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FACTORS AFFECTING PRODUCTIVITY OF UPLAND AND LOWLAND RICE FARMS IN MATALOM, LEYTE: A QUANTILE REGRESSION APPROACH

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This study investigates the determinants of productivity in selected upland and lowland rice farms in Matalom, Leyte using quantile regression approach. Data on rice production are obtained from 40 upland and 40 lowland rice farming households which are randomly selected across all 30 barangays in Matalom, Leyte. Quantile regression analysis is used to provide complete characterization of the determinants of productivity at the higher and lower tails of the distribution. Results show that the factors affecting rice production differ across distribution. In the lower quantile, labor cost and fertilizer cost are the main determinants of rice production while in the median quantile, labor cost, fertilizer cost and farm area positively affect rice production. Moreover, in the upper quantile there are more determinants positively affecting rice production. These include labor cost, fertilizer cost, farm area, household size, male household head, and technical assistance provided to farmers. In addition, results of quantile regression are compared with ordinary least squares (OLS) estimation. The comparative analysis shows that there are some factors which do not have significant coefficient in the OLS estimation but are found to have significant effects with quantile regression. This shows that the coefficients estimated through OLS only provide a partial view of the determinants of rice productivity. By performing quantile regression, we are able to identify significant determinants of productivity which cannot be detected using the mean based regression approach.

Keywords: rice production, farm practices, socio-economics, median regression, Cobb-Douglas

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1. INTRODUCTION

Rice is a major food crop and is the staple food of more than half of the world's population. It grows in a wide range of environments and is productive in many situations where other crops would fail. Most classifications of rice environments are based on altitude (upland or lowland) and water source (irrigated or rainfed). Although upland rice is characterized typically by low yields compared to lowland rice production, farmers still continue to engage in upland rice farming because of farmers' limited access to lowland rice farms.

In the Philippines, rice is the most important agricultural commodity. In 2014, it accounted for 41% of the total value of crop production and about 35% of the total agricultural crop area in the country was devoted to rice farming (Philippine Statistics Authority [PSA], 2015). Although a remarkable improvement in rice production in the country had been shown by a steady rise from 15.77 million metric tons in 2010 to 18.96 million metric tons in 2014, the country's production is far below the national requirement. Through the years, rice has remained the main source of livelihood and staple food of many Filipinos. In 2014, about 11.21 million persons were employed in the agriculture sector, and this comprised 30% of the national employment (PSA, 2015). Thus, an increase in agricultural productivity has the potential to increase farm income and alleviate poverty in this sector.

Productivity in general relates the level of output to the levels of resources employed in a given period of time. Several studies have been conducted to investigate the factors affecting productivity of rice farms. For example, Sarfaraz et al., (2016) found that capital, labor, education of the farmers, availability of credit and farm size have a positive effect on rice output among rice farms in Pakistan. Battese and Coelli (1992) found that among paddy farmers in India, land and labor cost, and ratio of irrigated land to total land has significant and positive relationship with the production of rice. Among small-holder rice farmers in Nigeria, the determinants of farm productivity are years of education, fertilizer and use of improved variety (Mbam & Edeh, 2011). In the Philippines, land area, planting season, fuel cost, fertilizer cost, and land rent are found to have significant positive relationship with the value of rice production (Koirala, Mishra & Mohanty, 2014).

Previous studies on productivity used the traditional regression approach, particularly the ordinary least squares (OLS), to investigate the influence of relevant farm characteristics and socio-economic factors across the mean of the conditional distribution of rice production. The estimated coefficients in the regression mean approach represent the average change in rice production associated with a change in the related explanatory variable. However, this approach may miss how the explanatory variables affect rice production at the upper and lower tails of the distribution. Thus, this study uses the quantile regression approach to estimate the effect of explanatory variables on the rice productivity at different points of the distribution. Limited studies have employed the use of quantile regression in rice production, hence this study adds to the literature on rice productivity by evaluating the determinants at different points of the distribution. This approach allows parameter variation across rice production quantiles and also enables the analysis of factors affecting productivity for extreme categories such as the top or bottom quantile of the distribution.

