TECHNICAL EFFICIENCY OF MANDARIN KEPROK SOE DRYLAND FARMING SYSTEM IN WEST TIMOR, EAST NUSA TENGGARA PROVINCE, INDONESIA

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Abstract: This paper investigates farm level technical efficiency differences of production and its determinants in a sample of 360 high- and low-land mandarin keprok SoE producing farms in 12 villages in six sub districts of South Central Timor district in west Timor, Indonesia. This study used a Translog functional form using technical inefficiency effect model of stochastic production function approach, simultaneously applied to cross section data. Results indicate that, overall, technical efficiency of production in the samples of mandarin keprok SoE producing farms investigated in both zones ranges from a minimum of 17\% to a maximum of 92\% with an average technical efficiency estimate of 66\%. This suggests that mandarin keprok SoE farmers may increase their production by as much as 34\% through more efficient use of production inputs. In addition, mean technical efficiency in the highland area, 67\%, is greater than lowland area, 61\%. Farm size of $<1$ ha indicates lower technical efficiency level than bigger farm size of $\geq 1$ ha, both in high- and low-land producing farms. Furthermore, overall, estimated coefficients in the technical inefficiency model indicate positive effect on the technical efficiency of experience, farmer age, selling method and the farmer group. While education, contacted with agricultural field officers and other sources of income give a negative effects on technical efficiency. All determinants of efficiency level in highland producing farms give positive effects, except for education factor.

Keywords: Technical efficiency, stochastic frontier production function, mandarin keprok SoE producing farms, high- and low-land areas, West Timor

I. INTRODUCTION

Citrus (keprok or orange) was one of the main and popular economic commodities in Indonesia. That was the case why Indonesia held the 9\textsuperscript{th} biggest citrus producer in the world (the 2\textsuperscript{nd} for mandarin keprok producer) in 2008. However, Indonesia was still not able to fulfill domestic citrus demands of, for example, RT consumers, export, industrial raw materials processing as well as import substitution. This condition had made citrus import still increase from year to year (Deptan, 2009) on one side, and the domestic citrus consumption tended to increase approximately up to 10\% each year on the other. It is interesting that the condition was marked by the increase of population and the life style of consuming more healthy fruit.
Most domestic mandarin keproks available in markets everywhere in Indonesia were specified with “local label”. The province of Nusa Tenggara Timur (NTT) for example, which was the 10th biggest keprok producer in Indonesia, specified keprok with local label such as “Jeruk SoE” in Timor Tengah Selatan. The province contributed up to 2% to total national keprok production. If compared with other kinds of fruit produced by farmers in NTT, by looking at the areas of planting from 2005 to 2009, the mandarin keprok type reached the 4th position after avocado, mango, and banana (BPS, 2009). Similarly, by looking at the amount of production during the same years, the keprok gained the 4th position after banana, mango, and avocado.

There were 20 regencies that were central areas for keprok development in NTT province. Timor Tengah Selatan (TTS) regency contributed up to 23% to total production of keprok, and it was chosen to be the first central area for keprok variety development called keprok SoE (JKS). This was the only variety developed in TTS at that time; and since 1998 the variety was stated as the pledge commodity in the provincial and regency level. It contributed up to 60-75% for the income of the keprok farmers. Such contribution, by looking at the agro-ecological, economical, and social-cultural sides, was deservedly developed. Then it needed attention from the government side to seriously develop the keprok variety, indicating that keprok commodity is very important, that it was one of the sources of regional economy, as a source of local labor utilization, as well as regional competitiveness power.

The keprok productivity in NTT was only 16 kg obtained from a keprok tree. That was still below the national average, i.e. 95 kg from a tree (BPS, 2009), very far below its potential productivity of 250 kg obtained from a tree or 69 ton per hectare. It was assumed that such low productivity and quality was due to inefficient production process and less professional keprok farmers. That all had motivated (the researchers) to do study on: (1) to what extent the use of the available technology had determined economic condition of JKS farmers at agro-climate zone of highlands and lowlands based on the size of their farming areas; (2) how JKS farming productivity and efficiency was improved in such highlands and lowlands based on the size of their farming areas; (3) how the capability of farmers was improved to do JKS farming professionally in such highland and lowland based on the size of their farming areas; (4) what policy is necessary to increase productivity and efficient production of JKS at the specific farming area zone.

