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Proceedings of the International Conference on Agriculture, Social Sciences, Education, Technology and Health (ICASSETH 2019)

Preface

I take this opportunity to welcome you all to the Proceedings of the 1st International Conference on Agriculture, Social Sciences, Education, Technology and Health (IC-ASSETH) 2019. As the purposes of the conference is to provide and develop scientific contributions to the society, these proceedings are intended to answer the challenge of the Industrial Revolution 4.0 and build a global scale network to support the development of multidisciplinary researches.

Sincere thanks to the following individuals: Prof Dr. Banthit Chetsawang from Mahidol University, Thailand; Prof. Dr. H. Eman Suparman, SH.,MH from Universitas Padjadjaran, Indonesia; Prof. Hermanto Siregar, Ph.D from Insitut Pertanian Bogor, Indonesia and Hossein Mottaghi from Azad University, Iran for invaluable presentations in the agenda.

It is also wonderful to have over 80 papers or speakers from different cities and universities around Indonesia, New Zealand and Australia representing various issues from multidisciplinary perspective. Each contributed paper was refereed before being accepted for publication in these proceedings. The papers were accepted for publication based on their interest, relevance, innovation and application to the related fields.

In addition, special thanks go to all all authors and participants for their contributions. We would also like to express our most sincere gratitude to the Advisory Boards, Scientific Committee, the Organizing committee, well-wishes and all people for your invaluable contribution to make the Conference outstanding.

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International Conference on Agriculture, Social Sciences, Education, Technology and Health (ICASSETH 2019)

Determinants of Technical Inefficiencies of Sweet Potato Farming in Kuningan District

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Abstract—The study was conducted to analyse the technical inefficiency of sweet potato farming in Kuningan District. 51 farmers were analysed using the stochastic frontier production function. The sample is determined using simple random sampling with one output and six inputs (land, seed, organic fertilizer, chemical fertilizer, pesticides and labour). The results showed that the average technical efficiency was 66%. The technical inefficiency model shows that non-formal education, experience, and family size have a significant effect on technical inefficiency.

Keywords: farming, sweet potato, technical inefficiency

I. INTRODUCTION

Sweet potato has the potential to substitute flour. Sweet potato also can substitute rice for food diversification programs and can be processed into various products that can encourage the development of agroindustry. Sweet potato is preferred by farmers because it is easy to manage and resistant to drought.

West Java Province is the largest sweet potato production centre in Indonesia. Kuningan District has the highest production level compared to other districts in West Java Province. Cilimus District is a centre of sweet potato production in Kuningan District [1].

The productivity of sweet potato farming in Kuningan District is 137 tons/ha lower than the productivity of sweet potato farming in West Java Province of 194 tons/ha which is allegedly because farmers are less efficient in allocating production factors.

Cultivation techniques carried out by the majority of farmers are cultivation techniques that are passed down from generation to generation so that they are suspected to be technically inefficient, while farmers' income is determined by efficiency in allocating their production factors in various alternative production activities to avoid inefficiencies in the use of production factors [2].

The lack of use of technology and the expansion of cultivation causes sweet potato farmers to have no choice but to have to operate under traditional agriculture [3]. Based on the description above, this study aims to determine the level of technical efficiency achieved by farmers in carrying out sweet potato farming in Kuningan District, and also to identify factors that influence technical inefficiencies in sweet potato farming in Kuningan District.

II. RESEARCH METHODS

Cilimus District was determined as the location of the study using purposive sampling because it has the largest sweet potato production in Kuningan District. Sweet potato farmers in the District of Cilimus were 510 people, and 10% were taken so that the sample size of 51 farmers was determined using simple random sampling.

The level of technical efficiency and the factors that influence technical inefficiency are analysed simultaneously [4] using the stochastic frontier production function [5] as follows:

$$\ln q_i = x_i'\beta + v_i - u_i \quad (1)$$

where q_i represents the output of the i-th firm; x_i is a K x 1 vector containing the logarithms of inputs; β is a vector of unknown parameters; vi is a symmetric random error to account for statistical noise; and u_i is a nonnegative random variable associated with technical inefficiency.

The empirical model used in estimating the production function and the level of technical efficiency is as follows:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i - U_i \quad (2)$$

Where, Y_i = output (kg), X_1 = land (ha), X_2 = seed (kg), X_3 = organic fertilizer (kg), X_4 = chemical fertilizer (kg), X_5 = pesticide (litter), X_5 = labour (man-days), β = coefficient of regression, V_i = random error, U_i = technical inefficiency effects.

Factors affecting technical inefficiency are analysed using the following equation:

$$\mu_{it} = z_{it}\delta \quad (3)$$

where z_{it} is a vector (1xM) of the explanatory variables are observed, which has a constant value, and δ is a vector (Mx1) of unknown scalar parameters to be estimated.

The empirical model used in identifying the factors that influence technical inefficiency is as follows:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_1 Z_1 + \delta_1 Z_1 + \delta_1 Z_1 \quad (4)$$

Where, U_i = technical inefficiency, Z_1 = age (year), Z_2 = non-formal education (1 if yes, 0 if not), Z_3 = experience (year), Z_4 = family size (person), δ = coefficient of regression.

Estimation of production functions and technical inefficiency functions using Front 4.1 version 4c.

III. Results and Discussion

A. Technical Efficiency

The frequency distribution of the level of technical efficiency achieved by farmers in sweet potato farming in Kuningan District is presented in Table 1.

