ECONOMIC EFFICIENCY OF RICE FARMERS IN A RAINFED LOWLAND ENVIRONMENT BEFORE AND DURING THE FINANCIAL CRISIS

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ABSTRAK

Penelitian ini bertujuan untuk menilai efisiensi ekonomi dari petani padi lahan sawah tadah hujan sebelum dan selama krisis ekonomi di Jawa Tengah. Data yang digunakan dalam analisis adalah panel data dari 90 petani responden yang mencakup musim tanam 1997 dan 1999. Teknik analisa yang digunakan adalah analisa pendapatan dan biaya, uji beda nilai tengah, dan analisa regresi. Hasil regresi dari fungsi keuntungan menunjukkan bahwa harga gabah, pupuk dan tenaga kerja secara statistik nyata pengaruhnya terhadap keuntungan usahatani baik pada musim hujan maupun musim kemarau. Petani secara ekonomi ternyata lebih efisien dalam memproduksi padi selama krisis dari pada sebelum krisis ekonomi. Efisiensi ekonomi pada musim hujan ternyata lebih tinggi dari pada musim kemarau karena infestasi hama dan kompetisi gulma lebih rendah serta air cukup. Efisiensi ekonomi meningkat selama krisis ekonomi seiring dengan meningkatnya harga sarana produksi terutama pupuk, herbisida dan insektisida. Efisiensi ekonomi sangat dipengaruhi oleh tingkat pendidikan, krisis ekonomi, dan musim tanam. Pengalaman usahatani, ukuran rumah tangga, dan status penguasaan lahan tidak nyata pengaruhnya terhadap efisiensi ekonomi.

Kata kunci : *efisiensi ekonomi, petani padi, krisis ekonomi*

ABSTRACT

This study assessed the economic efficiency of rainfed lowland rice farmers before and during the financial crisis in Central Java. Panel data from 90 farmers were gathered by means of a structured questionnaire covering the 1997 and 1999 crop seasons. The analytical techniques employed in this study were costs and returns analysis, statistical test of means, and regression analysis. Regression results of the unit profit model showed that the prices of rough rice, fertilizer and labor were statistically significant for both the wet season and the dry season. Regardless of cropping season, the farmers were more economically efficient in producing rice during the period of financial crisis than before the financial crisis. Economic efficiency in the wet season was higher than in the dry season because of lower pest infestation and weed competition and because of sufficient water supply. Economic efficiency was significantly affected by level of education, financial crisis and cropping season. It increased during the financial crisis despite the price increase of input factors, especially fertilizer, herbicide and insecticide. During the wet season, farmers were found to be more economically efficient

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than in the dry season. Farming experience, household size, and tenure status did not significantly affect farmers' economic efficiency.

Key words : *economic efficiency, rice farmers, financial crisis*

INTRODUCTION

Rainfed lowland rice environments are common in Indonesia. More than 50 percent of Indonesia's rainfed lowland rice areas are in Java, 324,420 hectares of which are in Central Java(CBS,1998). Because of the large area they cover, rainfed lowland areas are the main source of potential growth in rice production in Indonesia. Rainfed lowland rice will, therefore, be the focus of a long-term rice intensification program to compensate for the stagnation of irrigated lowland rice yield.

In addition, the rapid growth of the industrial sector led to the dimunition of available fertile and productive agricultural lands since the demand for factories, housing, and other public facilities increased. In Java, about 30,000 hectares of productive lands had been converted to non-agricultural uses annually (CRIFC, 1992).

The increase in production cost as a result of rising wages, fertilizer and pesticide prices also caused production to slow down. Real wages and chemical prices have increased substantially after the currency crisis in 1997. Real wages increased by 7.6 percent per year, while fertilizer subsidy was gradually reduced. On the other hand, pesticide subsidy is being phased out. Thus, these resources which used to be available to farmers are no longer sufficient.

Moreover, in some areas, rice production response to fertilizer use has been declining. Kasryno (1985), Adnyana *et al.* (1990), and Darwanto (1993) pointed out that a relatively high proportion of rice farmers in Java are using more fertilizers than what is recommended, resulting in a negative effect on yield. This negative effect causes lower allocative and economic efficiency. The implication of this situation is that the efficiency of fertilizer use should be given priority in order to increase productivity. The extension and training programs for farmers should be intensified to improve their technical knowledge and skills and consequently, their technical efficiency.

It was also noted that the terms of trade received by rice farmers in Java decreased by 34 percent in 1985 (Sumodiningrat, 1989). This situation makes it unlikely for farmers to have any surplus income from their production to be invested in a more productive endeavor. Without improving their efficiency in rice farming, they would not be able to sustain economic gain given their resource endowment, technology, current socio-economic environment and knowledge.

This is mainly because no substantial change in technological progress was taking place.

Moreover, the Indonesian government faces the problem of budgetary austerity, but it has to continuously maintain self-sufficiency by increasing rice production, employment and income of rice farmers. To meet this objective, the government has implemented various programs such as input subsidies, price support, training and extension services to farmers, research and development and infrastructure investment. The current rice development strategies may not be sustained in the same degree as before since the currency crisis also affects input prices and the price of rice.

