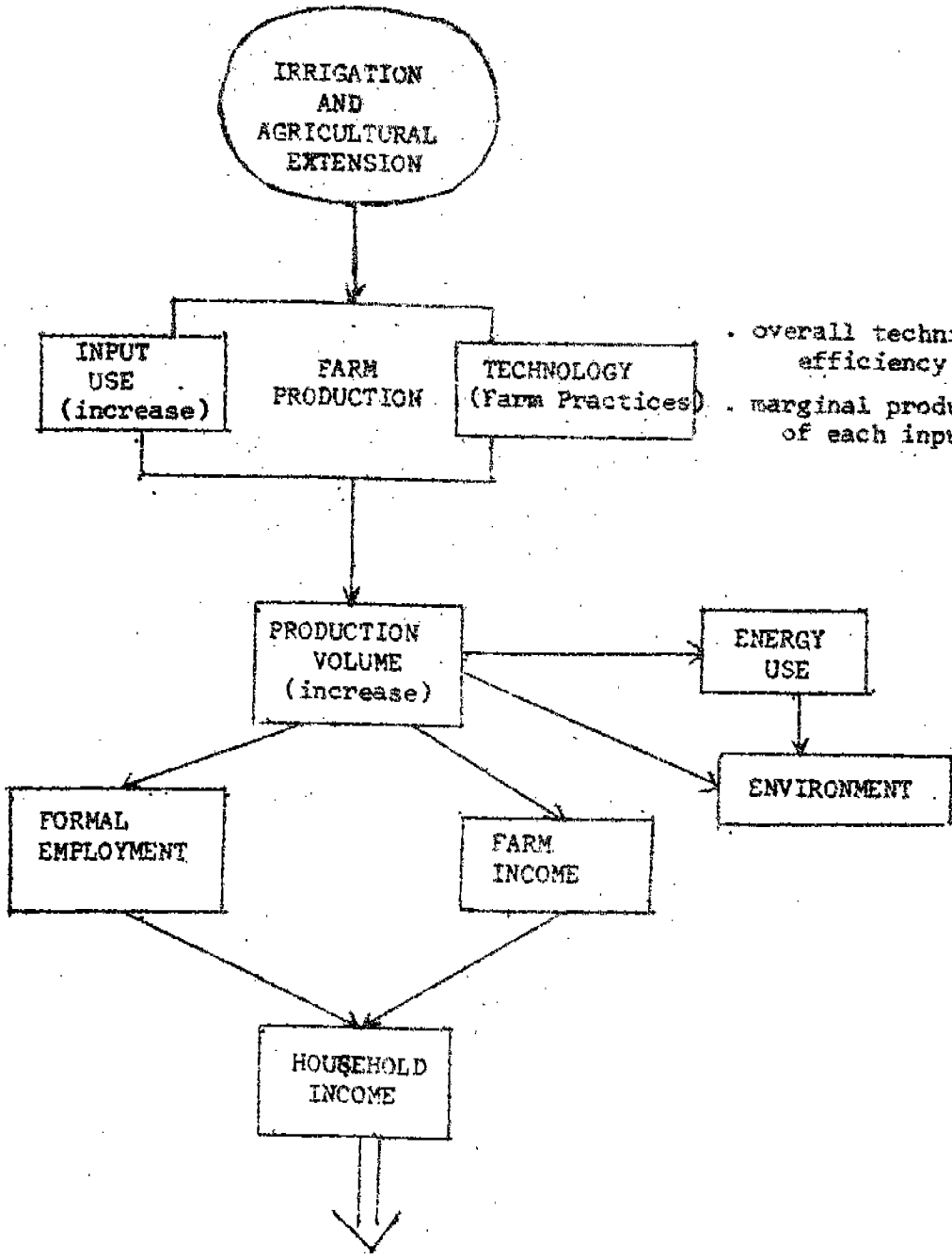


FIGURE 2

IMPACT OF IRRIGATION AND AGRICULTURAL EXTENSION ON AREAS OF CONCERN

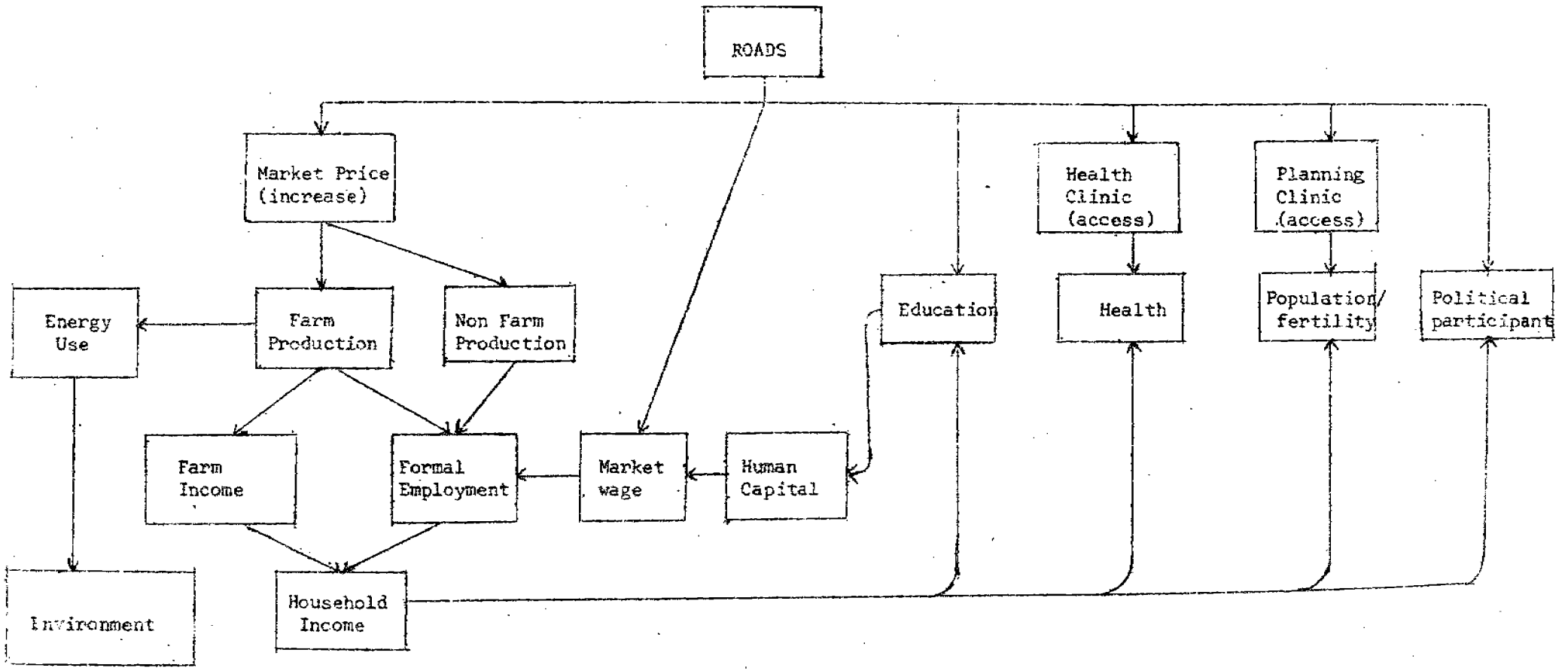


FIGURE 3

IMPACT OF ROADS ON AREAS OF CONCERN

Like roads, electrification directly affects the infrastructure that supports, for example, schools, public services like water sources and toilet systems and leisure activity. This expands the areas of choice for households aside from altering the relative prices of these activities. Schools, for example, can be open at night and schooling can be combined with farm work during the day. Electrification, then, will have an effect on several areas of concern, over and above its effect on household incomes.

