RESOURCE PRODUCTIVITY ESTIMATES ON LOWLAND RICE FARMS IN BAYBAY, LEYTE

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ABSTRACT

Estimates using the Cobb-Douglas production functions indicate that aside from irrigation; land tenure, type of farming and farm size had no significant effect in improving the technological efficiency in both dry and wet seasons. The significant effect of irrigation in improving the productivity of resource-use was attributed to the adequacy of water supply for irrigation in both seasons. In the lowland farms, farmers were not allocating the resource inputs efficiently particularly nitrogen applied, land cultivated and human labor employed. Farm income in the lowland rice farms can still be increased by adjusting the level of inputs used. Addition of nitrogen applied and reduction of the current labor employed appear to be some of the adjustment possibilities.

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KEY WORDS: Productivity estimates. Resource allocation. Cobb-Douglas function. Lowland rice farms.

INTRODUCTION

In the past years when land suited to agricultural production in the country was relatively abundant, increase in production was principally through expansion of the area under cultivation (Hayami and Kikuchi, 1975). However, the closing of the land frontier brought a shift in resource use in agriculture, and rice production came to depend on measures designed to increase land productivity. This includes, among others, the strong support of the Philippine government towards the adoption of the high yielding varieties (HYVs) with its nationwide extension program popularly known as the Masagana 99; the construction of more irrigation systems, the liberal credit to farmers, and the intensification of fertilizer use. As a result, increase in rice output in the Philippines in the last two decades was primarily due to increase in yield per hectare. From 1960 to 1974, rice production increased at 2.4% annually. Yield increased from 1.19 tons/ha in 1960-1963 to 1.56 tons/ha in 1972-1975. Since fertilizer-responsive high yielding varieties were introduced in 1965, the HYVs were planted on more than 61% of the rice area in 1974 (Barker et al., 1977). Although self-sufficiency in rice has been claimed as early as 1976, the country's average rice production is still very low from desired levels.

Increasing productivity on rice farms may be achieved through the adoption of improved production technology, efficient allocation of available inputs, or a combination of both. On lowland rice farms, the shift from traditional to high-yielding varieties, the application of fertilizer, prevention and control of pests and diseases, and other cultural management practices that go with the use of high yielding varieties are sufficient evidences that farmers have adopted the improved production technology. However due to the farmers' lack of knowledge on resource use and the non-suitability of production technology being introduced to farmers' fields, combined with various economic and social constraints, yield potentials and increase in resource productivity are not fully realized. The apparent problem is whether the farmers, upon adopting the improved production practices, are efficiently allocating the resource inputs in the production process.

MATERIALS AND DISCUSSION

The study was conducted in 3 barangays of Baybay, Leyte which are adjacent to the Visayas State College of Agriculture (ViSCA), namely; Gacat, Kansungka and San Isidro. The barangays were chosen as study areas because the main source of livelihood of the residents is rice farming, and these were then considered "social laboratories" of ViSCA. Since the rice farms were homogeneous with respect to physical attributes like topography and drainage condition, systematic random sampling was employed to select the farmer respondents. Data and information were collected by means of field interviews using pretested interview schedule.

The Model. In order to evaluate the resource-use productivity on the lowland rice farms, the input coefficients of the power form of production function was estimated using the regression model. Resource inputs on farms were classified into five categories: area of land operated; amount of nitrogen applied per farm (kg); operating costs which included cost of herbicides, cost of animal labor per animal-day, and cost of machine/tractor rental; human labor in man-days per farm; and farm investment. Since it was felt that output and farm productivity are functions not only of the said quantitative inputs but also of the qualitative and categorical factors existing on farms the following dummy variables with zero or one value were included in the models; namely, land tenure, farm size, type of farming and irrigation availability. The fitted functions with their corresponding dummies were:

$$Y = a\, LA^{b_1} KN^{b_2} OC^{b_3} HL^{b_4} FI^{b_5} \exp.(b_6 LT_1 + b_7 LT_2 + e) \quad (1)$$

$$Y = a\, LA^{b_1} KN^{b_2} \ldots FI^{b_5} \exp.(b_6 LS + b_7 I + b_8 TF + e) \quad (2)$$

$$Y = a\, LA^{b_1} KN^{b_2} \ldots FI^{b_5} \exp.(b_6 LT_1 + b_7 LT_2 + b_8 LS + b_9 I + b_{10} TF + e) \quad (3)$$

Where:

- Y = physical rice output in cavans per farm;
- LA = farm area in hectares;
- KN = amount of nitrogen fertilizer in kilograms per farm;
- OC = operating costs which include costs of insecticides and herbicides, costs of animal labor and machine/tractor rental per farm;
- HL = human labor in man-days per farm;
- FI = value of farm investment per farm;
- LT_1 = dummy variable for land tenure, taking the value 1 for share tenant and 0 value 1 otherwise;
- LT_2 = dummy variable for land tenure, taking the value 1 for leaseholder and 0 value for other tenure classifications;
- LS = dummy variable for farm size, taking the value 1 for farms having an area of 0.50 hectare or less and 0 value if otherwise;
- I = dummy variable for irrigation, taking the value 1 for irrigated farms and 0 value if otherwise;
- TF = dummy variable for type of farming, taking the value 1 for full-time farmer and 0 value if otherwise.

The t-statistic was employed to test the statistical significance of the input coefficients and the difference in resource-use productivity among the different farming conditions expressed as dummy variables in the regression equations.

RESULTS AND DISCUSSION

With the power form of production function used in the study, the different input coefficients directly indicate the production elasticities of the different inputs included. These elasticities express the percentage change in the total output forthcoming from a 1% increase in any of the resource inputs, holding other inputs at predetermined levels. For instance, the coefficient of elasticity of nitrogen applied for the dry season is 0.1324 (Table 1). This means that 1% increase in nitrogen input would bring an average of 0.1324% increase in total output, when other inputs are held at the geometric means.