2. METHODOLOGY

Production function analysis was used to analyze the factors affecting productivity of rice farms in Matalom, Leyte. The relationship between factors of production and the output that is created is referred to as the production function. This describes the maximum quantity of output that can be produced with each combination of factors of production and given the state of technology. In the long run, the firm can change its scale of operation by adjusting the level of inputs that are fixed in the short run, thereby shifting the production function upward. The production function is expressed as follows:

$$Q=f(X_{1,2},X_3,\ldots,X_n) \qquad (1)$$

where:

Q = is the quantity of output

X_1, X_2, $X_3,\ldots,X_n$ = are the factor inputs such as capital, labor, land and raw materials

Rice production is a major activity among farmers but its production is mainly in the hands of small-scale farmers who depend on the use of traditional technologies resulting to low productivity (Adebayo & Onu, 1999). Bamidele et al., (2008) noted that low productivity is the characteristic of small-scale crop farms and Hussain and Perera (2004) observed that agricultural productivity changes with such factors as land and water related factors, climatic, agronomic, socio-economic, and farm management factors.

The factors which were hypothesized to affect the productivity of rice farms in Matalom Leyte were based on the existing literatures and were classified into social, biophysical, technical, environmental, and economic factors. Social factors included the age of farmers, educational attainment, household size, tenurial status, and farming experience. The biophysical factors included topography, water supply of farms, and farm size. The technical factors included the machinery used, variety of seed planted, farm to market road structure, and irrigation system. The environmental factors included soil quality, plant diseases, irrigation management, and water pollution and the economic factors included farmers' income, fertilizer applied, pesticide used, and labor used.

Empirical Model

The Cobb-Douglas production function was adopted in the data analysis since this functional form is preferable to other forms if there are three or more independent variables in the model (Khai & Yabe, 2011). The Cobb-Douglas production function with nine independent variables was adopted in this study. This was expressed in the following equation:

$$lnY = bo + b_1lnX_1 + b_2lnX_2 + b_3lnX_3 + b_4lnX_4 + b_5lnX_5 + b_6lnX_6 + b_7lnX_7 + b_8D_1 + b_9D_2 + u \quad (2)$$

where:

lnY = natural log of production of rice (kg/ha)
lnX_1 = natural log of age of the farmer in years
lnX_2 = natural log of household size
lnX_3 = natural log of educational attainment in years
lnX_4 = natural log of labor employed (man-day/ ha)
lnX_5 = natural log of number of years in rice farming
lnX_6 = natural log of fertilizer cost per hectare (kg/ha)
lnX_7 = natural log of pesticide cost per hectare (kg/ha)
D_1 = dummy variable for water supply in the farm taking the value of 1 rainfed 0, irrigated
D_2 = dummy variable for farm location taking the value of 1 upland 0, lowland
bo = intercept
b_i = output elasticity of the ith input
u = the residual term

Data and Sampling

Primary data were gathered from rice farmers in Matalom, Leyte. The rice farms were categorized into upland and lowland. All rice farmers in the 18 mountain barangays served as the upland farm group, while all rice farmers in the 12 other barangays of the municipality served as the lowland farm group.

Simple random sampling was done to draw four barangays each from the upland and lowland farm groups, then ten farmers were randomly chosen from each barangay. Forty (40) upland farmers and forty (40) lowland farmers were interviewed totaling eighty (80) sample farmers. The data covered one cropping season (September to December, 2014).

Data Analysis

Descriptive statistics was used to describe the socio-economic characteristics of the respondents. Quantile regression approach was used to analyze the factors affecting productivity in rice farming. This method yields an informative regression since it evaluates the factors of production across quantiles rather than focusing only on the mean. Results from this regression provide useful insights for identifying and evaluating the factors affecting productivity of rice farming.

The quantile regression model is postulated as follows:

$$Y_i = ln(Z_i)'ß\theta + U\theta_i \qquad \text{with } Quant\ \theta(Y_i \mid ln(Z_i) = ln(Z_i)'\ ß\theta \qquad (3)$$

where $Quant\ \theta(Y_i \mid ln(Z_i)$ denotes the θ'th conditional quantile of production (Y) given the set of independent variables (Z) expressed in logarithmic form and the subscript i=1,2,…,n indexes of the individual farmer, and $U\theta i$ represents the error term.