The conceptualization described provides the framework for the estimation of the project's impact. The analytical derivation of tentative results are discussed in subsequent pages.

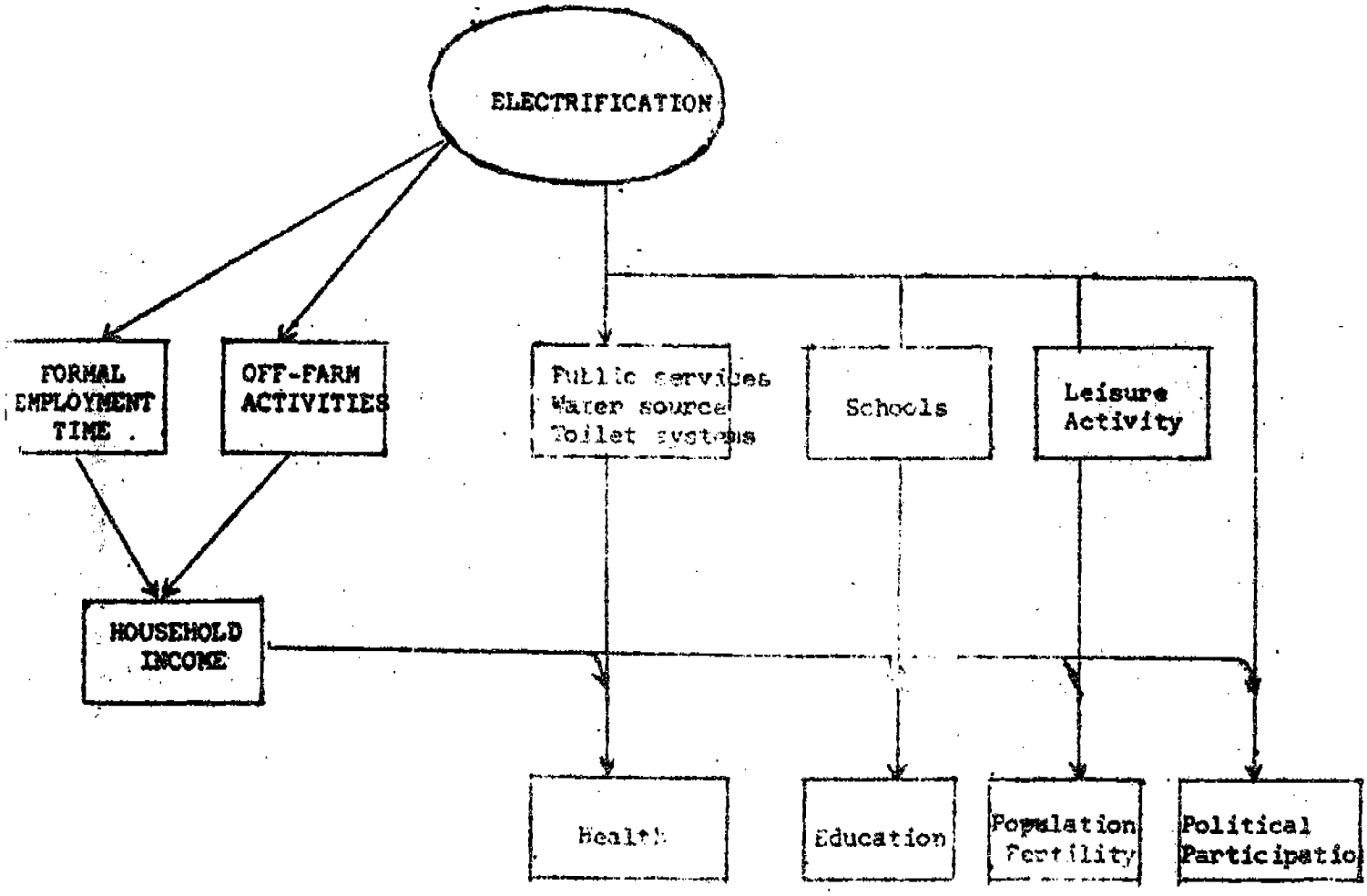


FIGURE 8

IMPACT OF ELECTRIFICATION ON THE AREAS OF CONCERN

II. IMPACT ON ECONOMIC CONCERNS

A. Farm Activities

The major impact of CIADP is expected to be coursed through changes in production practices and quantity, on productivity and, therefore, on farm income. These changes will be ultimately transmitted to other economic activities through the household labor supply and consumption choices. Through a chain of there effects, even non-farm incomes in the area will be affected.

Analysis of impact through the production function is undertaken.[2/] Results are available for the production function phase. A variant of the Cobb-Douglas function is used to represent production technology in the project area. The initial project impact is captured by introducing the appropriate dummy variables for the project.

$$Q = e^{\alpha_0 + \sum_j \beta_{j0} D_j} \prod_i X_i^{\alpha_i + \sum_j \beta_{ji} D_j}$$

where

$e^{\alpha_0 + \sum_j \beta_{j0} D_j}$ = technical efficiency parameter

X_j = input

where

[2/] The integration of labor supply and consumption decisions with the production decisions will require further refinement of the data.

j = L for Land

= K for capital services

= N for labor

= M for other inputs

D_j = 1 if $j^{\underline{th}}$ project is present

= 0 otherwise

where

j = 1 for irrigation

= 2 for technical extension

= 3 for electrification

= 4 roads[3/]

The impact of the $j^{\underline{th}}$ project component may be felt in two ways: (a) directly on the overall productivity of farm operations, or (b) it may be mediated through any of the production inputs, X_i. A change in overall technical efficiency is measured by the significance of the coefficient β_{jo}. The significance of the other dummy variable coefficients, β_{ji}'s, would imply that the project affects the marginal productivity of each input.

Present data limitations inhibit the direct estimation of the project's effects on labor supply and employment energy use and

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[3/] The roads component is represented by a categorical variable "Timepob" which denotes the length of time a household needs to get to the poblacion, i.e., $\frac{\partial}{\partial \text{Road}}(\text{Timepob}) < 0$.

income.[4/] Tentative assumptions are maintained in order to trace the first-round effects of the project components on these variables. Specifically, we tentatively assume that input and output prices are constant over the area under study and that the rural household tries to maximize net farm income. Casual knowledge of the study area tells us that the first assumption is not such a bad one, at least as a first approximation. The second assumption has come under increased criticism in recent years. It is being held here because this paper is interested, for now, in the rough indications of impact. Refinements will be introduced gradually. These set of assumptions enable us to measure the first-round effects of the project.

The scheme of the analysis may therefore be sketched briefly. We start out with the maintained profit function.

$$(2) \quad \pi = pQ - \sum_i w_i X_i$$

where p = price of the commodity

X_i = i^{th} input

w_i = price of input i

This formulation enables us to represent the optimal farm demand for each input, X_k^*

[4/] Measures of barangay-specific prices and wages are still unusable.

$$(3) \quad X_k^* = \left(\frac{pQ}{W_k}\right)\left[\alpha_k + \sum_j \beta_{jk} D_j\right]$$

The project's effect on the farm's demand for each input can then be estimated. Among the inputs would be labor and energy. This effect of the $e^{\underline{th}}$ component, for example, would be:

$$(4) \quad \frac{\partial X_k^*}{\partial D_e} = \frac{P}{W_k}\left[Q\beta_{1k} + \left(\alpha_i + \sum_j \beta_{ji} D_j\right)\frac{\partial Q}{\partial D_e}\right]$$

The first term within the brackets is the first-round effect of the project component which is its impact on the marginal productivity of the input. The second term is the second-round effect of the component on input demand due to its impact on overall production.

