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COMPARATIVE ECONOMIC STUDY OF ORGANIC AND CONVENTIONAL RICE FARMING IN MAGSAYSAY, DAVAO DEL SUR

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ABSTRACT

This study compares the economics of production between organic and conventional lowland rice farming in Magsaysay, Davao del Sur. The two farming systems were compared in terms of production function and cost and return. An OLS translog production function was estimated for both production systems using SHAZAM Version 9.0.

The production functions suggest that organic rice farmers should increase their seeding rate to further increase their production while conventional rice farmers should increase their labor input and pesticide application to increase their output.

Yield of conventional rice farms is 23% higher than organic rice farms but its high input costs and lower farm gate price lower the net returns. Though the difference is not significant returns above total costs of organic farming is higher by than conventional rice farming.

I. INTRODUCTION

Agriculture is identified as a series of activities that necessitates the efficient mobilization of resources especially in most Asian countries like the Philippines where these resources are limited. The utilization of these resources primarily depends on the farming system that farmers adopt. There are farming systems that are labor intensive and there are those that are capital intensive. The choice of farming system used will ultimately determine the net revenue of farmers and sustainability of the production system. Oftentimes, a trade-off between sustainability and profitability exists. This is the issue that confronts our farmers when faced with the choice between organic and conventional rice farming.

Conventional method of growing rice requires chemical fertilizers, pesticides and herbicides. Though touted for its high yields, this production system is believed to enhanced soil degradation, pollution, chemical residues in food and loss in biodiversity (Mendoza, 2002). It also intensifies the farm household's actual and physiological burden on high-cash capital expenses (Mendoza 2003). This prompted farmers and researchers to look for alternatives and one of these is organic farming.

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Organic agriculture includes all agricultural system that promotes the environmentally, socially and economically sound production of food and fibers (International Federation of Organic Agriculture Movements, 2003). It is a key to a sustainable agriculture and this captured the attention of many countries worldwide. Currently, almost 23 million hectares are managed organically worldwide (International Federation of Organic Agriculture Movements, 2003) and the interest in organic agriculture is still growing.

The initial survey of Philippine Development Assistance Program (PDAP) showed that about 14, 419 hectares in fifteen provinces of the country were producing more than 82 thousand metric tons of organic rice per year. More than 36,592 farmers were practicing organic farming (Doyo, 2003). These figures represent only 0.53% of the total rice areas in the country (www.pdap.net/organic&natural.html). In Mindanao where a significant percentage of the country's rice production is accountable, conversion of inorganic rice farms to organic ones have been in constant deliberation. Given the benefits and advantages of organic rice farming, some farmers are still reluctant to convert their farming system.

The above scenario is true in Magsaysay, the rice granary of Davao del Sur, only 5% of its 3,000 hectares of rice fields is planted with organic rice (Davin, 2005). In spite of the benefits derived from the technology and promotion by some government and non-government organizations adoption is at slow pace. Reluctance to adopt is maybe of economic reasons and results of this study are very helpful as an input in policy making to promote organic farming.

1.1 Objectives of the Study

The general objective of this study is to compare the economics of organic and conventional lowland irrigated rice farming in Magsaysay, Davao del Sur.

Specifically, this study is aimed;

1. To profile of the conventional and organic rice farmers and their farms;
2. To compare the production function and other related information of the two rice production systems; and
3. To determine and compare the profitability of organic and conventional rice farming.

Scope and Limitations of the Study

The study was conducted in Magsaysay, Davo del Sur. Organic rice farmers in this study are those registered by the Organic Certification Center of the Philippines. Data used was based on the May to September cropping season of 2006.

II. DATA AND MODEL SPECIFICATION

Data and Data Collection

The study used a primary data. These data was gathered from organic and conventional rice farmers in Magsaysay, Davao del Sur. It was collected through interviews of the farmers by using a prepared and pre -tested questionnaire. The list of organic rice farmers was contrived from DTI Davao del Sur while the list of conventional rice growers was taken from Agricultural Technicians of the municipality.

This study was composed of 110 respondents. Fifty-five organic and another fifty-five conventional farmers interviewed. Only conventional rice farmers were sampled while complete enumeration was done to organic farmers.

Data Analysis and Statistical Procedure

The study is divided into three phases namely;

Phase I covers the profile of conventional and organic farmers and their farms where data was summarized and analyzed using descriptive statistics like frequency counts, percentage and mean.