Four regression analyses were done to describe and compare the factors affecting productivity of rice farms. First, using the traditional linear regression approach, particularly the ordinary least squares (OLS), an analysis was done on the overall data structure in analyzing the influence of relevant farm characteristics and socio-economic factors across the mean of the distribution of rice production. Though this approach was widely used in the literature, this study explored other options in analyzing the effect of these factors on rice production. This study used quantile regression to compare the influence of farms' characteristics and farmers' socio-economic background by dividing the distribution into lower, median, and upper quantile distribution. In this set-up, this study investigated the determinants of rice production among those farmers whose output belong to the bottom 25% in terms of rice production, median or the middle 50% in rice production, and the upper production quantile or those farmers with bigger output belonging to the upper 25% in terms of rice yield.

3. RESULTS AND DISCUSSION

Socio-Economic Characteristics of Rice Farmers

Table 1a and 1b presents the socio-economic characteristics of the rice farmers. Results shows that majority of the farmers in both upland and lowland farms are males and married, with an average age of 53 years old. In terms of education, the upland and lowland farmers are very similar with majority having attended elementary school, and with an average education of a little over 6 years or elementary graduate. While upland farmers have a bigger household size than the lowland farmers, both farmer groups have only one household member involved in farming.

Table 1a. Socio-economic characteristics of upland and lowland rice farmers in 2014.

Characteristics	Upland (n=40)		Lowland (n=40)	
	Frequency	Percent	Frequency	Percent
A. Gender				
Male	25	62.5	30	75
Female	15	37.5	10	25
Total	40	100	40	100
B. Age				
22-45	10	25	9	22.5
46-59	18	45	19	47.5
60 and above	12	30	12	30
Total	40	100	40	100
Mean	53.0		53.18	
C. Civil Status				
Single	2	5	1	2.5
Married	32	80	37	92.5
Widow/er	6	15	2	5
Total	40	100	40	100
D. Educational Attainment				
Elementary	24	60	31	77.5
High School	15	37.5	7	17.5
College	1	2.5	2	5
Total	40	100	40	100
Mean	6.5		6.32	
E. Household Size				
1-4	15	37.5	19	47.5
5-8	22	55.0	20	50.0
9 above	3	7.5	1	2.5
Total	40	100	40	100
Mean	5.12		4.46	

Table 1b. Continuation.

A. No. of Years in Farming				
1-10	5	12.5	17	42.5
11-20	9	22.5	7	17.5
21-30	10	25	10	25
31-40	6	15	0	0
41-50	6	15	2	5
51-60	4	10	4	10
Total	40	100	40	100
Mean	30.40		19.92	
B. Household Size				
1-4	15	37.5	19	47.5
5-8	22	55.0	20	50.0
9 above	3	7.5	1	2.5
Total	40	100	40	100
Mean	5.12		4.46	
C. No. of Household members involved in farming				
0-2	31	77.5	30	75
3-5	7	17.5	9	22.5
6-8	2	5.0	1	2.5
Total	40	100	40	100
Mean	1.28		1.28	
D. Tenurial Status				
Owner-operator	13	32.5	7	17.5
Tenant	23	57.5	31	77.5
Amortizing owner	4	10.0	2	5
Total	40	100	40	100
E. Availability of technical assistance				
Avail	17	42.5	29	72.5
Did not avail	23	57.5	11	27.5
Total	40	100	40	100

Majority of the farmers in both groups are tenants, but the percentage of tenants is greater among the lowland farmers (78%) compared to the upland farmers (58%). Some of the farmers are owner-operators, and a few are amortizing owners. Upland farmers appear to have longer farming experience (30.4 years) compared to the lowland farmers (19.92 years).

Most of the technical services that the farmers in Matalom, Leyte received are from the Department of Agriculture (DA). The proportion of lowland farmers (72.5%) who availed of technical services are higher than that of the upland farmers (42.5%). This can be explained that lowland farms are located along the highway and are more accessible by the government agricultural technicians. The technical services include seminars and trainings on cultural management practices in rice farming, including pest management and irrigation system.

Description of the Farm

Land is the predominant resource in farming and farmers differ in their area of land cultivated. The average area cultivated by the upland farmers is slightly higher (2.98 ha) than the average farm area of the lowland farmers (2.28 ha). All the upland farms are located in hilly areas while among the lowlands farms, only one is located in a rolling area and the rest are located in flat lands (Table 2).

All upland farmers are dependent on water from the rain. However, in the lowland, some areas (30%) are rainfed while the majority are irrigated (70%). Irrigated farms have great advantage over the rainfed farms in terms of production and plant survival. The crops in irrigated farms have better capability to survive during drought because of the available water supply.