Based on the foregoing discission, the following effects on ESIA/WID areas of concern are expected if the project does increase technical efficiency and productivity.

(1) Increase in productivity -- especially labor productivity

(2) Increase in production and net farm income -- an increase in production is expected from the coverage of irrigation and extension services. This will occur if the cost of new inputs due to changes in volume and farm technology does not exceed the expected incremental revenue from increased production. If this happens, incomes will increase except for miscalculations by the farm household .

(3) Increase in energy use -- as long as relative input prices are constant and if the farm uses energy in the first place.

(4) Increase in employment: An increase in employment in the area is expected. This will be induced by the increased demand for labor in the farms. If the marginal revenue product of each farm household's member rises above the wage rate in the off-farm sector, members presently working outside will move to farm work, opening places for other members of society. If the marginal revenue product at the farm does not rise high enough, the farm household will hire laborers at wages less than what some household members earn off-farm. In both cases employment will increase.[5/]

The effect of CIADP on income distribution is presently difficult to assess. On a geographic basis, there is no question that the project will change the previous balance of economic resources. And although, the electrification component is supposed to be area wide, the least accessible places may still be deprived of its benefits. It is difficult to conceive that the effects of these components will be so distributed as to keep the previous distribution of income remain the same.

Besides the geographically based concept of distribution, a related but perhaps more meaningful for impact analysis is to take the view that

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[5/] This assumes that the income effect on leisure is not large enough to swamp the incentive effect of higher wages. More is said on this in the following section.

the valley is a society over which an income distribution can be meaningfully defined. The average place of the beneficiaries of the project can be pinpointed. Changes in the distribution can then be observed after the estimated project impacts are incorporated into the household incomes. This procedure requires that one incorporate into the analysis not only the response of household members to higher labor productivity in the farms but also their response to expected higher monetary incomes due to the project. The ramifications of this side-effect is explored in the following section on work effort.

Consumption and Work Effort

Earlier, the observation that CIADP is expected to increase the incomes of farm households in the areas covered was made. The full story is more complex than what has already been recounted. Increasing labor productivity in the farm has two implications for household members: first, it means that the incremental income from working in the farm is now higher; second, it also means that the household as a whole will now enjoy higher income. This higher income may be expected to increase household demand for commodities -- one of which is leisure. For each household member, therefore, there will be at least two alternatives to working in the farm: working in the formal labor market and spending time in leisure activities.

The final effect on the work effort of target households will be the result of the interplay of factors affecting household work-leisure choice. In the case of leisure, the project will have two conflicting effects. The price of leisure will go up with increased labor productivity at the same time that the increase in income will make leisure more attractive. The net result on leisure (and, therefore, work effort) will depend on the balance between the incentive effects of higher productivity and wages and the income effect on leisure. The final effect on work effort, consumption and farm production can be estimated with the aid of a model that integrates the farm production and household consumption decisions.[6/] This has not been attempted here. Instead, what we have is the effect on farm demand for labor by the various CIADP components.

Empirical Results for Economic Activities

In order to measure the project's effect on farm activities, a production function was estimated for corn and rice which were the two major crops planted in the area. Out of the households in the sample whose head had worked in an agricultural land in the year previous to the survey, 97 percent had rice and corn as their main crops. (Table 1).

[6/] Please refer to Paderanga, "Towards a Model of the Agricultural Sector in Cagayan Valley," ESIA/WID Project. May 7, 1981.

Table 1

DISTRIBUTION OF MAIN CROPS

	Frequency	%
Rice	464	57
Corn	210	30
Tobacco, Peanuts and others	17	3
T o t a l	691	100%

While the project started in April 1977, only a few of the project components were in place at the time the survey was carried out in 1980. This meant that actual project effects would not realistically be measured. However, the interventions introduced by the different project components are already present in the area is some form or another. What CIADP does, is to add to these -- like the increase in irrigated areas through its irrigation.[7/] Another CIADP innovation would probably be to make the presence of these interventions more systematic since the planning is now done on an area wide basis.

We measured the cross-section effects of those features that are identical with those of the project's components. These are then

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[7/] To the extent that more fertile areas have been irrigated first, the estimated coefficients would be biased upwards. However, casual observation does not support an a priori assumption of this type.

Table 2

CROSSTABULATION: IRRIGATION* AND AGRICULTURAL EXTENSION

Agricultural Extension	Irrigation		
	With	Without	Total
With	2	30	32
Without	13	186	199
Total	15	216	231

*Irrigation = with diesel/electrical pumps.

ascribed to the project in the areas where the components will be installed. The Cobb-Douglas formulation was used and the following assumption was made:

$$\sum_i \alpha_i = 1$$

The use of this restriction enabled estimates where the dependent variable was output per hectare, (Q/L). Estimates incorporating this restriction were invariably better than unrestricted regression results. Using the transformation and taking natural logarithms, we arrive at the following estimating form:

$$(5)\quad \ln(Q/L) = \ln q = \alpha_o + \sum_j \beta_{jo} D_j + \left(\sum_j \beta_{jL} D_j\right) \ln X_L + \sum_{i \neq L} \left(\alpha_i + \sum_j \beta_{ji} D_j\right) \ln X_i$$

where

$i = L$ for Land

= K for capital services

= N for labor

= M for other inputs

and,

$$\alpha_L = 1 - \sum_{i \neq L} \alpha_i$$

Effects on Production, Income and Input Demand

The effects on production per hectare are obtained in the form of elasticities[8/] with respect to each component.

$$(6) \quad \frac{\partial \ln q}{\partial D_j} = \beta_{jo} + \sum_i \beta_{ji} \ln X_i$$

The direct effect, given by the first term β_{jo}, is the increase in overall technical efficiency brought about by the introduction of each project component. The second term gives the net effect of the project component manifested through the change in marginal productivity of the inputs.

The estimates of the project's effects on production per hectare is extended in order to estimate the impact on production volume, income and input demand. We rewrite equation (5) to get the "marginal productivity" of the presence of each component.

$$\frac{\partial \ln Q}{\partial D_j} = \frac{\partial Q/Q}{\partial D_j}, \text{ and therefore}$$

[8/] These should be interpreted as percent changes in production given the presence of a project component.

$$(7) \quad \frac{\partial Q}{\partial D_j} = Q \left[\beta_{jo} + \sum_i \beta_{ji} \ln X_i \right]$$

Assuming that product prices remain constant, we deduce the impact on income:

$$(8) \quad \frac{\partial \Pi}{\partial D_j} = P\frac{\partial Q}{\partial D_j} = pQ \left[\beta_{jo} + \sum_i \beta_{ji} \ln X_i \right]$$

Given the estimates for equation (6) above, we can deduce the projects impact on input usage utilizing equation (4) earlier.

The framework for the empirical study sketched above is utilized for the measurement of the impact on farms. Only rice and corn farms were included because there were very few observations for the other products. Production functions were estimated for both products. The following variables were used.

DEPENDENT VARIABLES:

Q = total quantity harvested

Q/L = quantity harvested per hectare

INDEPENDENT VARIABLES:

L = farm size in hectares

N = household labor in man-seasons

N* = cost of hired labor in pesos

F = cost of fertilizers, herbicides and fungicides

E = cost of equipment rentals and expenses on energy using farm implements

S = cost of purchased seed (different from seed sewed from previous harvest)

D_I = {1 if farm is irrigated[9/]; 0 otherwise}

D_T = {1 if an agricultural extension worker visits the barangay; 0 otherwise}

T = travel time to poblacion

The distinction between hired and household labor is made because the presence of recall errors in hours of hired labor and the translating man-seasons into man-hours or pesos could not be overcome. As a result, these two types of labor had to be treated as distinct inputs.