Phase II compares the production function and other related information of the two rice production systems. The transcendental logarithmic (Translog) production function was estimated for each system. In general terms, this is expressed as;

$$\ln Q = \beta_0 + \sum_{i}^{n} \beta_i \ln X_i + \frac{1}{2} \sum_{i}^{n} \sum_{k}^{n} \beta_{i,k} \ln X_i \ln X_k \qquad (1)$$

where Q is the output of the farm and X_i and X_k are farm inputs (i,k) to the production process and $ß_0$, $ß_i$ and $ß_k$ are unknown parameters.

The five input Translog production function in this study is:

$$\ln Y = \ln ßo + ß_1 \ln X_1 + ß_2 \ln X_2 + ß_3 \ln X_3 + ß_4 \ln X_4 + ß_5 \ln X_5 + ½ (ß_{11} \ln X_1^2 + ß_{22} \ln X_2^2 + ß_{33} \ln X^2_3 + ß_{44} \ln X^2_4 + ß_{55} \ln X^2_5) + ß_{12} \ln X_1 \ln X_2 + ß_{13} \ln X_1 \ln X_3 + ß_{14} \ln X_1 \ln X_4 + ß_{15} \ln X_1 \ln X_5 + ß_{16} \ln X_2 \ln X_3 + ß_{17} \ln X_2 \ln X_4 + ß_{18} \ln X_2 \ln X_5 + ß_{19} \ln X_3 \ln X_4 + ß_{20} \ln X_3 \ln X_5 + ß_{21} \ln X_4 \ln X_5 \quad (2)$$

where: Y = yield per hectare

X_1 = total labo r (mandays, man-machine and man-animal days)

X_2 = Organic (solid, kg/Ha) /Inorganic Fertilizer (Nitrogen, kg/Ha)

X_3 = Organic (liquid, lit/Ha)/Inorganic Fertilizer (Phosphorous, kg/Ha)

X_4 = Organic (lit/Ha) /Inorganic Pesticides (kg/Ha)

X_5 = Seeds (kg/Ha)

The traditional ordinary least squares method was used to estimate the production functions. From the generated production function, the different production elasticities at means of significant inputs were computed. This measures the responsivene ss of output to changes in the quantity of inputs. In general, this is written as:

$$\text{Elastiticity} = \frac{\text{\% change in output}}{\text{\% change in input}} \quad (3)$$

Phase III deals with the comparative cost and return analysis of organic and conventional farming system. The cost items were delineated into cash and non-cash costs. Cash costs are costs that require cash outlays while non-cash costs are costs of inputs owned by the farmer.

The different financial analyses conducted were as follows: Returns above Cash Costs, Returns above all Costs and the Cost of Producing a kilo of palay or break-even price. The formulae used in computing the above financial analysis on a per hectare basis are as follows:

Gross Returns = output/Ha (kg) x farm gate price (4)

Returns above Cash Cost = Gross Returns – Cash Cost (5)

Returns above Total Cost (Profit) = Gross Returns – Total Cost (6)

Total Cost = Non-cash Cost + Cash Costs (7)

Cost / kg (break-even price) = Total Cost per Ha/ Yield per Ha (8)

A t-test was used to determine whether there is a significant difference between the means of the above analyses between the organic and conventional rice production systems.

III. RESULTS AND DISCUSSION

Phase I. The Farm and Farmers' Profile

Table1. shows the profile of rice farmers and their farms. On the average, the organic and conventional rice farmers in Magsaysay are with similar profile except on some aspects. They are male, married, with household size of 5, 47-48 years old, 21-22 years in rice farming and 8-10 years of formal schooling. Apparently the conventional rice farmers have higher monthly income (Php 15,070.00) than organic rice farmers (Php 13, 198.00) but a greater percentage of them (66%) availed loans. It is also apparent that a higher percentage of organic farmers (76.4%) are landowners and owned hand tractors/turtles (13%) and a "saphig" (14.55%). Owing to the fact that they have tractors, only few of them (29%) owned a plow. On the average, they owned a larger land area (1.9 Ha) but with smaller utilization of these for rice (0.87Ha).