Effect of Farming Conditions.

On the assumption that the differences in productivity were only observable in the intercept term of the production function, dummy variables for the 3 tenure status were included in the regression analysis. The dummy variable LT_1

Table 1. Estimates of the production functions for lowland rice farms in Baybay, Leyte.

Item (Log)	Dry Season	Wet Season
Intercept	0.8249** (0.1418)	1.2131** (0.1399)
Land operated (ha)	0.5056** (0.0553)	0.6530** (0.0538)
Nitrogen applied (kg)	0.1324** (0.0329)	0.1189** (0.0347)
Operating costs (₱)	0.1493** (0.0432)	0.0347ns (0.0428)
Human labor (man-days)	0.1710** (0.0617)	0.1786** (0.0597)
Farm investment (₱)	0.0253ns (0.0144)	0.0014ns (0.0114)
Dummy variables:		
Land tenure (LT_1)	0.0366ns (0.0250)	0.0199ns (0.0243)
Land tenure (LT_2)	0.0422ns (0.0286)	0.0397ns (0.0277)
R-Square	0.7122	0.7315
F-Value	98.99	109.00

Figures in parenthesis are standard errors of the input coefficients.
**Highly significant (1%)
*Significant
ns Not significant

represented the share-tenant dummy, LT_2 represented the lessee dummy, while the owner-operator was to take the base intercept as reference point for test and comparison. As shown in Table 1, none of the land tenure dummies was significantly different from the base intercept. This finding revealed that, on the average, no statistical differences in productivity existed among the 3 tenure classifications.

In testing the hypothesis that irrigation, type of farming, and farm size affected the productivity of lowland rice farms, another model was run both in the dry and wet seasons (Table 2). The result for both seasons showed that the coefficients of the farm size and type of farming dummies were not statistically significant. On the other hand, the irrigation dummy appeared significantly different from zero in both dry and wet seasons.

Table 2. Estimates of the production functions for lowland rice farms in Baybay, Leyte with irrigation, type of farming and farm size as dummy variables.

Item (Log)	Dry Season	Wet Season
Intercept	0.8114** (0.1401)	1.2101** (0.1370)
Land operated (ha)	0.5497* (0.0627)	0.7035** (0.0605)
Nitrogen applied (kg)	0.1251** (0.0327)	0.1114** (0.0316)
Operating costs (₱)	0.1555** (0.0430)	0.0369^ns (0.0423)
Human labor (man-days)	0.1514** (0.0613)	0.1570** (0.1570)
Farm investment (₱)	0.0149^ns (0.0128)	0.0082^ns (0.0124)
Dummy variables:		
Irrigation (I)	0.0944* (0.0388)	0.1268** (0.0374)
Type of farming (TF)	0.0382^ns (0.0252)	-0.0039^ns (0.0243)
Farm size (LS)	0.0229^ns (0.0312)	-0.0276^ns (0.0301)
R-Square	0.7195	0.7415
F-Value	89.47	100.08

Figures in parenthesis are standard errors of the input coefficients.
**Highly significant
*Significant
ns Not significant.

Resource-Use Efficiency.

The analysis of resource-use efficiency provided evidences on inefficiency of the current resource allocation such as amount of nitrogen applied, area of land cultivated and human labor on lowland rice farms (Table 3). The ratios of marginal value product (MVP) to marginal factor cost (MFC) of nitrogen applied to land cultivated for both seasons were greater than one, indicating that lesser amount of nitrogen fertilizer and lesser farm area were employed at the level when other inputs are at their geometric means. On the other hand, the low MVP of human labor, which was only more than one half of the MFC of labor, indicates that too much labor was being employed on the rice farms.

The high marginal productivity of land which was about 2 times compared with marginal factor cost in the dry season and about 2.5 times in the wet season was due to the very small farmholding per farmer in the area which averaged 0.40 hectare only (Table 4). The small parcels of land that farmers worked on created high pressure of human labor upon a unit of land. This pressure of human labor on lowland farms plus the limited nonfarm and off-farm employment opportunities for rural workers might have exerted a significant impact on the optimization of labor employment.

Table 3. The marginal value product of inputs in relation to input prices as of 1981 per cropping season in lowland rice farms in Baybay, Leyte.

Input Classification	Season	
	Dry	Wet
	(₱)	
	Marginal Value Product (MVP)	
Nitrogen applied	11.78	9.90
Land operated	2210.90	2488.43
Human labor	7.99	7.26
Operating capital	1.10	—
	Marginal Factor Cost (MFC)	
Nitrogen applied	6.44	6.50
Land operated[a]	1124.73	1017.25
Human labor	13.91	13.91
Operating capital	1.00	1.00
	MVP/MFC	
Nitrogen applied	1.83	1.52
Land operated	1.97	2.44
Human labor	0.57	0.52
Operating capital	1.10	—

[a]Landlord share of the produce was used as an estimate of the opportunity cost of land.

Table 4. Resource-use per hectare by irrigation availability in lowland rice farms in Baybay, Leyte.

Item	Irrigation Availability		
	Rainfed (n = 19)	Irrigated (n = 270)	Average (n = 289)
Land area (ha)	0.38	0.40	0.40
Nitrogen applied (kg)	44.09 (39.04)	58.65 (46.72)	57.74 (46.31)
Tractor/machine cost (₱)	458.34 (143.30)	404.88 (257.86)	408.53 (251.77)
Human labor (man-days)	92.04 (38.44)	108.46 (52.75)	107.38 (52.04)
Animal labor (animal-days)	12.44 (8.98)	9.86 (6.81)	10.06 (7.01)

Figures in parenthesis are standard errors of means.

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