In short, this research therefore was to: (1) analyze and describe the economic condition of JKS farming aims; (2) measure the efficiency level of JKS production technology; (3) determine any factors that motivate or cause technical efficiency and inefficiency, that in turn recommended how capability of farmers was improved to do JKS farming professionally; and (4) recommended a policy in how to improve technical efficiency of production, productivity, capability of farmers, and to develop the grade of JKS farming in highland and lowland in Timor Tengah Selatan regency.

II. RESEARCH METHOD

The research applied multi-stage cluster random sampling method to determine the location (the regency, zone, district, example village) and farmer examples, and was done in 12 village examples selected from 6 central districts of JKS exploration in highland and
lowland in Timor Tengah Selatan regency, Nusa Tenggara Timur province. The primary data were obtained from 360 farmer examples (180 farmers per distributional zone of 254 with the farming size < 1 hectare, and 106 farmers having farming size ≥ 1 hectare) by applying survey questionnaire. Meanwhile, the secondary data were obtained from BPS and related institutions. The study applied stokastik frontier production function of translog to measure technical efficiency and inefficiency of JKS farming and factors affecting the efficiency and inefficiency, which was more flexible than others, for it had estimation coefficient of second order terms and interaction between the input variables (Battese, 1992; Greene, 2000). The model of stokastik frontier production function to estimate the level of technical efficiency (TE) of SoE keprok farming was specified as follow:

\[
\ln Y_{ik} = \beta_{0k} + \sum_{j=1}^{4} \beta_{jk} \ln X_{ijk} + 0.5 \sum_{j=1}^{4} \sum_{s=1}^{3} \beta_{jsk} \ln X_{jsk} \ln X_{sik} + \theta_{ik}D_{ikhk} + V_{ik} - U_{ik} \tag{1}
\]

where \( Y_{ik} \) is the amount of SoE keprok production (in kg); \( X_{1} \) is amount of productive JKS trees; \( X_{2} \) is age (year) of productive JKS trees; \( X_{3} \) is amount of compost (in kg); \( X_{4} \) is amount of family labor (HOK); \( D_{1} \) is dummy germ or seed (1 is for the one that uses grafting germ and 0 for non-grafting germ); \( V_{i} - U_{i} \) is error term (\( V_{i} \) is external technical inefficient effect that is not modeled and \( U_{i} \) is internal technical inefficient effect (in the model); \( i \) is farming samples (\( i = 1, 2, ...N_{i} \)); \( j \) is input type (\( j = 1, 2, ..., 4 \)); \( h \) is the amount of dummy variable (\( h = 1 \)); \( k \) is group (zone and farming size (1, 2)); \( \beta \) and \( \theta \) is the parameter used to estimate. For the unbiased parameter estimation method, the Maximum Likelihood Estimation (MLE) is used. The technical efficiency is the actual output ratio toward frontier output Coelli, 1995 dan Coelli, et al. (1998).

The technical inefficiency measurement method used in this research refers to the technical inefficiency model of Battese dan Coelli (1995) and Coelli, et al. (1998). The \( u_{ik} \) variable used to measure the effect of technical inefficiency is assumed free (but not identical) which is not negative, and it has half normal distribution with the mean \( \mu \) and variants \( \sigma_{u}^{2} \) or \( N(\mu, \sigma_{u}^{2}) \). The value of \( u_{ik} \) variable is the result directly obtained from FRONTIER 4.1 program. Mathematically, the technical inefficiency effect model is formulated as follow:

\[
u_{ik} = \delta_{0k} + \sum_{l=1}^{5} \delta_{lk} z_{lk} + \sum_{m=2}^{4} \omega_{mk} D_{mk}
\]

where \( u_{ik} \) is technical inefficiency value automatically obtained through the FRONTIER 4.1 program; \( z_{1} \) is formal education of farmers (in year); \( z_{2} \) is experience of farmers of SoE keprok farming (in year); \( z_{3} \) is contact with field official (number of contacts in 2008 – 2009); \( z_{4} \) is age of farmers (in year); \( z_{5} \) is age square of farmers (in year); \( D_{2} \) is dummy source of other incomes (1 is for farmers who have other income and 0 for those who do not); \( D_{3} \) is dummy selling method (1 is for those who sell by using price system of per kg and/or lumpsum when harvest time, and 0 for those who sell by using future-sale system per kg
The equation model (1) and (2) are separately applied for the whole samples as well as per zone samples of agro-climate in highland and lowland and the size of the farming areas. For the purpose of consistency, the estimation of production function and inefficiency function parameters (equation (1) with (2)) is simultaneously done by applying FRONTIER 4.1 program (Coelli, 1992 dan Coelli, 1996). The absolute value as the result of efficiency and inefficiency analysis show the level of technology use of JKS production. The determinant factors of inefficiency as well as types of JKS development policy are descriptively and qualitatively analyzed and discussed. Meanwhile, to calculate the production elasticity partially this study follows the manual recommended by Greene (2000) and Wollni (2007).

