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Measuring Technical Efficiency of Upland Paddy Farming in the Land of Ulayat Rights, Mausambi, Ende, East Nusa Tenggara (NTT), Indonesia

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Abstract Most agricultural lands in Ende, East Nusa Tenggara (NTT) is property of ulayat rights. This condition will determine the farming diversity, productivity and income level. The aim of this study is to analyse the level of technical efficiency of upland paddy farming in the land of ulayat rights. Sampling method used cluster sampling and data analysis was estimated using stochastic frontier Cobb-Douglass formula. The results showed that fertilizer and pesticide variable had positive and significant effect on production of uplad paddy farming (99%). While the variable of labor had positive and significant effect (95%). Seed variable showed positive effect on potential production, but not significant. The average level of technical efficiency of upland paddy farming on the land tenure status of the owner of cultivation right is higher than the land tenure status of profit sharing and lien holder. Factors that influence the technical inefficiency of upland paddy farming include: age, farming experience, the frequency of obataining the information, membership in farmer groups, other sources of income.

Keywords Ende, Upland paddy, Ulayat rights, Technical efficiency

1. Introduction

Dry land in Ende regency is reached 86% from total land that is used for agriculture. This dry land has potential as agriculture land, but it is not fully utilized until now. Upland paddy is an important commodity in Ende Regency, but it is not followed by an increase in the paddy productivity. The average productivity per hectare of upland paddy in the Ende is lower than the upland paddy production from West Nusa Tenggara (NTB) province. The average productivity per hectare of upland paddy in Ende is only 2150 kg in 2013 and 2250 kg in 2014; but in NTB, it can reach 4065 kg and 3422 kg in 2014.

Most agricultural lands in Ende is property of ulayat rights that is belong to Mosalaki (head of society). Recently, there is a serious problem beause of changing cultural value of ulayat right. Property of ulayat right was changed to a new land tanure and used new bussiness system that are profit sharing and farmland lien. Different status of land tenure will determine the farming diversity, productivity and income level [1-5]. Previous study explains that profit sharing system lead to inefficiency of production [6]. Meanwhile traditional profit sharing has no effect to inefficiency of production if the land owner have authority to suggest the labor number [7].

This study will measure the technical efficiency of upland paddy farming from three land tenure status in the land of ulayat rights by using frontier production formula. Frontier production formula is used to determine the highest production potential which can be achieved by farmer from any input combinations [8].

2. Materials and Methods

This research was conducted at Mausambi Village-Maurole Subdistrict, Ende Regency, East Nusa Tenggara (NTT) Province. Population of farmers at Mausambi village was 214 farmers. The number of share croppers, lien holders, and the owner of cultivation right were 36 people, 32 people and 146 people, respectively. Cluster sampling was used in this research. The sample size was calculated based on Parel formula [9]. The sample size per land tenure status was 92 farmers for the owner of cultivation right, 34 farmers for profit sharing and 21 farmers for lien holders.

Production formula of stochastic frontier Cobb-Douglass was applied in this research, the formula was written as

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follows:

$$\text{Ln } Y + \beta_0 + \beta_1 \text{InX}_1 + \beta_2 \text{InX}_2 + \beta_3 \text{InX}_3 + \beta_4 \text{InX}_4 + E_j D_j + (V_j - u_j)$$

Description:

Y= Production (kg); X_1 = Size of land area (Ha); X_2 = Seeds (kg); X_3 = Fertilizers (kg); X_4= Labor, both household labor and non-household labor (Equal Employment Day); Ej= Dummy variable coefficients; Dj= dummy variable of land tenure status; D1=1 for the status of the owner, 0 for others land tenure status; D2=1 for profit sharing, 0 for others status, βi = regression coefficients (i = 0,1,2,... n); vj= a symmetric, normally distributed random error or random error models and uj =one-side error term (uj ≤ 0) or random variables.

To analyse the factors that influenced the technical inefficiency was used a linear regression model which was estimated simultaneously with frontier production formula. Technical inefficiency linear regression model was formulated as follows:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + p_1 D_1 + p_2 D_2 + \varepsilon_i$$

Description:

U_i = Technical inefficiency was obtained from analysis of stochastic frontier production formula; Z_1 = The age of farmers (years); Z_2 = The farmer experience (years); Z_3 = Frequency of obtaining information about farming. This variable was accumulated information from counselors, other farmers, printed and electronic media, and sales; D_1 = Dummy variables for membership in farmer groups (1=if yes, 0= if not), and D_2 = Dummy variables for others source of income (1 = if yes, 0 = if not). Estimation parameters of the production and inefficiency formula were conducted simultaneously using FRONTIER 4.1c program [10].