As mentioned earlier, the per hectare estimates incorporating the coefficient restrictions on marginal productivities performed invariably better than the gross production version. The estimated coefficients are shown in Table 3 and the implied production function is shown below.

$$Q_{corn} = e^{6.695} L^{1.016} (S)^{0.096} (N^*)^{-0.112} E^{0.367D_I} T^{-0.249} B^{-0.777}$$

where L = area of farm in hectares

S = cost of seed bought[10/]

[9/] For rice, an irrigated farm is one that uses fuel or electricity driven pumps. For corn, irrigated farm uses rainfed irrigation (so it could be a proxy for level land).

[10/] The danger of seed purchased explaining all variation in corn production was explored and rejected primarily because seed represented only bought (perhaps, hybrid) seeds and probably proxied for improved practices.

N^* = cost of hired labor

E = cost of equipment rentals

T = distance from the poblacion, in terms of commuting time

$$B = \begin{cases} 1 \text{ if corn farm is greater than or equal to one-half hectare} \\ 0 \text{ otherwise} \end{cases}$$

$$D_1 = \begin{cases} 1 \text{ if the farm is rainfed irrigated (as contrasted with upland corn planting)} \\ 0 \text{ otherwise} \end{cases}$$

Table 3

ESTIMATED PRODUCTION PER HECTARE FOR CORN

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN Quantity/Hectare	5.914		
INDEPENDENT VARIABLES:			
Intercept		6.695	
LN Seed/Hectare (S/L)	1.462	0.096	1.893+
LN H_i Labor/Hectare (N*/L)	2.014	-0.112	-2.471*
Irrigation* LN (Equipment	0.081	0.367	2.028*
Timepob	0.528	-0.249	-1.983*
BigfarmC	0.763	-0.777	-3.662**
R-squared	18.63%		
F-value	5.72		
N	130		

**Significant at 1% two-tailed.
*Significant at 5% two-tailed.
+Significant at 10% two-tailed test.

The most salient feature of the corn estimates is the conspicuous insensitivity of production per hectare to most other inputs. This is

highlighted by the fact that the implied coefficient for land L is virtually one, $\alpha_L = 1.016$. It would seem then that the cultivation of corn in the study area is that of a subsistence crop using very uniform practices that do not respond to increases in inputs other than land. As a result, corn production also proved insensitive to all of the project components -- except for a negative response to rainfed irrigation mediated through equipment expenses. Distance from the poblacion proved to have a negative impact (implying that access through roads may have a positive effect). However, this is surprising in the presence of the pronounced unresponsiveness of production to the other inputs and project components. We may be capturing the effect of hilly terrain and marginal land which tend to be farther away from the poblacion. Still, this is a tentative result that should be investigated further and should be considered in further project development.

The implied impact of the CIADP project on corn productivity (per hectare) can be derived using equation (6) and is given in Table 4. The inputs which enter into the production function in pesos are mostly imported from outside the study area, except for hired labor. It is therefore reasonable to tentatively maintain that prices of these inputs are constant over the cross-section and we are observing changes in input volumes. The same belief is held in the case of hired labor. Table 4 shows positive elasticities with respect to (rainfed) irrigation and roads (access). However, it should be noted that none of the corn farms were irrigated by mechanical means, the project component, and distance may proxy for marginal farms. The predictive value of the

Table 4

IMPLIED ELASTICITIES OF CORN PRODUCTION WITH RESPECT TO PROJECT COMPONENTS*

Component	Effects		
	Direct	Indirect	Net
Irrigation	**	0.392	0.392
Extension	**	**	**
Roads	+0.249	**	+0.249
Electrification	**	**	**

*Evaluated at the means.

**No measured effect.

estimated function is not very high. However, this may just mean that random and other factors (like natural soil fertility) are the major determinants of corn yield. At any rate, our initial estimates show that corn harvests are not very responsive to variables that proxy for project components.[11/] The possible implications of this is discussed in a later section.

Rice

The estimates for the production function for rice production tell a more interesting story. In the first place, the predictive

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11/ Cross-section cannot capture technological changes like change in crop to which farms are devoted, which may well be the main impact of the Agricultural Productivity Center of CIADP.

power of the function is much higher. The R-squared is 47%. But perhaps, more important, the estimates reveal the manner in which CIADP may be expected to have its impact on farm activities. The results are shown in Table 5 and the implied production function is given below.

Table 5

ESTIMATED PRODUCTION PER HECTARE FOR RICE

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN Quantity/Hectare	6.960		
INDEPENDENT VARIABLES:			
LN Fertilizers/Ha.	2.207	0.086	3.650**
LN Equipment/Ha.	1.694	0.067	2.927**
LN H_i L/Ha.	3.522	0.066	3.176**
LN HR L/Ha.	0.338	0.169	2.667**
LN Seed/Ha.	2.346	0.051	2.271*
Irrigation	0.052	0.698	1.840+
Irrigation* LN Hi L	0.199	-0.174	-2.187*
Tech. Ext.* Hectares	0.036	-0.559	-5.855**
Timepob	0.492	-0.176	-2.230*
Intercept		6.354	
R-squared	47.04%		
F-value	21.81		
N	230		

**Significant at 1%, two-tailed test.

*Significant at 5%, two-tailed test.

+Significant at 10%, two-tailed test.

$$\text{Quantity}_{\text{Rice}} = e^{6.354 + 0.698D_I} \times L^{0.561 - 0.559D_T} \times N^{0.159} \times N^{*0.066 - 0.174D_I} \times F^{0.086} \times E^{0.067} \times S^{0.051} \times T^{-0.176}$$

L = farm area in hectares

N = household labor in man-seasons

N* = hired labor in pesos

F = cost of fertilizers

E = cost of equipment rentals and expenses

S = cost of purchased seeds

T = travel time to the poblacion

D_I = dummy variable for irrigated farms (fuel driven pumps)

D_T = dummy variable for presence of an agricultural extension worker

The estimates indicate substantial impact that may be expected from the Cagayan Integrated Agricultural Development Project. The irrigation and roads components positively influence overall production efficiency. However, irrigation and agricultural extension tend to lower the marginal productivities of hired labor and land respectively. These effects are analyzed in the following sections.

The implications of our results on the economic concern of ESIA/WID may be traced.

1. Technical efficiency.

The proxy for irrigation had a significant effect on overall technical efficiency while that for agricultural extension turned

out to be insignificant. This is disappointing because CIADP is supposed to bring about better practices as well as induce the use of better inputs. However, this may not be an accurate reflection of the extension component of CIADP. At the time, the survey was made, the Agricultural Productivity Center had not been in operation and the project's extension workers had not really been in place for a long time. In other words, the effects of extension work are not yet observable. A more accurate measurement of this component's effects may be done after a longer period has elapsed and should include the effects of the shift towards crops better suited to the soil and climate conditions of the area.[12/]

2. Production and productivity.

The results on the marginal productivity of inputs are mixed. Irrigation tends to decrease the marginal productivity of hired labor, keeping the size of farm constant. However, this should be balanced with the increase in overall technical efficiency that results from irrigation. On balance, irrigation leads to higher production (see Tables 6 and 7 later.)