Hypothesis Testing

All parameters and variants were estimated by using MLE. At a certain significance level (5% or 10%) the criteria of one-sided generalized likelihood ratio (LR-test) test was used as shown by the following equation formula:

\[
LR = -2 \left\{ \ln \left( \frac{L(H_0)}{L(H_1)} \right) \right\} = -2 \left\{ \ln[L(H_0)] - \ln[L(H_1)] \right\} \tag{3}
\]

where L (H₀) and L (H₁) are vaues of likelihood function of of nol alternative hypotheses. H₀ is accepted if \( LR > \chi^2 \) and H₀ is not accepted if \( LR < \chi^2 \). If the the testing result of H₀: \( \gamma = \delta_1 = \delta_2 = ........... = \delta_8 = 0 \) is accepted, means the effect of technical inefficiency is not found in the production function model.

III. RESULT AND DISCUSSION

The condition of how JKS production input of example farmers is used is shown by Table 1. Their income average during harvest season of 2009 – 2010 is Rp 4150 357.5 per 0.92 in highlands while Rp 920 425.0 per 0.44 in lowlands. The overall income average is Rp. 2512 674.5 per 0.66 ha. The income inequality between the farmers is very high, that is, between the minimum of Rp -598 285.71 and the maximum of Rp 8558 303.57 per 0.92 ha per farmer per year. The total farmers of negative income in the highlands and lowlands are respectively 1.7% and 28.3%, and their total is 15%. The opportunity of increasing incomes of the SoE keprok farmers in the highlands and lowlands is very high, at respectively 99% and 98.3%, and their total is 99% against their potential income. The low income of farmers is due to the low productivity of land (8.4 kg per tree in the highlands; 4.0 lowlands, and 6.9 in total) as a result of technical inefficiency of SoE keprok production.
Table 1. Statistical Summary of Variables Used in Frontier Model of JKS Production in TTS

<table>
<thead>
<tr>
<th>Notasi</th>
<th>Variable</th>
<th>Highland</th>
<th></th>
<th>Lowland</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Max</td>
<td>Min</td>
<td>Mean</td>
</tr>
<tr>
<td>Y</td>
<td>Production (kg)</td>
<td>451,3</td>
<td>1215</td>
<td>123,0</td>
<td>111,3</td>
</tr>
<tr>
<td>X1</td>
<td>Number of productive Trees</td>
<td>57,7</td>
<td>265</td>
<td>12,0</td>
<td>27,9</td>
</tr>
<tr>
<td>X2</td>
<td>Age of productive plants (year)</td>
<td>14,45</td>
<td>21,7</td>
<td>7,0</td>
<td>11,94</td>
</tr>
<tr>
<td>X3</td>
<td>Compost (kg)</td>
<td>7,1</td>
<td>60,0</td>
<td>2,0</td>
<td>2,2</td>
</tr>
<tr>
<td>X4</td>
<td>Family Labor (HOK)</td>
<td>12,7</td>
<td>53,7</td>
<td>8,3</td>
<td>5,4</td>
</tr>
<tr>
<td>D1</td>
<td>Grafting Seedlings (germs) (dummy)</td>
<td>0,97</td>
<td>1,0</td>
<td>0,0</td>
<td>0,93</td>
</tr>
</tbody>
</table>

3.1 The Empirical Model of Frontier Stokastik Production Function of SoE Keprok

The level of technical efficiency of farming production tangerines SoE and its determinants were investigated by using the 360 farmer examples selected from 12 villages in six districts in highlands and lowlands in Timor Tengah Selatan regency, the province of Nusa Tenggara Timur. The data used were of the cross section. The data were analyzed by applying the approach commonly used or recommended in stochastic frontier production that is translog models with computer package Frontier 4.1. The results of the analysis are listed in Table 2.