Results of the study will provide information on the profitability of rainfed rice farmers as a result of the currency crisis and also determine the relative importance of other factors affecting their economic efficiency. Such information will be useful to policy makers in formulating development strategies to improve the economic efficiency of rainfed rice farmers in Central Java.

The general objective of this study was to examine the effect of the currency crisis on economic efficiency of rainfed lowland rice farmers in Central Java. Specifically, the objectives of the study were as follows: (1) to compare mean input use, yield, production cost and farm profit of rainfed lowland rice farmers before and during the financial crisis; (2) to measure and compare economic efficiency of rainfed lowland rice farmers before and during the financial crisis; (3) to determine the effects of selected socio-economic factors on economic efficiency of rainfed lowland rice farmers; and (4) to formulate policy recommendations based on the results of the study.

METHODOLOGY

Selection of Study Areas and Methods of Data Collection

The study covered four villages in two districts in the Province of Central Java. The purposively selected villages were Megulung and Meteseh in Rembang District, and Sidomukti and Mojoluhur in Pati District. The primary data used in this study were obtained partly from the panel data collected under the Rainfed Lowland Rice Consortium, a collaborative research project of the International Rice Research Institute (IRRI) and the Central Research Institute for Food Crops in Bogor. The data were collected from 90 farmers covering the 1997/98 and 1999/00 crop season using a structured questionnaire and stratified random sampling. The following types of data were collected from three groups of farmers classified by cropping pattern (i.e. rice-rice-mungbean, rice-rice-peanut, rice-rice-fallow), their socio-economic profile, input use, rice yield, price of inputs and outputs. Secondary data on the socio-economic and biophysical profile of the study areas were collected from the Jakenan Experimental Station and the District Agriculture Services both in Pati and Rembang, Central Java.

Analytical Procedure

To determine the profitability of rice production in each period, cost and returns analysis were employed. Profitability is a measure of how efficient resources are used to produce profit or net income (Kay, 1994). Net Cash Farm Income (NCFI) was used to measure the profitability of rainfed rice production

Since the nominal input and output prices indicated a big difference during the period, all the input and output prices before the financial crisis in 1997/98 were converted to real prices by dividing the average price index in 1999/00 by the average price index in 1997/98 and then multiplied by the nominal price in 1997/98. Real prices were used for the profit function computation.

Estimation of Technical and Allocative Efficiency Using the Profit Function Approach

Efficiency is usually estimated by separately estimating technical and allocative efficiency from a production frontier using farm level data or by combining farm level data with experimental data. However, a production function approach may not be appropriate when estimating the economic efficiency of individual farms because they may face different prices and factor endowments. As a result, they have different best-practice production functions and thus, different optimal operating points. Therefore, the estimation of efficiency should incorporate farm-specific prices and level of fixed factors as an argument in the analysis. Indeed, the incorporation of farm-specific prices and resource endowments led to the profit function formulation of the production process in estimating efficiency (Ali and Flinn, 1989).

Recently, the profit function has been extended through the estimation of a profit function frontier analogous to the production frontier. In the stochastic frontier model, deviation from the profit frontier is decomposed into a component owing to random error and another component owing to economic inefficiency, which includes both technical and allocative inefficiency (Ali and Flinn, 1989 and Huang *et al.,* 1986).

Assuming that the firm is allocatively efficient but technically inefficient, then the production function is specified as follows:

$$Y = A \prod_{i=1}^{m} X_i^{\alpha_i} \prod_{j=1}^{n} Z_j^{\beta_j} e^{-u} e^{v} \quad \ldots\ldots\ldots\ldots \quad (1)$$

where:

Y = quantity of output
X_i = quantity of variable input i
Z_j = fixed factor j in the short run
A = constant term
α_i, β_j are the coefficients to be estimated.

The error term in the production function consists of two parts: a technical efficiency term (e^{-u}) and a random error (e^{v}). The technical efficiency term refers to the ratio of actual yield to the best farmer's yield on the farm's input level. Its value is between zero and one. It indicates the magnitude of the output of the farm relative to the output that could be produced by a fully efficient farm using the same input vector. The farmer operates on the frontier production function if e^{-u} is equal to zero. The random error term e^{v} has a symmetric distribution to capture the random effects of the measurement error and exogenous shocks.

The restricted profit of a firm is defined as gross revenue minus all variable costs and is expressed as follows:

$$\pi = pY - \sum_{i=1}^{m} X_i w_i \quad \text{.......} \quad (2)$$

Y and X have the same definitions as in (1) and p and w_i are the output and input prices, respectively.

For a given technology and a given endowment of fixed factors of production, the profit function expresses the profit of a firm as a function of prices of output and variable inputs and the quantities of the fixed factors of production (Lau and Yotopoulus, 1971).