The upland farms are located closer to the market with an average distance of 4.33 km compared to the lowland farms (5.13 km). Distance of farm to market is an important factor in production. If farms are closer to the market, it is easier to transport farm inputs to the farm, and farm output to the market.

Among upland farmers, a huge proportion (47.5%) use their own produce as their source of seeds and the rest secure their seeds from the Department of Agriculture (25%) and other farmers (25%). However, among lowland farmers many acquire their seeds from other farmers.

Cultural Management Practices

The planting method used by all farmers in upland and lowland areas is transplanting. However, the two groups vary in terms of method of fertilizer application (Table 3). All lowland farmers use broadcast method in fertilizer application. However, among upland farmers, while majority (90%) use the broadcast method, there are some who did not apply fertilizer (7.5%) and one respondent use foliar fertilizer. The method of weed control is very similar between the upland and lowland farms with the majority (82.5%) of farmers using manual weed control method. A few farmers in both farm groups use chemical weed control.

Material Inputs Used

The farmer-respondents are aware that one way of increasing rice productivity is by applying the right amount of fertilizer. Most of the upland farmers (32.5%) prefer to apply both complete fertilizer and urea to their farm (Table 4). There are also many upland farmers (27.5%) who use chicken manure to supplement the nutrient in their farm. These farmers are the major users of organic fertilizers in the municipality of Matalom. The other upland farmers use complete fertilizer only (25%) and urea only (15%). The lowland farmers, commonly use complete fertilizer (80%) to supplement their farm, while some apply both complete and urea (15%) and chicken manure (5%).

Pesticide is another material input used by the farmers. While all lowland farmers apply pesticide, some of the upland farmers do not (32%). Karate is the most widely used pesticide by both upland farmers (20%) and lowland farmers (37.5%). Other brands of pesticide used by the farmers are chix, cymbush, lannate and parapest.

There are two rice varieties that are widely used by the farmers, namely RC-22 and RC-18. More than half (52.5%) of the upland farmers use the RC-18. Other varieties used by the farmers are the traditional varieties like the *mayaman*, *lubang*, *pulahan*, *tago*, and *kabuli*. It is observed that there are more upland farmers (40%) than lowland farmers (32.5%) who uses the traditional varieties.

Average Production and Disposal

As shown in Table 5, the average production in the upland farms is 2,822.11 kg per hectare while lowland farms have 3,695.84 kg per hectare. The higher production in the lowland farms can be attributed to the availability of irrigation water and the higher expenditure on fertilizer and pesticides. Also, more lowland farmers than upland farmers avail technical assistance from the Department of Agriculture which means that they are more updated on rice production technology. The t-test however, reveals that the difference in average yield between the two farm groups is not statistically significant.

Most of the farmers' harvest are for home consumption, representing 62.01% of the harvest in the upland farms and 63.53% in the lowland farms. It is observed that none of the lowland farmers sell their produce, while among the upland farmers, only a small portion of their produce is sold. This indicates that both upland and lowland farmers in the study area are subsistence farmers and their production is primarily intended for home consumption. The rest of the farmers' produce goes to harvester's share, thresher's share, landlord's share, and some are used to pay the farmers' debts.

Table 2. Area planted, source of water, topography, distance of farm to market and source of seeds of upland and lowland rice farmers in Matalom, Leyte in 2014.

Items	Upland (n=40)		Lowland (n=40)	
	Frequency	Percent	Frequency	Percent
A. Area Planted (Hectare)				
0-0.25	12	30	10	25
0.26-0.50	8	20	16	40
0.51-0.75	9	22.5	7	17.5
0.76-1.0	6	15.0	7	17.5
Total	40	100	40	100
Mean	2.93		2.28	
B. Sources of Water				
Irrigated	0	0	28	70
Rainfed	40	100	12	30
Total	40	100	40	100
C. Topography				
Flat	0	0	39	97.5
Rolling	40	100	1	2.5
Total	40	100	40	100
D. Distance farm to market				
> 3.0 km	9	22.5	0	0
3.1-5.0 km	17	42.5	20	50
5.1 and above	14	30	20	50
Total	40	100	40	100
Mean	4.33		5.13	
E. Source of Seeds				
Own produce	19	47.5	10	25
Middlemen	0	0	2	5
Dept. of Agriculture	10	25.0	8	20
Other farmers	10	25.0	19	47.5
Other sources	1	2.5	1	2.5
Total	40	100	40	100

Table 3. Cultural management practices of upland and lowland rice farmers in 2014.