Table 2. Parameter estimation and t ratio of production Function Model of Stokastik Frontier
The technical efficiency of Mandarin Keprok SoE dryland farming system in West Timor, East Nusa Tenggara Province, Indonesia

Table 2 shows the estimation results that the value of the generalized-likelihood ratio (LR) of the stochastic frontier production function model is greater than table value distribution of \( \chi^2 \). The ratio value statistically is real or evident at \( \alpha = 5\% \) for all of the analysis bases, i.e. total, within zone, and size of farming areas. This means that all the stochastic frontier production function in the study area can explain the efficiency and technical inefficiency of farmers during production process of keprok. The cause of inefficiency at the lowlands with the farming size of \( < 1 \) ha is lower if compared to that of highlands of bigger farming size. This is indicated by \( \gamma \) value which is smaller when compared with other analytical units. The \( \gamma \) parameter estimation is the ratio of the variance of technical efficiency (\( u_i \)) toward total variance (\( e_i \)) with the obtained value within 0.70 to 0.97. Statistically the obtained value is significantly different form null at \( \alpha = 5\% \) for all analysis units. This shows that 70\% to 97\% of the product variation among the respondent farmers was caused by differences in technical efficiency; and the 30\% and 3\% is caused by stochastic effects such as climate, pest and modeling errors.

The sign and the bigness of the estimated parameters obtained are what to be expected. The estimated coefficient values of all variables are positive, except the value of age variable of productive plants. This shows a positive relationship between the factors of the technical production with production amount of the SoE keprok. The increase use of the technical production factors will increase the production of SoE keprok either in total, between the zones, and in the various farming sizes.

In total, it is known that all the production function variables significantly affect farmers' production limit of respondents, except the number of productive trees. The use of grafting seedlings in the highland areas is an important factor for the production increase of SoE keprok. It is interesting that in the highland zones, only the grafting seedlings show significant affect. The production factors like JPP, compost and family labor, despite having a positive relationship with the production of SoE keprok, do not show significant affect. The estimated coefficient value of all production factors is very small and not significant, except the UTP. The same trend occurred also in lowlands. The analysis results on the farming size \( \geq 1 \) ha showed that all variables significantly affected the production frontier of the respondent farmers, except the use of compost and labor.

The calculation result of partial elasticity of production (Table 2) shows that labor gives a greater effect on production JKS compared with JPP and compost, except for the

<table>
<thead>
<tr>
<th>TK</th>
<th>0.44</th>
<th>0.75</th>
<th>1.66</th>
<th>1.20</th>
<th>0.59</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to scale</td>
<td>1.24</td>
<td>1.72</td>
<td>2.80</td>
<td>1.93</td>
<td>2.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variant Parameter:</th>
<th>( \sigma^2 )</th>
<th>( \gamma )</th>
<th>Log-Likelihood</th>
<th>LR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.263</td>
<td>13.58*</td>
<td>-66.91</td>
<td>23.45*</td>
</tr>
<tr>
<td></td>
<td>0.270</td>
<td>6.96</td>
<td>-108.5</td>
<td>21.03*</td>
</tr>
<tr>
<td></td>
<td>3.12*</td>
<td>3.67</td>
<td>-229.7</td>
<td>21.3*</td>
</tr>
<tr>
<td></td>
<td>0.508</td>
<td>10.24*</td>
<td>-169.1</td>
<td>21.9*</td>
</tr>
<tr>
<td></td>
<td>2.04*</td>
<td>0.75</td>
<td>-19.18</td>
<td>35.6*</td>
</tr>
<tr>
<td></td>
<td>0.366</td>
<td>5.76*</td>
<td>0.970</td>
<td>0.270</td>
</tr>
<tr>
<td></td>
<td>2.48*</td>
<td>0.66</td>
<td>0.366</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>0.81</td>
<td>0.77</td>
<td>0.66</td>
<td>0.59</td>
</tr>
</tbody>
</table>

*: nyata pada \( \alpha = 5\% \); **: nyata pada \( \alpha = 10\% \).