Moreover, Yotopoulos and Lau (1973) used the profit function to estimate technical and allocative inefficiencies. Based on their profit function model, a method was developed to test the absolute and overall price efficiency hypotheses and the input-specific efficiency of a group of farmers by comparing technical efficiency, overall price efficiency, and input-specific price efficiency.

Although this model can be extended to the case of different firm types, it can not be applied to investigate efficiency on a firm-by-firm basis (Forsund *et al.*, 1980). To overcome this weakness, recently the profit function was extended by estimating a profit frontier function analogous to the production frontier (Ali and Flinn, 1989; Huang *et al.*, 1986). In the stochastic profit frontier function model, deviation from the profit frontier can be decomposed into two parts: one is due to random error (e^{v}) and the other to economic efficiency(e^{-u}) which includes both technical and allocative efficiency. A method to segregate the estimated efficiency from the profit frontier function into these two components was developed by Ali and Flinn (1989).

OLS was used to estimate the average profit function of rainfed rice farmers. The profit function frontier was estimated using the MLE technique after the final functional form of the profit model is specified. The estimation of the stochastic frontier profit function was done by using FRONTIER version 4.1 software program developed by Coelli (1994).

In its notation, the specification of the Cobb-Douglas restricted profit function is the same as the production function. The difference is in the independent variables included in the model. In the logarithmic form, the Cobb-Douglas restricted profit function to be estimated is specified as follows:

$$\ln \pi^* = \ln \alpha_0 + \alpha_1^* \ln PR + \alpha_2^* \ln PS + \alpha_3^* \ln PF + \alpha_4^* \ln PL + \alpha_5^* DI + \alpha_6^* DH + \alpha_7^* DSIZE + e^* \quad \ldots\ldots (3)$$

where:

π^*	=	unit profit (Rp/kg),
PR	=	price of rough rice (Rp/kg),
PS	=	price of seed (Rp),
PF	=	price of fertilizer (Rp/kg)
PL	=	price of pre-harvest labor (Rp/person day),
DI	=	dummy variable for insecticide use equals 1 if the farmer used insecticides and equal to 0 if otherwise,
DH	=	dummy variable for herbicide use equals 1 if the farmer used herbicides and equal to 0 if otherwise,
DSIZE	=	dummy variable for farm size equals 1 if farm size was greater than 0.5 ha, and 0 if otherwise.
αl	=	parameters to be estimated,
e^*	=	error term.

The Cobb-Douglas form was chosen to estimate the profit function because direct estimation of this type of production function is less rammed by multicolinearity problem as compared to more flexible functional forms such as the translog profit function which includes a second order form in the right hand side (Ha, 1993).

The profit loss or forgone profit of rainfed rice farmers was computed as follows:

Profit Loss = Maximum Possible Profit x Farm Specific Economic Inefficiency .... (4)

Where the highest profit from specific farm is assumed to be a maximum possible profit and farm specific economic inefficiency is calculated by $(1- e^{-u})$ as explained in the previous section.

The t-test of means for paired samples was employed in comparing the mean levels of input utilization, yield, nominal and real production cost, gross returns, and net income as well as efficiency rating and profit loss before the financial crisis (1997 crop season) and during the financial crisis (1999 crop season

Once farm-specific economic efficiency indices have been computed, regression analysis was employed to determine the effects of selected factors on the variation in farmers' economic efficiency levels. To determine and evaluate the impact of socio-economic and technological variables on the economic efficiency of rainfed rice farmers, the following model was specified:

$$EFF = A + \alpha_1 EDUC + \alpha_2 FEXP + \alpha_3 HHS + \alpha_4 TS + \alpha_5 FC + \alpha_6 CS + e \quad \text{.......} \quad (5)$$

where:

EFF = Economic efficiency indices,
EDUC = Years in school of the household head,
FEXP = Farming experience of the household head,
HHS = Household size,
Dummy Variables:
TS = Tenure status,
FC = Financial crisis,
CS = Cropping season
A, α_i = Parameters to be estimated,
E = Error term.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Sample Farmer-Respondents

An average farmer was 49 years old with elementary school level of education or an average schooling of six years. The average family size was four members with an available family labor force of four persons. This indicates that family labor was the major source of labor in rice farming.

The average landholding of the farmer-cooperators was 0.96 hectare. In terms of distribution, 64.4 percent of the farmers had more than 0.5 hectare and only 35.6 percent of them had less than 0.5 hectare. This indicates that farmers in rainfed lowland areas had larger farms compared to the farmers in irrigated lowland areas, who had only 0.4 hectare (CBS, 1998). Land tenure status in the study areas can be classified mainly into two categories: (1) owner-operators, and (2) owner-cum-tenants. Most of the farmer-cooperators in this study were owner-operators (88.9%). The rest were owner-cum-tenants (11.1%). Only 6.6 percent of them attended agriculture-related training courses such as integrated pest management, cooperative business management, and on-farm water reservoir management. Although only a few of them had been technically trained, they had been engaged in rice farming for an average of 31 years. Aside from getting income from rice farming, 57.8 percent of the respondents had other sources of income such as driving, vending, fishing, and other kinds of village services.