TABLE I. TECHNICAL EFFICIENCY

Technical Efficiency	Frequency	Percentage
0.31 – 0.40	2	3.92
0.41 – 0.50	4	7.84
0.51 – 0.60	12	23.53
0.61 – 0.70	13	25.49
0.71 – 0.80	12	23.53
0.81 – 0.90	2	3.92
0.91 – 1.00	6	11.76
Total	51	100.00

minimum = 0.36; maximum = 0.99; mean = 0.66

Table 1 shows that the average level of technical efficiency achieved was 0.66, indicating that the sweet potato farming was not yet technically efficient. These results are consistent with the findings of Sanusi and Adesogan [6]. Farmers who achieved technical efficiency levels above 0.70 were 39.22%, while those who achieved technical efficiency below 0.70 were 60.78%. Farmers are technically efficient if they reach an efficiency index value of more than 0.70 [7].

Technical efficiency ranges from 0.36 to 0.99 with an average of 0.66, which indicates a technical inefficiency gap of 0.34. This shows that an increase in production of 34% can be achieved without the addition of inputs, or the use of inputs can be reduced by 34% to achieve the same level of production. On average farmers to achieve the highest level of technical efficiency achieved by other farmers can save costs by 33% [i.e. 1- (0.77 / 0.99)]. On the other hand, the most efficient farmers can save costs by 64% [i.e. 1 (0.54 / 0.99)].

B. Estimation of Production Function

Estimates of the stochastic frontier production function of sweet potato farming in Kuningan District are presented in Table 2. The estimated value of the parameter (γ) of 0.9999 is statistically different from zero, which shows 99.99% of the variation in the level of output in sweet potato farming attributed to technical inefficiencies in the use of inputs. The model uses a log linear equation so that the regression coefficient shows the elasticity of production of each input. For example, the addition of 1% organic fertilizer will increase production by 2.02%. The sum of all coefficients more than unity (3.72) shows the increasing returns to scale.

TABLE II. PRODUCTION FUNCTION AND INEFFICIENCY FUNCTION

Parameter	Coefficient	Std	t-value
Production function			
Constant	1.9191	3.1127	0.6165
Land	-1.8014	0.9952	-1.8859[c]
Seed	1.0688	0.5274	2.0228[b]
Organic fertilizer	0.1380	0.0643	2.1462[b]
Chemical fertilizer	-0.0506	0.0538	-0.9415
Pesticide	0.9013	0.6836	1.3184
Labor	0.2066	0.1944	1.0629
Inefficiency function			
Constant	-0.4192	0.9728	-0.4309
Age	0.3134	0.2666	1.1753
Non-formal education	0.1213	0.0392	3.0943[a]
Experience	-0.4020	0.1252	-3.2101[a]
Family size	0.1986	0.1121	1.7723[c]
Sigma-squared	0.0011	0.0003	3.2838
gamma	0.9999	0.1630	6.1346
Log likehood function	46.9372		
LR test of one sided error	32.3121		

significant at 1%, [b]ignificant at 5%, [c]ignificant at 10%

Table 2 shows that land, seeds and organic fertilizer have a significant effect on production; while chemical fertilizers, pesticides and labour have no significant effect.

Land has a negative and significant effect on production, which indicates that the addition of land will reduce production. This shows that the increase in production is better done by using intensification rather than extensification. These results are consistent with the findings of Xie et al [8].

Seeds have a positive and significant effect on production which indicates that the addition of seeds will increase production. This shows that the seeds used have good quality. Farmers use local variety seeds, namely kuningan putih (Anakan Ciremai Putih) which are suitable to the conditions of the local farming location. These results are consistent with findings from Pudaka et al [9].

Organic fertilizers have a positive and significant effect on production which shows that the addition of organic fertilizer will increase production. This shows that the land used for sweet potato farming is land that lacks soil nutrients. These results are consistent with findings from Ngango and Kim [10].

C. Factors Affecting Technical Inefficiency

The estimated coefficients of the technical inefficiency function (Table 1) provide some explanation for the level of technical efficiency among individual farmers. Non-formal education, experience and family size significantly influence technical inefficiency, while age has no significant effect.

Age has a positive but not significant effect on technical inefficiency. This shows that the older the farmers, the sweeter potato farming is technically inefficient. These results are

consistent with the findings of Mukwalikuli [11] and Yekti et al [12].

Non-formal education has a positive and significant effect on technical inefficiency. This shows that non-formal education which is followed by farmers in the form of counselling is not in accordance with the objectives of achieving technical efficiency. These results are consistent with the findings of Ismail et al [13].

Experience has a negative and significant effect on technical inefficiency. This shows that the more experienced the farmers, the more efficient the sweet potato farming technically. These results are consistent with the findings of Gebrehiwot [14].

Family size has a positive and significant effect on technical inefficiency. This shows that the more family size the sweet potato farming is increasingly technically inefficient. These results are consistent with the findings of Sudrajat and Yusuf [15].

IV. Conclusion and Recommendation

Technical efficiency ranges from 0.36 to 0.99 with an average of 0.66 which indicates that sweet potato farming has not yet reached the level of technical efficiency. Land, seeds and organic fertilizer have a significant effect on production, while chemical fertilizers, pesticides and labour have no significant effect. Non-formal education, experience and family size significantly influence technical inefficiency, while age has no significant effect.

The experience of farmers in sweet potato farming can be improved through comparative studies to other areas where sweet potato farming has reached a level of technical efficiency.

Acknowledgment

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