The effect of technical extension on the marginal productivity of land is negative -- and puzzling. It is possible that technical extension at the moment is geared toward extensive land cultivation

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[12/] This is important because this is consistent with our observation on corn production.

and, therefore, may be capturing the effect of decreasing marginal land productivity.

The roads component enters in a negative way. It is represented by the distance to the poblacion in terms of travel time (we assume travel time and transportation cost to be proportional). An improvement of roads will therefore be captured in the decrease of travel time. Our estimates indicate that travel time to the poblacion has a negative effect on rice production.[13/] The effect of greater access would therefore be positive. The net effects of each project component are traced using equation (6) and are shown in Table 6. We note that electrification had no direct impact at the time of the survey because irrigation pumps were still not being run by electricity. No indirect impact was captured either.

The net effect of the implied "elasticities" to the project components on total production are shown in Table 7. This is an application of equation (7). There is a very slight increase in total production per crop amounting to 3% of the production volume. However, it should be remembered that with irrigation, farms could now be planted at least twice a year instead of once a year. This would mean that total production increase will be equal to one production crop plus the marginal per crop increase that we have observed.

[13/] Our qualification on travel time in relation to corn production should also be borne in mind here. However, it is probably less significant for rice because most rice farms are found on level land.

Table 6

IMPLIED ELASTICITIES OF RICE PRODUCTION WITH RESPECT TO PROJECT COMPONENTS

Component	Effects		
	Direct	Indirect	Net
Irrigation	0.698	-0.657	0.041
Extension	**	-0.189	-0.189
Roads+	0.176	**	0.176
Electrification	**	**	**

** No measured influence.

* Evaluated at the mean of production (using equation (6)).

+ Evaluated at mean distance to poblacion.

Table 7

EFFECT OF PROJECT COMPONENTS ON TOTAL PRODUCTION AND INCOME*/

Component	Effect on	
	Total Production 1/	Farm Income 2/
Irrigation	60.69	₱ 66.76
Extension	-279.78	- 307.76
Roads 3/	260.53	286.58
Electrification	**	**
Net Effect	41.44	₱ 45.58

*/ Evaluated at the mean of rice production.

1/ In kilos.

2/ In pesos.

3/ Evaluated at mean distance from the poblacion.

Assuming that all prices are constant and that output price is equal to the National Food Authority support price of ₱1.10 per kilo, Table 7 reports the effect on income per crop of the average rice farm of the CIADP project components. Again, we should observe that the number of crops per year have increased.

3. Farm demand for labor.

The irrigation, extension and road components are expected to increase the marginal productivity of inputs, especially labor. This occurs even if the project components do not directly increase the estimated coefficient for these inputs. We use equation (3) as a representation of the farm's demand for inputs given the assumptions made. Equation (4) is then utilized to trace the ultimate impact of each project component on the demand for inputs. The results are shown in Tables 8A, 8B and 8C.

Table 8A

NET EFFECT OF IRRIGATION ON THE FARM'S DEMAND FOR INPUTS

Input	Effect		
	Direct	Indirect	Net
Land	**	0.12	0.12
Household labor	**	10.26	10.26
Hired labor	-257.57	- 6.55	-264.12
Fertilizers	**	5.22	5.22
Equipment	**	4.07	4.07
Seeds	**	3.10	3.10

Table 8B

NET EFFECT OF EXTENSION ON FARM'S DEMAND FOR INPUTS

Input	Effect		
	Direct	Indirect	Net
Land	-817.49	- 0.56	-828.05
Household labor	**	-47.28	- 47.28
Hired labor	**	30.22	30.22
Fertilizers	**	-24.06	- 24.06
Equipment	**	-18.74	- 18.74
Seeds	**	-14.27	- 14.27

Table 8C

NET EFFECT OF ROADS ON FARM'S DEMAND FOR INPUTS

Input	Direct	Indirect	Net
Land	**	0.52	0.52
Household labor	**	44.03	44.03
Hired labor	**	-28.14	-28.14
Fertilizers	**	22.40	22.40
Equipment	**	17.46	17.46
Seeds	**	13.29	13.29

** No measured effect.

The effect on demand for household labor is unambiguous. There will be an increase in the demand for household labor. The ultimate effect of this on fertility and other demographic magnitudes are

interesting and will be studied in a fuller model. The demand for hired labor is clouded by the negative interaction term between irrigation and hired labor. As a result, irrigation leads to lower demand for labor. However, this is a first-round effect. Once increased production is engaged in by most farms, there will be an increase in the demand for hired labor. We therefore, expect the long-term effect on the demand for hired labor to be positive. The sign shown in Table 9 is the short-term effect.

4. Energy use.

Energy use per se is not directly measured in the data. Instead it is proxied for by the cost of using farm equipment. The coefficient estimated for the variable indicates that the marginal productivity of irrigation and agricultural extension where this was not present before. Unless there are drastic changes in the structure of prices, demand for the use of farm machinery will increase and with it the use of energy. For one, the use of energy will increase to the extent of the increase in the number of crops. Our results, are also given in Tables 8A, 8B and 8C. Except for extension, the effect of the integrated agricultural development project is to increase energy use. This is probably an underestimate of the increase because a nonirrigated farm tends to use less farm machinery than irrigated farms.

Table 9

DIRECTION OF PROJECT EFFECTS ON
FARM DEMAND FOR INPUTS

Input	Project Component			
	Irrigation	Extension	Roads	Electrification
Land	+	-	+	**
Household labor	+	-	+	**
Hired labor	-	+	-	**
Fertilizers	+	-	+	**
Equipment	+	-	+	**
Seeds	+	-	+	**

** No measured effect.

IMPLICATIONS FOR ECONOMIC AREAS OF CONCERN

The foregoing analysis of the effects that may be expected from the introduction of the components of the Cagayan Integrated Area Development Project, at least, from early estimates, show that the impact of the project may depend on the economic activity being undertaken. It is, of course, too early to tell exactly by how much the introduction of electrification component on as complete a coverage as CIADP's will influence the growth of ancillary industries like light manufacturing and service industries in the project area. In the case of irrigation and agricultural extension, there is a very conspicuous difference between the effect of CIADP on rice and on corn

farms. Either because of the technology used by corn farmers or of the quality of the resources they work with (especially land), the type of interventions that CIADP do not seem to have an impact, at least from the early measurements available. Perhaps unintentionally, the major components of the project seem addressed towards rice farms and the development of ancillary industries to the agricultural sector in the area. Of course, there may be some features of the nature and full-blown project that will apply especially to marginal households to whom corn farmers seem to belong. This aspect of the early returns from studying the impact of CIADP points to the need to design special features of integrated area projects that are meant to influence the marginal producers to whom the project may potentially provide the greatest benefit. In the case of CIADP, even as of now, an examination may be made to find out if its programs are responsive to the needs of corn farmers who seem to constitute a substantial portion of the farm households in the area (Please refer to Table 1). These features may include research on which crops are optimal for the areas being cultivated to corn at the moment or, if it is the best, finding ways to increase yields through changes in farm practices.

The findings pertaining specifically to rice farms seem quite straightforward. Based on the resulting estimates, the project components of CIADP will bring about changes in farm practices and the use of farm inputs which will ultimately lead to increased production and productivity. This will in turn lead to increased employment

in the area. Ultimately, the project is expected to bring increased incomes to rice farmers in the area covered by the project and those industries which are closely linked to rice farming.

The ultimate effect of project on work effort by the households immediately affected by the project will depend on the households' differential valuation of higher income and more leisure. However, the final effect on employment is unambiguous as long as migration into the area is allowed freely. If local households decide to spend more time in leisure as farm incomes rise, wages will rise. This will be an incentive for outsiders to settle down in the valley. Thus, the long-term prospects seem to point toward more employment and/or greater immigration.