Rice was the main crop in the study area and mungbean, peanut, soybean, corn, and cassava were the secondary crops. Rice was grown during two distinct seasons: the gogorancah season (October-January) and the walik jerami season (February-May). The cropping pattern used by farmers was dry-seeded rice, followed by minimum-tillage transplanted rice, followed by secondary crops or fallow. The mean annual rainfall for the recent 20-year period (1980-1999) was 1,515 mm. The cultivation of dry-seeded rice and transplanted rice in sequence with a growing period of four months per crop needs about 1500 mm of rain per year since the minimum monthly requirement for lowland rice is about 200 mm. Based on this rule of thumb, the total annual rainfall may be classified into inadequate (<1500 mm) and adequate (>1500 mm) (Fagi, 1995).

Input and Output Prices in Real Terms

As shown in Table 1, both the costs of material inputs and labor in real terms were higher during the financial crisis in 1999 as compared to the before the financial crisis period in 1997 because the depreciation of the rupiah reached 200 percent (CBS, 1999-2000). The price of seeds significantly increased by 27 percent from 1,055 rupiah per kilogram (kg) during the 1997 wet season to 1,344 rupiah per kg during the 1999 wet season. The real price of herbicides significantly increased by more than 200 percent from 118 rupiah to 373 rupiah per gram of active ingredient. The real price of insecticide also significantly increased by 143 percent from 1,188 to 2,887 rupiah per gram of active ingredient. However, the real price of fertilizers did not increase significantly because urea was sold to farmers at a subsidized price until the 1999 wet season. Labor wages and animal power rental in real terms increased significantly. Likewise, the real price of rough rice increased significantly from 538 rupiah per kg before the financial crisis to 858 rupiah per kg in fresh weight form during the financial crisis.

In the dry season, the real price of seeds significantly increased by 40 percent from 1,053 rupiah per kg before the financial crisis to 1,477 rupiah per kg during the financial crisis. The real price of chemicals such as herbicides, insecticides, and fertilizer significantly increased during the financial crisis. Labor wages and animal power rental also increased significantly. As a result of the increase in input prices in real terms, the price of rough rice increased from 678 rupiah per kg before the financial crisis to 960 rupiah per kg in fresh weight form during the financial crisis.

Table 1. Real Input and Output Prices per Unit Before and During the Financial Crisis, Central Java, Indonesia, 1997/98 and 1999/00

Item	Before the crisis		During the crisis real	Difference real
	Nominal	Real		
Wet Season:				
Seed (Rp/kg)	624	1055	1344	289***
Fertilizer (Rp/kg)	489	827	844	17^{ns}
Herbicide (Rp/g a.i)	70	118	373	255***
Insecticide (Rp/g a.i)	703	1188	2887	1699***
Labor (Rp/person day)	4260	7199	10123	2924***
Animal power (Rp/day)	5748	9714	12379	2665***
Rough rice (Rp/kg)	319	538	858	320***
Dry Season:				
Seed (Rp/kg)	623	1053	1477	424***
Fertilizer (Rp/kg)	501	847	971	124***
Herbicide (Rp/g a.i)	23	39	203	164***
Insecticide (Rp/g a.i)	628	1061	3181	2120***
Labor (Rp/person day)	3778	6385	10909	4554***
Animal power (Rp/day)	5174	8744	10791	2047***
Rough rice (Rp/kg)	401	678	960	282***

*** : statistically significant at α=0.01

ns : statistically not significant α=0.10

Note: Average CPI of 1997/98 and 1999/00 is 372.8 and 628.4, respectively.

Input Use and Yield

Wet Season

Despite the increase in real prices of all inputs during the financial crisis, the levels of all inputs used by the farmers increased during the financial crisis, except for herbicide and pre-harvest labor (Table 2). Mean seeding rate significantly increased by 10 kg from 61.4 kg to 71.4 kg. Under normal conditions, seeding rate averaged 60 kg per hectare. This indicates that farmers are willing to use a higher seeding rate to increase their rice yield.

Table 2. Input Use and Yield Before and During the Financial Crisis, Central Java, Indonesia, 1997/98 and 1999/00

Item	Before The Financial Crisis	During the Financial Crisis	Difference
Wet season:			
Seed (kg/ha)	61.4	71.4	10.0***
Fertilizer (kg/ha)	306.1	358.7	52.6***
Herbicide (a.i. gram/ha)	216.2	166.0	-50.2*
Insecticide (a.i. gram/ha)	24.5	40.8	16.3^{ns}
Pre-harvest Labor (person-day/ha)	64.5	56.5	-8.0**
Post-harvest Labor (person-day/ha)	20.8	28.6	7.8***
Animal power (animal day/ha)	12.5	16.2	3.7***
Manure (bags/ha)	93.9	168.8	74.5***
Yield (kg/ha)	4794.3	4827.1	32.8^{ns}
Dry season:			
Seed (kg/ha)	46.7	52.0	5.3**
Fertilizer (kg/ha)	353.3	339.1	-14.2^{ns}
Herbicide (a.i. gram/ha)	215.8	316.6	100.8**
Insecticide (a.i. gram/ha)	53.7	62.8	9.1^{ns}
Pre-harvest Labor (person-day/ha)	71.8	74.3	2.5^{ns}
Post-harvest Labor (person-day/ha)	21.5	40.9	19.4***
Animal power (animal-day/ha)	8.8	7.3	-1.5***
Yield (kg/ha)	3666.9	3849.5	182.6^{ns}