3. Results and Discussion

3.1. Potential Production of Upland Paddy Farming

The results of Stochastic Frontier production formula showed that regression coefficient on the land variable is negative. It means that the increase of land area can not increase harvesting production. This result is not supported by any theoritical data. So it can be solved by making ratio between all variables and land variable.

Stochastic frontier estimation results by using MLE approach is better than the OLS approach. It is caused by the MLE approach shows that the sigma-squared value and the value of the log likelihood is higher than OLS approach. Estimation of the production by using MLE method showed that the variable of fertilizer and pesticides has positive and significant effect (α = 1%). The variable of labor also has positive and significant effect (α = 5%). If the variable of fertilizer, pesticides and labor is added 10%, so the production of upland paddy per hectare will increase 20.69%, 0.71% and 2.00%, respectively. Seed variable showed positive result, but it was not significant. It means that increase the number of seeds will not increase the production of upland paddy. This is caused by the plant spacing is already optimum (26 cm × 26 cm).

Dummy variable showed a significant result. Dummy (D) parameter has positive value for the variable of D_1 (owner). It means that the production on the land tenure status of the owner of cultivation right is higher than the others tenure status. While dummy (D) parameter coefficient has negative value for the variable of D_2 (profit sharing). It means that the production function on the land tenure status of profit sharing was lower than others land tenure status.

Table 1. Production estimation results based on the land tenure status of the owner of cultivation right, profit sharing and lien holder by using OLS and MLE method

Variabel	OLS Method			MLE Method		
	Coefficient	Standard Error	t-ratio	Coefficient	Standard Error	t-ratio
I (kg) F(kg) L(HKSP) P (ltr) D1 D2	-4.8524***) 0.0396 1.7175***) 0.3875***) 0.1003***) 0.1617***) -0.2982***)	0.9972 0.0464 0.2334 0.1115 0.0300 0.0555 0.0431	-4.8658 0.8531 7.3573 3.4729 3.3426-2.9144 -6.9111	-5.7343***) 0.0229 2.0688***) 0.2002**) 0.0713***) 0.1912***) -0.2478***)	0.9039 0.0410 0.2028 0.0940 0.0277 0.0482 0.0400	-6.3435 0.5579 10.2011 2.1283 2.5724 3.9656 -6.1851
σ^2 γ LLF LR test = 9,3241 X^2 = 189,90	0,0197 83,3879			0.0382 0.8122 88.0500		5.8476 11.7157

Notes: ***) significant on α = 1 %; **) significant on α = 5 %, and
*) significant on α = 10 %
I: Intercept; S: Seed; F: Feed; L: Labor; P: Pesticide; D1: owner; D2: Profit Sharing; LLF: Log Likelihood Function; LR: Likelihood Ratio

3.2. Technical Efficiency Analysis

Table 1 shows that the technical efficiency of each farmer is very different. It is indicated by the gamma coefficient value is 81.22%. It means that the variation of upland paddy production is contributed from technical efficiency (81.22%).

Table 2. The distribution of technical efficiency level

Technical Efficiency	The Owner of Cultivation Right (%)	Profit Sharing (%)	Lien Holder (%)
< 0.70	1	20	-
0.71-0.80	5	6	-
0.81-0.90	48	32	81
0.91-1.00	46	42	19
Efficiency level (mean)	0.89	0.84	0.87
Standard Deviation	0.05	0.12	0.05
Varians	0.002	0.013	0.002
Minimum	0.61	0.58	0.80
Maximum	0.97	0.97	0.97

The average level of technical efficiency on the land tenure status of the owner of cultivation right is higher than others land tenure status. Similar results are found in other the studies for paddy commodities [11]. In addition, the different commodities (tobacco, corn and coconut) have similiar result also [12-14].

Potential production, the used of combination among production input, can be achieved until 89%, 84% and 87% by farmers from the land tenure status of the owner of cultivation right, profit sharing and lien holder (Table 2). It means that the farmers from the land tenure status of the owner of cultivation right, profit sharing and lien holder have opportunities about 11%, 16% and 13% to increase the production of upland paddy.