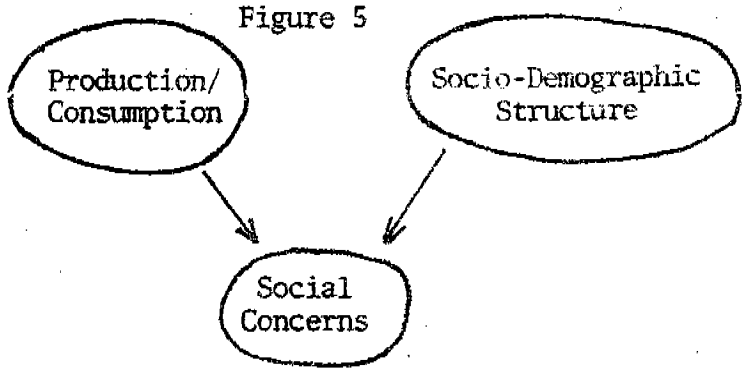
III. IMPACT ON SOCIO-DEMOGRAPHIC CONCERNS

The other set of variables are those which may be broadly described as socio-demographic. These are

1. population growth
2. migration
3. health and nutrition
4. environment, and
5. participation

The project's impact on them will be analyzed within a highly simplified framework. Briefly described, the framework conceptualizes these concerns as being affected by (and affecting) two major groups of variables: those that belong to the production/consumption model that we have analyzed in part II (the economic model); and a group of relationships existing beside the sphere and determining such concepts as power, status, acceptance, tradition and other related concerns. We call these interrelationships the socio-demographic structure. These two sets of variables jointly determine the second set of ESIA/WID concerns.*/ These relationships are shown in the following diagram.

Figure 5



*/As a first approximation, the feedbacks are deemed to be relatively weak and are ignored.

The analysis assumes that production/consumption and other economic decisions of the farm unit are largely independent of the social concerns and, therefore, we can take the economic variables as largely exogenous in this section.

The CIADP project is broadly envisioned as affecting the social concerns in three ways:

(a) through household income of which farm income is a part. (Farm income is directly affected by the project.)

(b) through changes in the variables that affect the socio-demographic structure like visible wealth holdings (electrical appliances, etc.), demographic composition and strategic placements (house beside new road, etc.).

(c) by directly requiring changes in social arrangements, as when irrigation entails that farmers form an organization to ensure cooperation in irrigation.

This is shown in the following diagram.

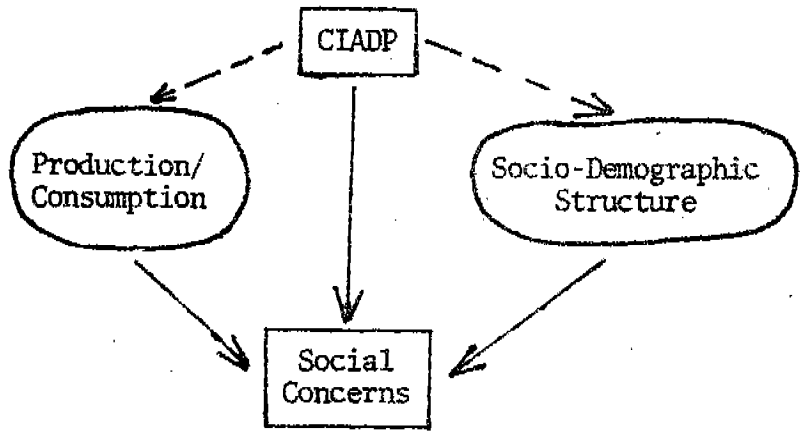


Figure 6

The first avenue is opened because material resources are believed to substantially influence the ESIA/WID social concerns. Farm income is a component of total household income. Any project component, therefore, that increases income indirectly affects the social concerns. This avenue has been modelled in the previous section.

The second path may be an important aspect of CIADP's impact on the population. However, this part of the probable range of influence has not yet been well modelled in development literature and the social sciences. In the succeeding pages, variables that have been mentioned as proxies for social standing and other structural considerations like land or home ownership and education, have been introduced even if more specific description of the relationships is not yet available.

The set of explanatory variables used in this section on ESIA/WID social concerns therefore may be conceptually divided into the three sets mentioned above. However, in most cases, variables may be plausibly classified to be part of several sets simultaneously, as when the education of the household head (husband) may belong to both the economic (by its effect on farm productivity) and the socio-demographic profile (by adding status). The variables for project components introduced can, therefore, be adduced to at least two spheres: the causality going through the socio-demographic structure and the project's direct effects on the social concerns. The variables representing project components are:

(a) ELECTRIFIED = 1 if the household is electrified
= 0 otherwise

(b) IRRIGATED = 1 if farm is irrigated by energy using pumps
0 otherwise

(c) EXTENSION = 1 if an agricultural extension worker visits the barangay
0 otherwise

(d) DISTANCE FROM POBLACION = average time it takes to get to poblacion

Strictly speaking, IRRIGATED and EXTENSION pertain only to farm households. However, they may affect the social concerns by increasing the farm households propensity to participate in organizations, for example, compared to other households. Consequently, they are tested in all estimates for social areas of concern. The empirical results are reported below.

Morbidiy

To test for nutrition and health, an indirect measure was used because of the expense of gathering data on objective physical measurements like weight and height. Costs of past surveys of this type were very prohibitive. Recall and measurement problems also rendered the data on type of food consumed temporarily unusable. Instead, the probability of being sick in the past 3 months was used as a proxy

for the absence of good health. The regressions revealed the following factors to be good explanatory variables: family income, urban location, education, age and provincial location. The coefficient estimates are shown in Table 10.

The overall predictive power of the equation is low although some variables were significantly different from zero. The coefficients for per capita income, urban and education were surprising. They are positive where negative relationships are expected. This may be due to the response bias reported in similar studies. As household incomes increases the family's perception of being sick changes so that they tend to report more cases of sickness rather than less. This is corroborated by the positive coefficients for both urban location and education of the housewife where negative signs are expected due to improvement in health practices. The estimates for age are used to control for susceptibility to sickness due to a person's age and are consistent with similar findings showing that the middle years have the lowest rate of morbidity. The controls for project components did not significantly affect the morbidity rate.

Fertility

The use of contraceptives was used as an indicator of fertility change because of the proximity of the project initiation to the survey date. The regression was run for married women between 15 and 49 years old. Table 11 lists the estimated coefficients. The

Table 10

PROBABILITY OF HOUSEHOLD MEMBER BEING SICK
IN THE PAST THREE MONTHS

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
Probability of being sick	0.25824		
INDEPENDENT VARIABLES:			
FY/Family Size	511.70	0.0001	6.42
Water	0.52	-0.00332	- 0.36
Toilet	0.91	-0.00825	- 0.53
Urban	0.14	0.02658	1.98
EDW > 10 years	0.08	0.03740	2.02
EDW > 14 years	0.02	-0.03056	- 0.82
Age ≥ 4 years	0.16	0.04788	3.52
10 ≥ Age > 4	0.28	0.02946	2.30
35 ≥ Age > 25	0.17	0.04705	3.07
49 ≥ Age > 35	0.13	0.01330	0.92
Age > 49	0.09	0.02173	1.30
Province: Cagayan	0.15	0.13202	12.35
INTERCEPT		0.13322	
R-squared:	5.70%		
F-value:	20.02		
N:	3,987		

Sick = 1 if household member was sick

= 0 otherwise

Water = 1 if water is piped in

= 0 otherwise

Toilet = 1 if toilet is sealed

= 0 otherwise

Urban = 1 if location is urban

= 0 otherwise

Table 11

PROBABILITY OF CONTRACEPTIVE USE

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE			
Contraceptive Use	0.16410		
INDEPENDENT VARIABLES			
Wifes Age	34.77	-0.00399	-2.51
No.oof Living Children	4.49	0.00843	1.61
Education of Wife	6.72	0.00788	1.96
Wife's Expected Wage	35.77	0.00001	0.06
Family Income (Less wife's wages)	4378.23	-0.00000	-1.12
INTERCEPT		0.21614	
R-squared:	1.35%		
F-value:	2.66		
N:	974		

education of the wife and the number of living children are significantly positive factors for the practice of contraception. The age of the wife is negatively related to contraceptive use however, this may be because younger wives tend to be better educated. Wife's expected wage and family income had unexpected signs but they were insignificant.