Figures in parentheses represent standard deviations;
***, **, * statistically significant at α=0.01, α=0.05, and α=0.10, respectively; ns = statistically not significant at α=0.10.

Fertilizer use was calculated in kilograms of urea, super-phosphate, and phosphorus, the three major fertilizers needed for the growth of the rice plant. Fertilizer applied after the financial crisis significantly increased by an average of 52.6 kg from 306.1 kg to 358.7 kg. The total amount of fertilizer used was still under the recommended dosage for irrigated lowland (400-450 kg/ha). The increase in use of fertilizer may be related to the increase in seeding rate, since farmers normally applied fertilizer only at 300 kg/ha. The difference in fertilizer use was statistically significant at one percent level. The average amount of manure used was significantly increased by 74.5 bags from 93.9 bags to 168.8 bags. Farmers increased the use of manure because they wanted to increase rice yield significantly.

The average amount of herbicides used by farmers significantly decreased by about 50 grams of active ingredient. The decrease in herbicide use may be due to the increasing in price and competition between paddy and weeds since the seeding rate was high. However, insecticide use did not significantly increase since the price of insecticides drastically increased and farmers' knowledge of the negative impact of insecticide use was probably improving.

Pre-harvest labor significantly decreased from 64.5 to 56.5 person-days due to the increase in wages. However, post-harvest labor significantly increased from 20.8 to 28.6 person- days. Mean total labor use, however, did not change. The farmers reduced pre-harvest labor by 8.0 person-days but increased post-harvest labor by 7.8 person-days. Farmers significantly used more animal power at lower cost in land preparation and planting to improve the quality of land preparation and substitute for manual labor which was more expensive.

Mean yield for wet season rice was 4.79 tons per hectare before the financial crisis and 4.83 tons per hectare during the financial crisis. However, the mean rice yield in kilograms of rough rice per hectare in the wet season did not increase significantly during the financial crisis although the use of other inputs such as fertilizer and seeds increased. This indicates that there are other factors affecting rainfed rice yield (e.g., weather).

Dry Season.

The amount of seed used by farmers in the dry season was less than that in the wet season because the rice cultivation method changed from direct-seeded flooded rice to transplanted rice. The seeding rate significantly increased from 46.7 kg to 52 kg per hectare since the plant spacing was closer, from 20x20 cm to 20x15 cm. The decrease in mean fertilizer use during the financial crisis was not significant despite the significant increase in real price of fertilizer.

The average amount of herbicide used significantly increased from 215.8 to 316.6 grams of active ingredient although the price of herbicide also significantly increased since weed competition with rice seedlings tremendously increased during the dry season. Insecticide use did not statistically increase during the dry season probably due to the significant increase in insecticide price. Pre-harvest labor use did not also increase significantly probably due to the significant increase in labor wages. In general, labor use in the dry season was more than in the wet season. Animal power use was significantly reduced because the rental of animal power increased significantly despite the fact that farmers used the minimum-tillage method of transplanting rice to save time and water between two consecutive seasons.

Yield levels did not differ significantly before and during the financial crisis, but a big gap was observed between the wet and dry season yields. This gap was probably due to differences in weather and water supply.

Results of Costs and Returns Analysis

Table 3 shows the per hectare net cash farm income analysis of lowland rainfed rice farming before and during the financial crisis in the wet and the dry season. The total cost of production per hectare was the sum of expenditures paid on seeds, fertilizer, herbicide, insecticide, animal rental, labor, and other expenses incurred. Gross returns per hectare were the product of yield and prices of rough rice in fresh weight form plus the value of rice straw sold as feeds. The difference between per hectare gross returns and total production cost gave the net cash farm income. All the input and output prices before the financial crisis (in 1997/98) were converted to real value using the 1999/00 farm price index as base year.