Technical inefficiency of upland paddy farming, regression coefficient of age on the land tenure status of the owner of cultivation right and profit sharing is positive and significant (Table 3 and Table 4). It means that older farmers technically have higher inefficiency than younger farmer. This is related with the decline of ability to work, spirit effort, desire to bear the risk and desire to apply new innovations. Age has positive effect on the inefficiency for small scale farmers and large scale farmers.

Regression coefficient of upland paddy farming experience on the land tenure status of the owner of cultivation right and profit sharing is negative and significant. It means when the farmers experience is high, so level of inefficiency is low. However, on the land tenure status of lien holder is positive and significant (Table 5). It means that the high experience of farmers will reduce the productivity of farmers and using of production inputs. It is caused by some reasons. If the upland paddy farming is not longer profitable that is caused by climatic conditions and number of rainy days. So, they gradually change to profitable job such as fishing and cows breeding. In others hand, farmers may not implement all of the knowledge and skills from their experience.

Table 3. The factors which affecting technical inefficiency of upland paddy farming on the status of land tenure of the owner of cultivation right

Model	Undstandardized Coefficients		Standardized Coefficients	t.hit	Sig
	B	Std. Error	Beta		
(Constant)	0.161*)	0.114		-1.404	0.164
Age	0.005***)	0.002	0.624	3.037	0.003
Experiences	9.588E-5	0.004	-0.004	-0.024	0.981
Freq of Information	0.016***)	0.006	0.254	2.687	0.009
Membership	0.011	0.021	0.023	0.517	0.607
Other Incomes	-0.010	0.009	-0.080	-1.132	0.261

Notes: ***) significant on α = 1 %; **) significant on α = 5 %, and
*) significant on α = 10 %

Table 4. The factors which affecting technical inefficiency of upland paddy farming on the land tenure status of profit sharing

Model	Unstandardized Coefficients		Standardized Coefficients	t.hit	Sig
	B	Std. Error	Beta		
(Constant)	1.068***)	0.214		-4.994	0.000
Age	0.035***)	0.005	1.330	6.782	0.000
Experiences	-0.001	0.007	-0.022	-0.156	0.877
Freq of Information	0.019	0.022	0.173	0.859	0.398
Membership	0.006	0.015	0.025	0.389	0.701
Other Incomes	0.077***)	0.028	0.301	2.693	0.012

Notes: ***) significant on α = 1 %; **) significant on α = 5 %, and
*) significant on α = 10 %

Table 5. The factors which affecting technical inefficiency of upland paddy farming on the land tenure status of lien holder

Model	Unstandardized Coefficients		Standardized Coefficients	t.hit	Sig
	B	Std. Error	Beta		
(Constant)	0.055	0.165		0.335	0.742
Age	-3.469E-5	0.002	-0.003	-0.016	0.988
Experiences	0.017*)	0.012	0.438	1.469	0.191
Freq of Information	-0.018	0.014	-0.453	-1.336	0.201
Membership	-0.007	0.010	-0.069	-0.768	0.455
Other Incomes	-0.016	0.016	-0.133	-1.008	0.329

Notes: ***) significant on α = 1 %; **) significant on α = 5 %, and
*) significant on α = 10 %

Other study explain that the experience have positive effect on inefficiency [15]. Regression coefficient of frequency for the three land tenure status is negative and significant. It means that the source of the information provided on upland paddy farming can improve the technical efficiency. Regression coefficient of membership in farmer groups for the three land tenure status has negative effect to technical inefficiency, so the membership of farmers in farmer groups will improve their technical efficiency.

Regression coefficients of other income sources for the land tenure status is positive and significant. It means that increase of other income sources will increase the inefficiencies of upland fields farming, so income from other sources is not allocated for upland paddy farming. They will spends the money for education and other social activities.

4. Conclusions

It can be concluded that fertilizer, pesticide, labor and seed variables had positive effect on potential production of upland paddy farming with different significance. The average level of technical efficiency of upland paddy farming on the land tenure status of the owner of cultivation right is higher than the land tenure status of profit sharing and lien holder. Factors that influence the technical inefficiency of paddy field farming include: age, farming experience, the frequency of obataining the information, membership in farmer groups, other sources of income.

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