MIGRATION

Two measures for migration were used: first, whether the family had migrated in the past or not; and second, whether the household head thought there was a possibility of migrating in the future or not. Aside from the project variables, among the explanatory factors used were:

(1) husband's wage

(2) household income per person

(3) quality of house construction (good quality = 1, 0 otherwise)

(4) type of land tenure (from tenants = 0 to landowners = 6), and

(5) urban location

The results for past migration behaviour (Table 12) are not very encouraging if viewed as a possible explanation for propensity to migrate. The dummy for house quality and husband's wage are positive contrary to what we would expect. If, however, viewed as the end result of past migration activity then the results are quite reasonable. Husband's wage and house construction are pull factors which have been realized, being short-term adjustment variables. Land ownership takes years to attain and is therefore not readily accessible to recent migrants. This is also consistent with findings which state that most recent migrants start as tenants in the places

Table 12

PAST MIGRATION ACTIVITY

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
Past Migrant	0.46872		
INDEPENDENT VARIABLES:			
Electrified	0.16821	-0.10567	-2.36
Irrigated	0.02359	0.15105	1.42
Technical extension	0.19179	-0.07058	-1.73
Distance from poblacion	0.44815	-0.01750	-1.30
Income per person	802.43	-0.00001	-1.87
Husband's wage	1461.09	0.00001	1.52
Sturdy house dummy	0.24308	0.06425	1.68
Land tenure	1.48615	-0.02966	-2.75
INTERCEPT			
R-squared:	2.27%	0.52880	
F-value:	3.39		
N:	974		

of destination. New migrants tend to locate where electricity and technical extension are absent.

Table 13 reports the results of the regression explaining future migration. Only income per person turns out to be significant. The positive coefficient of income would indicate that it places the household in a situation where it can now bear the costs of migration. The project variables are insignificant.

Table 13

POSSIBILITY OF MIGRATION

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE			
Possibility of migration	0.03590		
INDEPENDENT VARIABLES:			
Electrified	0.16821	-0.00036	-0.02
Irrigated	0.02359	-0.01068	-0.27
Distance from poblacion	0.44815	-0.00561	-1.12
Technical extension	0.19179	-0.00759	-0.50
Urban	0.24410	0.01640	1.12
Income per person	802.43	0.00001	3.19
INTERCEPT		0.03014	
R-squared:	1.42%		
F-value:	2.33		
N:	974		

The very low predictive power of these two regressions tend to cloud the conclusions that have been tentatively reached. A fuller model may very well modify the findings.

Participation

Participation was conceptualized in two ways: one, as the readiness to contribute to social andpolitical exercises in the barangay; and two, participation in the economic activities. For the husband, economic participation is treated as part of the economic model analyzed in section II. The wife's economic

participation is analyzed here in order to highlight the impact of CIADP on women's participation.

The estimating equation explaining the husband's organizational participation uses the same explanatory factors used in the other social concerns. Essentially, we use variables representing economic resources under a household's control and other socio-demographic characteristics that are indicators for status and power within the community (several alternatives were utilized). The results are shown in Table 14.

Table 14

HUSBAND'S MEMBERSHIP IN ORGANIZATIONS

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
No. of memberships	0.50667		
INDEPENDENT VARIABLES:			
Electrified	0.16821	0.15383	2.38
Irrigated	0.02359	0.00744	0.05
Technical extension	0.19179	-0.23562	-3.95
Distance to poblacion	0.44815	-0.01413	-0.71907
Household income	4,378.23	-0.00000	-0.25
Husband's wage	1,461.09	0.00001	1.35
Land tenure	1.49	0.02555	1.62
INTERCEPT		0.47846	
R-squared:	2.52%		
F-value:	3.57		
N:	974		

Land ownership and husband's wage positively influence participation in organizations although the latter is not statistically significant. Of the project components, electrification increases the husband's political participation while technical extension decreases it.

The wife's participation in organizations showed more or less the same kind of results (Table 15). The variables proxying for higher status -- family income, age, wife's education -- show a positive influence on political participation. Among the project components, distance to poblacion increases participation while irrigation decreases it. The latter probably entails more farm time for the housewife.

The other aspect of female participation is with regard to economic activity. The significant explanatory variables turned out to be the expected ones. (Table 16) Project variables were not significant. As expected, the wife's expected wage had a positive effect on her probability of working. Husband's wage could represent for education and would indicate greater willingness to allow the wife to work. Other income has the expected negative sign (if leisure is a normal good) but it is not significant. Among all regressions for social ESIA/WID concerns this has the highest predictive power. It is significant that this equation is closely related to the economic model in section II.

Table 15

WIFE'S MEMBERSHIP IN ORGANIZATIONS

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
Member	0.29128		
INDEPENDENT VARIABLES:			
Electrified	0.16821	-0.00682	-0.16
Irrigated	0.02359	-0.24827	-2.62
Technical extension	0.19179	-0.04190	-1.16
Distance to poblacion	0.44815	0.02648	2.21
Family income	4,378.23	0.00000	3.01
Age of wife	34.77	0.00472	2.87
Wife's education	6.72	0.02281	5.07
Urban	0.24410	-0.19329	-5.30
INTERCEPT			
R-squared:	6.57%		
F-value:	8.48		
N:	974		

Table 16

FEMALE LABOR PARTICIPATION

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
Wife's probability of working	0.072		
INDEPENDENT VARIABLES:			
Wife's expected wage	218.42	0.00024	8.22
Husband's wage	137.37	-0.00028	9.9[illegible]
Other income	2,520.00	-0.00000	-0.[illegible]
INTERCEPT		-0.01863	
R-squared:	16.06%		
F-value:	76.26		
N:	1199		

On Integration

The effect of integration on the impact of CIADP was naively tested by introducing binary variables for cases where two or more components were present in the production function estimates. In all cases, for both corn and rice, these "integration dummies" were insignificant. However, this should not be taken as proof that integration does not work. The results are probably due to the inadequate modelling of the way that integration works. What may perhaps be done now is an intensive case study of an integrated project*/ in order to come up with the process by which this factor works. This will be of use in the testing and monitoring as well as the planning of future integrated projects and plans.

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*/ This was not possible given the constraints of the ESIA/WID project because this case analysis is potentially huge.

IV. POLICY AND RESEARCH IMPLICATIONS

The Cagayan Integrated Agricultural Development Project had several components whose operations were centrally directed. This led to the expectation that the effectivity of the project components would be magnified *in toto* or through the individual effects of the projects. The one unexpected result that may be mentioned with the benefit of hindsight was that CIADP was conceived as an agricultural development project and the different interrelationships in the economic sphere were incorporated in the design. The project's impact on the socio-demographic concerns of ESIA/WID were, however, not a conscious part of the plan. It is therefore conceivable that in the socio-demographic sphere (Figures 6 and 6) the impact of the different projects will all get confounded and the net effect of each component may be visible only with very precise controls for these interactions. Without these, the ultimate impact of the project on the socio-demographic components may be washed out.