Cultural Practices	Upland		Lowland	
	Frequency	Percent	Frequency	Percent
A. Planting Method				
Transplanting	40	100	40	100
Direct seeding	0	0	0	0
Total	40	100	40	100
B. Fertilizer Application				
Did not apply	3	7.5	0	0
Broadcast	36	90.0	40	0
Foliar	1	2.5	0	0
Total	40	100	40	100
C. Weed control				
Did not control	3	7.5	5	12.5
Manual	33	82.5	33	82.5
Chemical	4	10.00	2	5.0
Total	40	100	40	100

Table 4. Material inputs used by upland and lowland rice farmers in 2014.

Materials	Upland (n=40)		Lowland (n=40)	
	Frequency	Percent	Frequency	Percent
A. Fertilizer				
Complete only	10	25	32	80
Urea only	6	15	0	0
Complete and Urea	13	32.5	6	15
Chicken Manure	11	27.5	2	5
Total	40	100	40	100
B. Pesticide				
Did not use pesticide	13	32.5	0	0
Karate	8	20.0	15	37.5
Chix	0	0	6	15
Cymbush	2	5.0	3	7.5
Lannate	1	2.5	7	17.5
Foliar	1	17.5	3	7.5
Parapest	6	15	0	0
Others	3	7.5	6	15.0
Total	40	100	40	100
C. Variety Used				
Rc-22	3	7.5	13	32.5
Rc-18	21	52.5	14	35.0
Traditional varieties	16	40.0	13	32.5
Total	40	100	40	100

Table 5. Average production and disposal per hectare by upland and lowland rice farmers in Matalom, Leyte in 2014.

Production	Upland		Lowland		Difference
	Kilogram	%	Kilogram	%	Kilogram
Production					
Yield per hectare (kg)	2,822.11		3,695.84		873.73[ns]
Disposal					
Home Consumption	1,750	62.01	2,347.92	63.53	597.92
Sold in the market	225.36	7.95	0	0	-225.36
Harvesting Share	225.96	8.01	293.75	7.95	67.79
Threshing share	225.96	8.01	310.42	8.40	84.46
Landlord Share	395.83	14.00	656.25	17.76	260.42
Paid to Creditors	0	0	87.50	2.37	87.50
Total	2,822.11	100	3,695.84	100	873.73

Note: ns = the t-test was not significant

Determinants of Productivity of Rice Farms

The Cobb-Douglas production function was employed to determine the relationship between the productivity of rice farms and the explanatory variables. Table 6 presents the regression results showing the overall data structure in analyzing the influence of relevant farm characteristics and socio-economic factors across the mean of the distribution of rice production in Matalom, Leyte. The dummy variable for upland and lowland rice production is positive indicating that on average rice production in lowland is higher compared to upland farmers however, the effect is not significant. Hence, the argument that rice production in lowland is higher than the upland cannot be strongly justified. This implies that with the current data set, farm location does not affect the production of rice in the municipality. Similarly, the dummy variable for irrigation is positive and not significant. The positive sign indicates that irrigated rice farms have higher production as compared to rainfed rice farms. However, the effect is not significant implying that there is no sufficient evidence to statistically claim that irrigated rice farms have higher production in comparison to rainfed rice farms using OLS approach. The factors that significantly influence rice production include labor cost, fertilizer cost and farm area. This means that an increase in these inputs will translate to an increase in rice production. These results conform to the production function that labor, fertilizer and larger farm area significantly affect farm production.

The quantile regression approach was used to investigate and compare the determinants of rice production among those who have low yield or those farmers whose output belongs to the bottom 25% in terms of rice production, median or the middle 50% in terms of rice production and the upper production quantile or those farmers with bigger output belonging to the higher 25% in terms of rice yield. Results show that there is a relative difference in the results between the usual regression approach which ordinary least squares (OLS) and the quantile regression. This shows that it is also important to consider the distribution of rice yields in analyzing its determinants.

Table 6. Factors affecting rice production by upland and lowland farmers in Matalom, Leyte in 2014 using OLS (overall structure).