Table 1. Profile of organic and inorganic rice farmers and their farms, Magsaysay, Davao del Sur, May- Sept. 2006

Attribute	Organic Farmer n=55	Inorganic Farmer n=55
A. Farmers Profile		
Sex		
Male	69.1%	70.9%
Female	30.9%	29.1%
Credit		
Avail	52.7%	66%
Do not Avail	47.3%	34%
Civil Status		
Married	92.70%	92.70%
Single/Widow/Widower	7.30%	7.30%
Average age (yrs)	48.4	47.4
Ave. years in rice farming (yrs)	21.0	22.5
Ave. household size	5	5
Ave. years in formal educ. (yrs)	10	8
Ave. monthly income (PHp)	13, 198.00	15,070.00
B. Farm Profile		
Tenure		
Owned	76.4%	56.5%
Tenant/Lease/Rent	23.6%	34.5%
Ave. land ownership (Ha.)	1.9	1.4
Ave. area Devoted to Rice (Ha.)	0.87	1.24
Farm Implements owned		
Tractor/Turtle	12.73%	9.09%
Plow	29.09%	41.82%
"Sudlay"	27.27%	27.27%
"Saphig"	14.55%	12.73%

Phase II. Production Functions of Organic and Conventional Farming Systems

The ordinary least squares estimates of the parameters and R^2 of the Translog production function given by equation 2 are presented in Table 2. The R^2 value indicates that the variables included in the model explain 57.36% and 67.58% of the variations in the yield of organic and conventional rice farming respectively. Estimate of organic rice production function showed that there are eight variables that significantly explain the variation of yield. Labor is significant in linear and squared terms but its squared term is negative making it confusing whether increasing labor will result to higher output, ceteris paribus. In this case, the production elasticities in Table 3 will clear the issue. The negative elasticity of 0.81 will clearly indicate that a 1% increase in labor will reduce output by 0.81% which implies that the level of labor application among organic rice farms in Magsaysay is beyond its optimum level. Another significant input is organic pesticides. It is significant in its linear term which is positive and interaction term with labor which is negative. The production elasticity of this factor suggests that increasing the application of organic pesticides by 1% will increase output by 0.015%. The negative sign of the interaction between organic pesticide and labor will imply that increasing one requires the reduction of the other to increase output, ceteris paribus. This could be explained by the fact that if we increase the application of organic pesticide, it will reduce the labor required in snail-picking, hanging of dead frogs and urine-submerged cloth. Similarly, the negative sign of the interaction term between labor and seed also implies increasing the seed input will reduce labor. This is so because increasing the seeding rate will to lead closer planting distance providing lesser space for weeds to grow thus minimizing the labor for eradicating weeds. According to Guyer and Quadranti (1985) as iterated by de Dios et.al (2000), higher seeding rates would be beneficial if no weed control is planned. The negative interaction term of solid and liquid fertilizer also suggests that the two types of fertilizers are substitutes.

Table 2. OLS estimates of the translog production functions of organic and inorganic rice in Magsaysay, Davao del Sur, 2006

Parameter	Organic Farming			Inorganic Farming		
	Variable	Coefficient	Standard Error	Variable	Coefficient	Standard Error
$ß_0$	Constant	-0.25246^{ns}	6.2155	Constant	8.02780**	3.4685
$ß_1$	Total labor	3.6989***	1.2899	Total labor	-0.62064^{ns}	0.9255
$ß_2$	Organic Fertilizer Solid	-0.30596^{ns}	0.5998	Nitrogen	0.24380^{ns}	0.5072
$ß_3$	Organic Fertilizer Liquid	-0.35242^{ns}	0.6182	Phosphorous	-0.90194**	0.4750
$ß_4$	Organic Pesticides	1.6026***	0.5320	Pesticides	1.06180^{ns}	0.9160
$ß_5$	Seeds	0.70919^{ns}	1.1523	Seeds	0.43905^{ns}	1.6995
$ß_6$	(Total labor)^2	-0.36243*	0.2270	(Total labor)^2	0.38196**	0.2247
$ß_7$	(Organic Fertilizer Solid)^2	0.00930^{ns}	0.0727	(Nitrogen)^2	0.16378**	0.0813
$ß_8$	(Organic Fertilizer Liquid)^2	0.03352^{ns}	0.0400	(Phosphorous)^2	0.10243*	0.0629
$ß_9$	(Organic Pesticides)^2	-0.03387^{ns}	0.0619	(Pesticides)^2	-0.083634^{ns}	0.4877
$ß_{10}$	(Seeds)^2	0.04387^{ns}	0.2409	(Seeds)^2	0.42523^{ns}	0.5812
$ß_{11}$	(Total labor)(OF Solid)	0.00339^{ns}	0.0612	(Total labor)(Nitrogen)	0.09851^{ns}	0.0815
$ß_{12}$	(Total labor)(OF Liquid)	-0.01209^{ns}	0.0646	(Total labor)(Phosphorous)	0.25038**	0.1202
$ß_{13}$	(Total labor)(Org Pesticides)	-0.20998***	0.6484	(Total labor)(Inorg Pesticides)	0.40430**	0.2261
$ß_{14}$	(Total labor)(Seed)	-0.47663***	0.1834	(Total labor)(Seed)	-0.35213*	0.2379
$ß_{15}$	(OF Solid)(OF Liquid)	-0.03669**	0.0179	(Nitrogen)(Phosphorous)	-0.10637**	0.0616
$ß_{16}$	(OF Solid)(Org Pesticides)	-0.00614^{ns}	0.0213	(Nitrogen)(Inorg Pesticides)	-0.15903^{ns}	0.1850
$ß_{17}$	(OF Solid)(Seeds)	0.11076**	0.0645	(Nitrogen)(Seeds)	-0.23178*	0.1518
$ß_{18}$	(OF Liquid)(Org Pesticides)	0.02171^{ns}	0.0229	(Phosphorous)(Inorg Pesticides)	-0.04537^{ns}	0.1016