Table 3. Costs and Returns Analysis (in real terms) of Rainfed Lowland Rice Production Before and During the Financial Crisis, Central Java, Indonesia, 1997/98 and 1999/00

Item	Before the crisis		During the crisis real	Difference real
	Nominal	Real		
			-thousand Rp/ha-	
Wet Season:				
Gross Returns	1524.8	2576.9	4234.3	1657.4***
Material Costs:	209.1	353.3	475.1	121.8***
Seed	36.1	61.0	94.5	33.5***
Fertilizer	153.4	259.2	304.5	45.3***
Herbicide	13.8	23.3	60.4	37.1***
Insecticide	5.8	9.8	15.6	5.8*
Pre-harvest Labor	309.9	523.7	741.4	217.7***
Total Cash Cost	519.0	877.1	1216.5	339.4***
Net Cash Farm Income	1005.8	1699.8	3017.8	1318.0***
R/C Ratio	2.9	2.9	3.4	-
Dry Season:				
Gross Returns	1449.7	2450.0	3746.0	1296.0***
Material Costs:	222.9	376.7	487.4	110.7***
Seed	31.9	54.0	76.2	22.2***
Fertilizer	174.9	295.6	328.6	33.0**
Herbicide	4.6	7.7	52.4	44.7***
Insecticide	11.5	19.4	25.4	6.0*
Pre-harvest Labor	297.5	502.8	796.4	293.6***
Total Cash Cost	520.4	879.5	1283.8	404.3***
Net Cash Farm Income	929.3	1570.4	2462.2	891.8***
R/C Ratio	2.8	2.8	2.9	-

Figures in parentheses represent standard deviations

*** statistically significant at α=0.01; ** statistically significant at α=0.05

* statistically significant at α=0.10

Wet Season

Although there was no significant difference between the average yields before and after the financial crisis, the farmers had a higher net cash farm income per hectare during the financial crisis owing to better output prices. Farmers had a mean net cash farm income of 3,017.8 thousand rupiah during the financial crisis compared to 1,699.8 thousand rupiah before the financial crisis. The difference of 1,318 thousand rupiah between the two periods was statistically significant.

On the average, total cash cost per hectare was higher during the financial crisis, amounting to 1,216.5 thousand rupiah compared to that before the financial crisis in the amount of 877.1 thousand rupiah. The difference in total cash cost of 339.4 thousand rupiah was highly significant at one percent level. The difference in total cash cost was due to the increasing cost of all material inputs and labor in real terms during the financial crisis.

Dry Season

As in the wet season, there was no significant difference between the average yields before and during the financial crisis, but the farmers had a higher net cash farm income per hectare during the financial crisis due to higher output prices. Farmers had a net cash farm income of 2,462.2 thousand rupiah during the financial crisis compared to 1,570.4 thousand rupiah before the financial crisis. The difference of 891.8 thousand rupiah was statistically significant (Table 3).

Total cash cost per hectare was higher during the financial crisis, amounting to 1,283.8 thousand rupiah compared to that before the financial crisis in the amount of 879.5 thousand rupiah. The difference in total cash cost of 404.3 thousand rupiah was highly significant at one percent level. The difference in total cash cost between the two periods was due to the increasing cost of all material inputs. Compared to the wet season, the yield in the dry season was slightly lower, averaging to one ton per hectare. Since the prices of inputs and output were similar and the mean yield during the dry season was lower, the net cash farm income in the dry season was also slightly lower than that in the wet season.

Labor had the greatest share in total cash cost, contributing 57-59 percent before the financial crisis and 61-62 percent during the financial crisis. Fertilizer was the second major cost item ranging from 30 to 34 percent before the financial crisis and 25 to 26 percent during the financial crisis. Seed cost share ranged from 6 to 8 percent and was likely the same before and during financial the crisis. Seed cost in the wet season had a higher share than in the dry season because of different methods of crop establishment.

Results of the Profit Function Analysis

OLS Estimation of the Unit Profit Model

A Unit Profit Model was fitted to the data using the OLS method to determine the functional form of the profit function and the parameter estimates. The variables included in the best functional form of the unit profit model were the prices of rough rice, seeds, fertilizer, labor, the dummy variable for herbicide, insecticide, and farm size.

Table 4 presents the regression results of the unit profit model. In the model, the prices of rough rice, fertilizer and labor were statistically significant for both the wet season and the dry season. As expected, the price of fertilizer had a negative effect on unit profit while the price of rough rice had a positive effect. The farm size dummy was statistically significant only during the wet season. On the other hand, the price of seed had an insignificant effect on unit profit in both seasons. This can be explained by the fact that farmers commonly used the seeds produced during the previous season. As in the case of seeds, the dummy for the price of insecticide and herbicide were not significant in both seasons.

The regression models for wet season and dry season rice have high R^2 value of 0.76 and 0.45, respectively. This indicates that 76 percent of the variations in the profit levels for the wet season rice are explained by the eight independent variables included in the model. On the other hand, only 45 percent of the variations in the profit levels for the dry season rice are accounted for by the eight independent variables included in the model.

Profit Function Elasticities

From the stochastic profit function, which was in natural log form, profit function elasticities were derived. The profit function elasticities of the prices of rough rice, seeds, fertilizer, and labor were the estimated regression coefficients of these variables in the unit profit function (Table 4).

As shown in Table 4, output price had the highest profit elasticity. The profit elasticity of rice in the wet season was 1.00, which implies that a one percent increase in price of rough rice would result in a one percent increase in the farmer's unit profit, other factors held constant. For the dry season, the profit elasticity of rice was 1.18, which implies that a one-percent increase in price of rough rice would result in a 1.18 percent increase in farmer's unit profit holding other factors constant. This shows the importance of keeping a relatively higher price to increase farm profits.