Determinants	Coefficient	Standard Error	P-value
Irrigated	0.4035	0.4121	0.331
Lowland	0.0798	0.4294	0.853
Age	-0.0034	0.0162	0.833
Household size	0.0437	0.0673	0.518
Education	-0.0659	0.0620	0.292
Male	0.1043	0.2886	0.719
Year in farm	0.0021	0.1449	0.989
Labor cost	0.0872***	0.0290	0.004
Fertilizer cost	0.0012***	0.0003	0.001
Pesticide cost	0.0351	0.0413	0.398
Farm area	0.3506 ***	0.0825	0.000
Assistance	0.0737	0.2816	0.794
Constant	0.8042	0.9996	0.424

Note: R^2 = *0.5136*
*** = *significant at 1% level, ** =significant at 5% level, *=significant at 10% level*

Table 7 shows the result of the lower quantile (0.25) regression representing the bottom 25% in terms of rice production. The analysis reveals that only labor cost and fertilizer cost has positive and significant effect on rice production. Labor cost is significant at 1% level and the fertilizer cost is significant at 5% level. The rest of the variables are not statistically significant. Holding other variables constant, rice production in the lower quantile is positively influenced by labor cost and fertilizer cost only.

Table 8 shows the result of the median (0.50) quantile regression representing median rice yield. The analysis reveals that the factors that can influence rice yield among median producers are fertilizer cost, labor cost and farm area. Labor cost is significant at 5% level of significance, fertilizer is significant at 1% level, and farm area is significant at 1% level. The rest of the factors are found to have no significant effect on rice production among median level rice yield.

With regards to higher production, Table 9 shows the regression result of the upper (0.75) quantile representing the upper 25% of the distribution. Results show that there are more factors that contribute to rice production among upper quantile production as compared to rice farmers in the lower quantiles. In addition to farm area, labor and fertilizer cost, the following factors significantly affect rice production in the top quantile; household size, dummy variable for male, and technical assistance. This implies that in higher production there are many factors that significantly affect the yield of rice. It is also worth to note that technical assistance extended to farmers is significant only among the upper quantile of the distribution and not significant at the bottom and median quantile. This may indicate that the upper quantile rice farmers are more receptive to the technical assistance extended than those farmers in the median and lower quantile. However, this does not imply that assistance extended to farmers with relatively low production shall be stopped but rather more technical assistance has to be extended to rice farmers in the lower and median quantile to encourage them to increase their production.

Table 7. Factors affecting rice production by upland and lowland farmers in Matalom, Leyte in 2014 using quantile regression (lower quantile).

Determinants	Coefficient	Standard Error	P-value
Irrigated	0.0777	0.6330	0.903
Lowland	0.5065	0.7014	0.473
Age	-0.0053	0.0228	0.817
Household size	0.0491	0.1008	0.628
Education	-0.0554	0.1099	0.616
Male	-0.1520	0.4384	0.730
Year in farm	0.0867	0.2059	0.675
Labor cost	0.1044**	0.0398	0.011
Fertilizer cost	0.0012***	0.0003	0.000
Pesticide cost	0.0411	0.0566	0.470
Farm area	0.2236	0.1438	0.125
Assistance	0.0286	0.4029	0.944
Constant	0.2727	1.6567	0.870

Note: R^2 = *0.3658*
**** = significant at 1% level, ** =significant at 5% level, *=significant at 10% level*

Table 8. Factors affecting rice production by upland and lowland farmers in Matalom, Leyte in 2014 using quantile regression (median quantile).

Determinants	Coefficient	Standard Error	P-value
Irrigated	0.3509	0.4655	0.454
Lowland	0.2330	0.4852	0.633
Age	-0.0007	0.0183	0.972
Household size	0.0806	0.0751	0.287
Education	-0.0167	0.0719	0.817
Male	0.2966	0.3453	0.394
Year in farm	0.7747	0.1545	0.618
Labor cost	0.0723**	0.0338	0.036
Fertilizer cost	0.0011 ***	0.0002	0.000
Pesticide cost	0.0257	0.0471	0.587
Farm area	0.3776***	0.0969	0.000
Assistance	0.1469	0.3290	0.657
Constant	-0.2020	1.2006	0.867

Note: R^2 = 0.3658
*** = *significant at 1% level, ** =significant at 5% level, *=significant at 10% level*

Table 9. Factors affecting rice production by upland and lowland farmers in Matalom, Leyte in 2014 using quantile regression (upper quantile).