The foregoing concerns may in fact be what is being observed in this impact analysis of the CIADP project on the ESIA/WID areas of concern. The project seems to have very strong positive effect on productivity, production, income, labor and energy use. These are also expected to strongly affect the distribution of income within the project area. Thus, in so far as the economic areas of concern, CIADP has very perceptible effects -- at least as a first round

approximation. Where the social variables are concerned however, the project's effects seem to get dissipated. There are two possible causes for this: first, this may have ensured because the project was not expressly planned to influence these objectives (as far as the operating components of the project at the time of the survey are concerned); second, the project's components may not yet have had the time to work out its effects in the social variables. As conceptualized, these concerns are in the nature of second-round effects which take place because of developments in the production -- consumption sphere. At the time of the survey, not all the components were completely in place, for one. For another, the time needed for all the effects to get worked out may be quite long.

The full evaluation of the project's effects will require the use of fuller models and the data is still continually being cleared. With the first-round effects already visible, there is no doubt that more effects will be uncovered as the estimates become more precise. There is also no doubt that evaluative surveys done at a later period will show more impact than has been seen up to now. What can perhaps be suggested here is that future project plans explicitly include the modelling of the socio-demographic areas of concern so that more precise methods of intervention can be designed and the traditional development projects be modified.

Appendix Table 1

CORN PRODUCTION AS A FUNCTION OF SEED PURCHASED

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN Quantity	5.971		
INDEPENDENT VARIABLE:			
LN Seed	1.504	0.114	2.294
Intercept	-	5.800	
R-squared:	3.92%		
F-value:	5.26		
N:	130		

Appendix Table 2

RICE PRODUCTION AS A FUNCTION OF SEED PURCHASED

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN Quantity	7.300		
INDEPENDENT VARIABLE:			
LN Seed	2.536	0.093	3.513
Intercept	-	7.063	
R-squared	5.39%		
F-value	13.05		
N	230		

Appendix Table 3

IMPLIED MARGINAL PRODUCTIVITIES[1/] IN CORN PRODUCTION WITH AND WITHOUT PROJECT[*/]

Input	Coefficients			Marginal Productivity	
	Q/X	Direct	Indirect	Without	With Project
Land	370.2	1.016	**	376.1	376.1
Seed	87.4	0.096	**	8.4	8.4
Hired Labor	48.8	-0.112	**	- 5.5	- 5.5
Equipment	134.8	**	+0.367	**	+ 49.5

Note: [1/] In kilos of corn harvested.

[*] Evaluated at the means of the variables.

[**] No estimated measure.

Appendix Table 4

INDIRECT EFFECTS OF PROJECT COMPONENTS ON INPUT DEMAND*/

Component	INPUT					
	Land	Household Labor	Hired Labor	Fertilizers	Equipment	Seeds
Irrigation	0.12	10.26	- 6.55	5.2[illegible]	4.07	3.10
Extension	-0.56	-47.28	30.22	-24.06	-18.74	-14.27
Roads	0.52	44.03	-28.14	22.40	17.46	13.29
Electrification	**	**	**	**	**	**
Whole Project	0.08	7.01	- 4.47	3.56	2.79	2.12

Appendix Table 5

DIRECT EFFECT OF PROJECT COMPONENTS ON INPUT DEMAND*/

Component	INPUT					
	Land	Household Labor	Hired Labor	Fertilizers	Equipment	Seeds
Irrigation	**	**	-257.57	**	**	**
Extension	-827.49	**	**	**	**	**
Roads	**	**	**	**	**	**
Electrification	**	**	**	**	**	**

*Measured by $Q\theta_{1k}$ of Equation (4) (we have divided by P/W_k).

**No measured effect.

Appendix Table 6

ESTIMATED PRODUCTION FUNCTION FOR CORN
(All Variables)

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN Quantity	5.77717		
INDEPENDENT VARIABLES:			
LN LAND	1.156	0.269	2.011*
LN HOUSEHOLD LABOR (HHL)	0.266	0.090	0.355
LN SEED	0.555	0.192	2.348*
LN Fertilizers	1.512	0.076	1.441
LN Farm Equipment	1.129	-0.023	-0.352
LN Hired Labor (HiL)	1.936	-0.038	-0.652
D_3	0.097	0.118	0.216
D_2	0.142	0.194	0.444
D_3* LN LAND	0.001	-0.560	-0.580
D_2* LN HHL	0.058	-0.355	-0.445
D_3* LN SEED	0.048	0.020	0.062
D_3* LN Fertilizers	0.020	-0.199	-0.277
D_3* LN Farm Equipment	0.123	0.027	0.117
D_3* LN HiL	0.227	0.024	0.135
D_2* LN LAND	0.005	-0.734	-1.409
D_3* LN HHL	0.018	-0.848	-0.630
D_2* LN SEED	0.109	-0.162	-0.624
D_2* LN Fertilizers	0.070	-0.040	-0.192
D_2* LN Farm Equipment	0.037	0.208	0.685
D_2* LN HiL	0.293	0.163	0.774
TIME	0.112	0.554	1.376

Appendix Table 6
(Continued)

D_2: Dummy variable = 1 if agricultural extension workers is present

0 otherwise

D_3: Dummy variable = 1 if irrigation is gravity or diesel/electric

0 otherwise

R-squared = 17.11%

F-value = 1.10

** Significant at the 1% two-tailed test.

* Significant at the 5% two-tailed test.

+ Significant at the 10% two-tailed test.

Appendix Table 7

ESTIMATED PRODUCTION FUNCTION FOR RICE FARMS
(All Variables Included)

	Mean	Coefficient	T-Statistic
DEPENDENT VARIABLE:			
LN QUANTITY	7.46		
INDEPENDENT VARIABLES:			
LN LAND	0.364	0.885	10.51**
LN Household Labor (HHL)	0.367	0.122	1.01
LN SEED	1.850	0.002	0.06
LN Fertilizers	3.136	0.110	3.57**
LN FERAT	2.339	0.011	0.40
LN Hired Labor (HiL)	3.864	0.036	1.50
D_1	0.234	0.122	0.30
D_2	0.195	-0.055	- 0.20
D_1* LN LAND	0.081	-0.362	- 2.24*
D_2* LN HHL	0.070	0.113	0.36
D_1* LN SEED	0.956	0.105	1.59
D_1* LN Fertilizers	1.328	-0.056	0.63
D_1* LN Equipment	1.107	0.144	2.49*
D_1* LN HiL	1.272	0.073	- 1.11
D_2* LN LAND	0.001	-0.430	- 2.46*
D_1* LN HHL	0.068	0.145	0.43
D_2* LN SEED	0.364	0.002	0.03
D_2* LN Fertilizers	0.644	0.009	0.12
D_2* LN Equipment	0.418	0.010	0.18
D_2* LN HiL	0.813	0.037	0.57
TIME	0.096	-0.152	- 0.59

Appendix Table 7
(Continued)

D_1: Dummy variable = 1 if irrigation is by diesel/electric pump

0 otherwise

D_2: Dummy variable = 1 if extension worker is present

0 otherwise

F-squared: 57.44%

F-value: 13.43

** Significant at the 1% two-tailed test.

* Significant at the 5% two-tailed test.

Significant at the 10% two-tailed test.