With respect to the prices of fertilizer, the profit elasticity for both seasons was -0.04. This means that increasing the price of fertilizer by one percent would trigger a reduction of 0.04 percent in the net income per kilogram of rice produced, other factors held constant.

Table 4. OLS Estimates of The Unit Profit Cobb-Douglas Model for Rainfed Lowland Rice, Central Java, 199798 and 1999/00

Variable	Wet Season	Dry Season
Intercept	-2.4074***	-1.2868***
	(0.5678)	(0.9504)
Explanatory Variables:		
Price of Rice	1.0037***	1.1796***
	(0.0786)	(0.1918)
Price of Seed	0.0399^{ns}	0.0604^{ns}
	(0.0609)	(0.1009)
Price of Fertilizer	-0.0367**	-0.0448^{ns}
	(0.0188)	(0.0326)
Price of Labor	0.2065***	0.0288*
	(0.0878)	(0.0093)
Insecticide Dummy	-0.0231^{ns}	-0.0033^{ns}
	(0.0309)	(0.0497)
Herbicide Dummy	0.0282^{ns}	0.0741^{ns}
	(0.0323)	(0.0563)
Farm Size Dummy	0.0918***	-0.0123^{ns}
	(0.0280)	(0.0477)
R^2	0.76	0.45
F-value	76.74***	19.95***

Figures in parentheses represent standard errors. *** statistically significant at α=0.01; ** statistically significant at α=0.05; * statistically significant at α=0.10; ^{ns} not significant at α=0.10

On the other hand, with respect to the price of labor, the profit elasticities both for the wet and the dry season were 0.21 and 0.03, respectively. Increasing the price of labor by one percent would increase farm profit by 0.21 and 0.03 percent for the wet and the dry season, respectively, other factors held constant. This indicates that an increase in wages would increase farm profit because a higher wage for laborers would serve as an incentive for them to work more effectively or efficiently and thereby increase yield.

Herbicide prices had no significant effect on the unit profit in both seasons at 10 percent probability level. As in herbicides, the increase in insecticide prices did not affect the unit profit, as indicated by the non-significant coefficient for both seasons. Farm size had a positive and significant effect on unit profit only in the wet season. It is because there were larger variations in area planted during the wet season and more or less the same area planted by farmers during the dry season.

The financial crisis had also a significant effect on the unit profit in both seasons. Table 6 showed that profit per kilogram of rice produced was higher during the financial crisis. In the wet season, the average unit profit significantly differed at 1 percent probability level between before and during the financial crisis. The difference in unit profit reached Rp 250 per kg. Before the financial crisis, the mean unit profit amounted to Rp 346 per kg, while during the financial crisis, it amounted to Rp 596 per kg. As in the wet season, the average unit profit in the dry season was also significantly different at 1 percent probability level between before and during the financial crisis. The difference in unit profit reached Rp 190 per kg. Before the financial crisis, the mean unit profit amounted to Rp 417 per kg, while during the financial crisis, it amounted to Rp 607 per kg.

The unit profit in the wet season was considerably lower than that in the dry season. Before the financial crisis, the difference amounted to Rp 71 per kg, which was significantly different between the wet season and the dry season. On the other hand, during the financial crisis, the difference was not significantly different between the wet and the dry season. This indicates that farmers' efforts to optimize their use of input due to the significant increase in the price of inputs during the financial crisis.

Table 5. Average Unit Profit of Rainfed Lowland Rice Farmers in Rp/kg by Season, Before and During the Financial Crisis, Central Java, Indonesia, 1997/98 and 1999/00

item	Wet Season	Dry Season	Difference
Before the financial crisis	346	417	71***
	(76)	(123)	
During the financial crisis	596	607	11^{ns}
	(92)	(166)	
Difference	250***	190***	-

Figures in parentheses represent standard errors.

*** statistically significant at α=0.01; ** statistically significant at α=0.05

^{ns} not significant at α=0.10.

Factors Affecting Economic Efficiency of Rice Farmers

To determine and assess the impact of selected factors on the economic efficiency of rainfed lowland rice farmers, farm-specific economic efficiency indices were regressed against some variables for both internal and external characteristics of farmers. OLS estimates of the relationship between economic efficiency and selected factors are presented in Table 6.

Of the seven factors considered to influence economic efficiency, only three explanatory variables were significant. As shown in Table 6, economic efficiency was significantly affected by level of education, financial crisis and cropping season. Education was the most important factor in explaining economic efficiency having the highest positive contribution to the economic efficiency level of the farmers.

Other factors that significantly affected the economic efficiency of farmers were financial crisis and cropping season. Economic efficiency increased during the financial crisis since the increase in the price of rough rice was relatively higher compared to the before the financial crisis situation despite the increase in the input prices, especially fertilizer, herbicide, insecticide and labor during the financial crisis period. During the wet season, farmers were found to be more economically efficient than in the dry season because of higher rice yields. Farmers obtained higher yields in the wet season because of abundant water supply, low weed competition, and low pest infestation. Farming experience, household size, and tenure status did not significantly affect farmers' economic efficiency.