Table 2 continuation…

Para-meter	Organic Farming			Inorganic Farming		
	Variable	Coefficient	Standard Error	Variable	Coefficient	Standard Error
ß$_{19}$	(OF Liquid)(Seeds)	0.13430 ^{ns}	0.1061	(Phosphorous)(Seeds)	0.04689 ^{ns}	0.16831
ß$_{20}$	(Org Pesticides)(Seeds)	-0.19834**	0.0871	(Inorg Pesticides)(Seeds)	0.33780*	0.25007
R-Square		0.5736			0.6758	
Log of the Likelihood Function		-22.8949			-5.8478	

*Significant at 10%level **Significant at 5% level ***Significant at 1% level

The production function for organic rice farming is:

Y = -0.25246 + 3.6989Total labor – 0.30596OF Solid – 0.35242OF Liquid + 1.6026Pesticides + 0.70919Seeds – 0.36243(Total labor)^2 + 0.00930(OF Solid)^2 + 0.033524(OF Liquid)^2 – 0.033871(Pesticides)^2 + 0.043872(Seeds)^2 + 0.00339(Total labor)(OF Solid) – 0.012099(Total labor)(OF Liquid) – 0.20998(Total labor)(Pest) – 0.47663(Total labor)(Seeds) – 0.036690(OF Solid)(OF Liquid) – 0.0061487(OF Solid)(Pesticides) + 0.11076(OF Solid)(Seeds) + 0.021717(OF Liquid)(Pesticides) + 0.13430(OF Liquid)(Seeds) – 0.19834(Pesticides)(Seeds)

The production function for inorganic rice farming is:

Y = 8.0278 – 0.62064Total labor + 0.24380Nitrogen – 0.90194Phosphorous + 1.0618Pesticides + 0.43905Seeds + 0.38196(Total labor)^2 + 0.16378(Nitrogen)^2 + 0.10243(Phosphorous)^2 – 0.083636(Pesticides)^2 + 0.42523(Seeds)^2 + 0.098511(Total labor)(Nitrogen) + 0.25038(Total labor)(Phosphorous) + 0.40430(Total labor)(Pest) – 0.35213(Total labor)(Seeds) – 0.10637(Nitrogen)(Phosphorous) – 0.15903(Nitrogen)(Pesticides) – 0.23178(Nitrogen)(Seeds) – 0.045368(Phosphorous)(Pesticides) + 0.046890(Phosphorous)(Seeds) + 0.33780(Pesticides)(Seeds)

The positive interaction term of seeds and solid fertilizer obviously implies that more seeds require more fertilizer. Meanwhile, the negative interaction of organic pesticide and seeds is somehow vague and remains to be resolved. However, according to Dalvi and Salunkhe (1975), repeated and indiscriminate use of pesticides has the tendency to inhibit or impair seed germination, thus requiring more seeds. Table 3 also shows that yields in organic farms are responsive to amount of seeds. A 1% increase in seeds will increase yield by 1.71%. According to www.fao.org, the recommended seedling rate for organic rice is 60-80 kg/ha while organic farmers of Magsaysay utilized only 53.15kg/Ha.