Determinants	Coefficient	Standard Error	P-value
Irrigated	0.0506	0.2787	0.856
Lowland	0.2132	0.2811	0.451
Age	-0.0015	0.0106	0.886
Household size	0.0507	0.0291	0.089
Education	0.0034	0.0354	0.925
Male	0.4134**	0.19823	0.041
Year in farm	0.0118	0.0961	0.903
Labor cost	0.497**	0.0199	0.015
Fertilizer cost	0.0011***	0.0001	0.000
Pesticide cost	0.0159	0.0291	0.584
Farm area	0.5811***	0.0572	0.000
Assistance	0.5384***	0.1961	0.008
Constant	0.0571	0.6651	0.932

Note: R^2 = 0.3016
*** = *significant at 1% level, ** =significant at 5% level, *=significant at 10% level*

Problems encountered

Pest infestation is a major problem encountered by all farmer respondents (Table 10). The major pest is rice black bug (RBB) which is experienced by 87.5% and 30% of the upland and lowland rice farmers, respectively. Rodents are also a major problem encountered by all upland farmers and 72.5% of the lowland farmers. Other pests include golden snail, rice worms, and birds.

Aside from high cost of material inputs, other problems met by farmers in rice production include drought and typhoon. Drought is a major problem of all upland farmers and some of the lowland rainfed farmers (30%). Over 40% of the farmers in both farm groups have problems on typhoons. Lack of capital is also a major problem in both farm groups (Table 11).

Table 10. Pest and diseases incidence in upland and lowland rice farms in Matalom, Leyte in 2014.

Type of pest and diseases*	Upland		Lowland	
	Frequency	Percent	Frequency	Percent
Rice Black Bug	35	87.5	40	100
Golden Snail	38	95	35	87.5
Rodent	40	100	29	72.5
Rice Worm	19	47.5	19	47.5
Maya	21	52.5	26	65
Others	2	5	1	2.5

*Note: * multiple responses*

Table 11. Problems met by upland and lowland rice farms in rice production in Matalom, Leyte in 2014.

Problems met*	Upland		Lowland	
	Frequency	Percent	Frequent	Percent
High cost of firm inputs	30	75	12	30
Drought	40	100	12	30
Typhoon	19	45	17	42.5
Lack of capital	36	90	32	80
Pest infestation	40	100	40	100

*Note: * multiple response*

4. CONCLUSION

This study was conducted to examine the factors that influence rice production in lowland and upland areas in Matalom, Leyte. The ordinary least squares (OLS) estimation and quantile regression approach were used to address the objectives of the study. The results show that while lowland farms have relatively higher production than upland farms, the difference is not statistically significant. Both ordinary least squares regression and quantile regression show that lowland rice production has a positive coefficient implying that on average, lowland rice production is higher compared to upland rice production holding other factors constant, however, the effect is not significant. This indicates that there is no sufficient evidence to statistically indicate that rice production in lowland areas is higher than in upland areas of Matalom, Leyte.

The ordinary least squares (OLS) regression reveals that the factors that positively affect rice production across distribution are labor cost, fertilizer cost and farm area. Holding other factors constant, an increase in these inputs will translate to increased rice production. Results of this study suggest that farmers with lower production should consider applying more fertilizer and intensifying labor input utilization to increase rice production. Though the regression result suggests to also increase farm area to increase production, this option may not be applicable since increasing farm area is costly. Farmers should use high yielding variety or hybrid seeds which will help them increase their production.

While the variables that shows positive and significant coefficients through ordinary least squares (OLS) estimation preserve their signs in the quantile estimates, there are some factors that do not have significant coefficient in the OLS but are found to have positive and significant effects only in the upper quantile. These variables include household size, male household head, and technical assistance provided to farmers. Thus, farmers with low production are also encouraged to be receptive with technical assistance provided to them. Policy makers, local government units, and other related agencies should strengthen their extension services provided to farmers especially among farmers in the tail end of the distribution.

The findings of this study suggest that using the ordinary least squares (OLS) estimation in investigating the determinants of productivity of rice farms could not reveal significant determinants of rice production considering the spread of the distribution. While it is useful in analyzing the influence of relevant farm characteristics and socio-economic factors across the mean of the distribution of rice production, it may not be appropriate in dealing with extreme values such as those in the upper quantile or the lower quantile of the distribution. In this case, the quantile regression approach can be more appropriate because it allows investigation of determinants of productivity in the different quantiles. Future studies of a similar nature should therefore use the quantile regression approach, especially if there are certain sectors of interest, like the lowest producers or the highest producers in the distribution.

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