Table 6. Results of the OLS Estimation Showing the Factors Affecting Economic Efficiency of Rainfed Lowland Rice Farmers, Central Java, Indonesia, 1997/98 and 1999/00

Item	Coefficient	Standard error
Intercept	0.7321***	(0.0498)
Regression Coefficients:		
Education	0.0135***	(0.0038)
Farming Experience	0.0019ns	(0.0068)
Household Size	0.0019ns	(0.0068)
Dummy Variables:		
Tenure Status	-0.0233ns	(0.0269)
Financial Crisis	0.0411***	(0.0155)
Cropping Season	-0.0475***	(0.0155)
R^2	0.08	
Adjusted R^2	0.06	
F-value	4.85***	

Figures in parentheses represent standard errors.
*** statistically significant at α=0.01
ns not significant at α=0.10

The estimated mean economic efficiency levels of farmers before and during the crisis, for both the wet and the dry season are presented in Table 7.

Table 7. Average Economic Efficiency Rating (%) of Rainfed Lowland Rice Farmers by Season, Before and During the Financial Crisis, Central Java, Indonesia, 1997/98 and 1999/00

item	Wet Season	Dry Season	Difference
Before the financial crisis	83	78	5**
	(14)	(19)	
During the financial crisis	87	83	4**
	(9)	(16)	
Difference	4**	5**	-

Figures in parentheses represent standard errors.
** statistically significant at α=0.05

Regardless of cropping season, the farmers were more economically efficient in producing rice during the financial crisis period than before the financial crisis. The efficiency ratings before and during the financial crisis for both seasons were significantly different at 5 percent probability level. This could be due to the significant increase in the price of rough rice despite the increase in the prices of inputs during the financial crisis. In general, economic efficiency in the wet season was higher than in the dry season owing to low pest infestation, low weed competition, and abundant water supply.

Table 8 shows the average profit loss per hectare of rainfed lowland rice. Across seasons, the rainfed lowland rice farmers consistently incurred larger profit loss before than during the financial crisis. Profit loss was converted into per hectare basis using the farmers' maximum possible profit and their inefficiency.

Table 8. Profit loss of rainfed lowland rice farmers in thousand Rp/ha before and during the financial crisis, Central Java, Indonesia, 1997/98 and 1999/00

Financial Crisis	Wet Season	Dry Season	Difference
Before the financial crisis	499.8	780.4	280.6***
	(402.6)	(670.2)	
During the financial crisis	784.3	823.5	39.2^{ns}
	(555.2)	(757.6)	
Difference	284.5***	43.1^{ns}	-

Figures in parentheses represent standard deviations
*** statistically significant at α=0.01
^{ns} not significant α=0.10

In the wet season, the average profit loss significantly differed at 1 percent probability level between losses before and during the financial crisis. The difference in profit loss reached Rp284.5 thousand per hectare. Before the financial crisis, the mean profit loss amounted to Rp499.8 thousand per hectare, while during the financial crisis, it amounted to Rp784.3 thousand per hectare.

On the other hand, the average profit loss was not significantly different at 10 percent probability level in the dry season. Before the financial crisis, the mean profit loss amounted to 780.4 thousand rupiah per hectare, while during the financial crisis, it was 823.5 thousand rupiah per hectare. The profit loss in the wet season was considerably lower than that in the dry season. Before the financial crisis, the difference amounted to 280.6 thousand rupiah per hectare, which was significantly different between the wet season and the dry season. On the other hand, during the financial crisis, the difference was not significantly different between the wet and the dry season. This indicates that farmers' efforts to reduce the yield gap were promising as they also tried to optimize their use of input due to the change in prices.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The levels of all inputs used by the farmers increased during the financial crisis, except for herbicide and pre-harvest labor. Although there was no significant difference between average yields before and after the financial crisis, the farmers had a higher mean net cash farm income per hectare from wet season rice during the financial crisis owing to better output prices. Regression results of the unit profit model showed that the prices of rough rice, fertilizer and labor were statistically significant for both the wet season and the dry season. The farmers were more economically efficient in producing rice during the financial crisis period than before the financial crisis. Economic efficiency was significantly affected by level of education, financial crisis and cropping season.

Recommendations

Since output price elasticity exhibited the highest coefficient, this implies that strategies that will enable farmers to receive a higher price of rice would markedly increase their farm profit. Such strategies include: (1) strengthening the rice farmers' cooperative, and (2) provision of post-harvest facilities to dry and store their rice harvest during the peak rainy season.

Since economic efficiency is substantially affected by farmers' education, the government should give priority to farmers' education or upgrade farmers' technical knowledge through the conduct of more training programs on improved production technologies such as integrated pest management (IPM) and integrated crop management (ICM).

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