Table 3. Production elasticities of organic and inorganic rice farming, Magsaysay, Davao del Sur, 2006

Input Variables	Elasticity Estimate	
	Organic Farming	Inorganic Farming
Total labor	-0.801	1.493
OF Solid/Nitrogen	0.258	-0.639
OF Liquid/Phosphorous	-0.230	0.037
Organic/Inorganic Pesticides	0.015	3.145
Seeds	1.709	-1.965

Estimation of the production function of conventional rice shows that nitrogen indicates a positive relationship to yield in its squared form but with confusing signs in its interaction terms. To determine the net effect to yield, the elasticity of nitrogen in Table 3 shows that increasing utilization of nitrogen by 1% will decrease yield by 0.639% implying that there is an over application of Nitrogen among the conventional rice farms in Magsaysay. Another significant variable that explain variation in conventional rice yield is Phosphorous. Its linear term is negative while the squared term is positive sign while the interaction terms exhibit both positive and negative signs. However the elasticity estimate of 0.037 will indicate that holding other factors constant, a 1% increase in phosphorous will increase yield by 0.037%. Interaction of Phosphorous and Nitrogen indicates a negative sign. It is consistent to the observation above that in order to increase rice yield, a decrease in the utilization of Nitrogen should be accompanied with an increase in the usage of Phosphorous. Moreover, Phosphorous combined with labor exhibit a positive sign since additional application of Phosphorous necessitates labor. Interaction of labor and seeds exhibits a negative sign similar to organic rice and the reason could be probably the same. Lowering seeding rate makes population thinner providing more space for weeds that requires more labor for weeding. Meanwhile, the over-all effect of labor shows that increasing labor by 1% will increase yield by 1.5%. The positive interaction of labor with Phosphorous and Pesticides indicate that increasing the said inputs will require an increase in labor.

Seed input does not show significant coefficients in its linear and squared terms but significant and negative in its interaction with labor and nitrogen. The net effect of this input to output is negative as evidenced by its negative elasticity. Reducing the seeding rate by 1% will lead to an increase in output by 1.96% implying that conventional rice farmers are planting beyond the optimum seeding rate. The positive interaction of seeds and pesticides indicates that more seeds require more pesticides. According to Witt et.al (undated) a crowded the plant density will result to unhealthy seedlings and increase susceptibility to pest and diseases thus, requiring more pesticides. In this case production is very responsive to inorganic pesticide with an elasticity of 3.145 implying that a 1% increase in pesticide will entail a 3.145% increase in output.

Phase III. Cost and Return Analysis

Table 4 below shows that yield and gross revenue of conventional farming is significantly higher than organic farming. But cash cost in organic farming is lower so that its return above cash cost is significantly higher. Considering both cash and non-cash costs the net returns from the two farming types are not significantly different. The cost of producing one kilo of palay which is also the break-even price showed that a kilo of unmilled organic rice cost P9.09 while conventional rice cost P8.00.

Table 4. Comparative cost and return analysis of organic and inorganic farming per hectare, Magsaysay, Davao del Sur, 2006

Financial Indicator	Organic Farming	Inorganic Farming	t-value
Yield	3906.67	5073.48	-2.91***
Gross Revenue	48570.53	49175.09	7.30***

Total Cost	38097.13	48072.84	-3.36***
Cash Cost	14789.45	19154.52	
Capital Cost	2838.45	7846.72	
Labor Cost	9539.76	8281.81	
Other Costs	2411.24	3025.99	
Non-Cash Cost	23307.68	21419.28	
Family/Exchange Labor	2522.85	1137.59	
Harvester-Thresher Share	5823.27	5690.97	
Land Share	13718.89	13806.93	
Seeds (Exchange)	1212.68	783.79	
3. Return Above Cash Cost	36244.73	30020.57	-1.84*
4. Return Above Total Cost	12937.06	8601.29	0.72^{ns}
5. Break-Even Price	9.09	7.997	-9.09***

***Significant at 1% level *Significant at 5% level ^{ns}not significant

IV. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

Based from the results of the study, the following conclusions are drawn:

1. Most organic farmers are landowners with larger land ownership but with lesser monthly income compared to conventional rice farmers.
2. In order to increase output, organic farmers have to increase their seeding rate and reduce labor while conventional farmers should increase their application of pesticides and labor and reduce nitrogen application and seeding rate to increase their output.
3. Organic rice farming is as profitable as conventional rice farming. It has a lower yield and gross returns but lower in total cost. Breaf-even price for organic rice is higher than conventionally grown ric

4.2 Recommendation

With the above conclusion the following are recommended:

1. The local government of Magsaysay should widely promote and disseminate information on the profitability of organic farming. Organic rice is as profitable as the inorganic but with lower cash cost which is

favorable to farmers who are in shortage of cash to finance their farms. Given the same profitability organic farming is more advantageous considering its contribution to health, environment, and sustainability.

3. Soil test should be done especially among conventional rice farmers to determine the optimal rate of fertilizer application.
4. Seeding rate among organic rice farmers should be improve to increase their output.
5. A higher price should be offered for organic rice considering that this is health and environment friendly and higher break-even price.

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