JPP: Jumlah pohon produktif (Number of Productive Trees); UTP: Umur tanaman produktif (Age of Productive plants); TK: Tenaga kerja keluarga (Family labor); D: Variabel dummy (Dummy Variable).
farming size of ≥ 1 ha. Compost provides a small effect on the production of JKS since the quantity and quality of the compost used is still very low. The figures reflect the economic reality of JKS farming in dry land areas in West Timor. The amount of elasticity of production factors is > 1 (increasing returns to scale). This indicates that the farmer is currently increasing in its production, which in the long run they can decrease production costs per unit of output of JKS farming in dryland areas

The number of productive plants. What is meant by productive plant is JKS plants at aged of ≥ 5 years. The estimation results presented by Table 2 in the front indicate that the frontier production elasticity of this variable significantly affects JKS production as shown by its greater value because of wider size of farming areas. The farmers are said still rational if they want to increase the number of productive trees, mainly for farming size of ≥ 1 ha. However, in total, the production response to productive plant is very inelastic. The same trend occurred also in farming size smaller (<) than 1 ha, in the highlands or in lowlands. The SoE keprok farming in the location where this research was conducted was operated in critical dry lands that in fact require changes in technology of how to enhance fertility for the purpose of high productivity. The traditional farming system shows a fact that in a land unit there is a high JKS variation plants (both productive and non-productive).

Age of productive plants. Citrus plants aged of 5 to 20 years or more are categorized as productive plants. The average age of productive plants is 14.5 years. Oranges starts to produce the first at the age of 5 years and they start to decline at the age of over 17 years. The older the orange plants are, the less efficient they are (negative impact). The information of this variable will also encourage farmers to whether he will do replanting (replanting) or not in the next season. The research results show that, in total, this variable is negatively relates to and significantly affects the production of SoE keprok. When the results of the analysis are partially observed at each zone, the age of productive plants negatively and insignificantly affect both zones of developing JKS. Meanwhile, for the farming size of < 1 ha, this variable shows a negative relationship and significant affect.

Compost. This variable only shows significant affect in total analysis units. Compost has a small effect on all analysis units except for the analysis of bigger farming size over 1 ha. The efficiency response toward the the use of compost by the farmers is bigger in line with the increase of farming area cultivated. The use of compost has a minor effect on the production since the amount and quality of compost used by farmers is very low if compared with the standard operating procedures that have been made by the Department of Agriculture of NTT (2009). The average use of compost of example farmers during the production season at the period of 2009-2010 is 7.1 kg per farmer or 0.2 kg per productive tree. This number is much lower when compared with 20 kg per productive tree, the recommended amount.

Labor. This variable only shows significant effect on the SoE keprok production on farming size smaller than 1 ha and in its total. But this production input shows insignificant influence (for the farming size over 1 ha) toward JKS production JKS if the family labor shares very large, even reaches 100%. Labor shshow no significant effect on JKS production at both highlands and lowlands.

The use of grafting seedlings. The effects of the use of grafting seedling toward the SoE keprok production is significant at α = 5% and 10% in all the units of analysis, except in lowland areas. The grafting seedlings used by farmers are not labeled (100%). The use of non-labeled seed does not guarantee healthy plants and high production. The seeds used by farmers for keprok planting that already showed more (70%) production until the year of
2009/2010 is of the farmers’ themselves and of the local breeders who are not certified as a breeders.

The distribution of technical efficiency of the model used is shown in Figure 1, 2 and 3. The results of previous studies (Kumbakar, 2001; Dhehibi, et al., 2007, Wollni, 2007) indicate that the index efficiency value of the analysis results is categorized quite efficient if greater than 0.7. By tracing the distribution of technical efficiency value per respondent farmer individual, it is found that in total there are 51% of the total respondent farmers who have been efficient or consistently have reached efficiency level greater than 70%. The number of efficient farmers in the highlands is far more (49%) compared with that of the lowlands (32%). When compared with that between the farming sizes, the number of quite efficient farmers is found more at the farming size of ≥ 1 ha, i.e. 78% and 39% on farming size of <1 ha.

Based on the average value of technical efficiency in five frontier production function model can be presented that by average the respondent farmers still have opportunity to gain a higher potential results even up to maximum results as obtained technically by most efficient farmers. In the short term, in total, the JKS farmers in the research area has an opportunity to increase production by 34%; while for the highland zone is by 33%, and for lowlands by 39%; for the farming size of < 1 ha is at 38%, and for ≥ 1 ha is at 23%; by applying the skills and cultivating techniques used by the most efficient farmers in each analysis groups.

![Diagram 1: Distribution of Technical Efficiency inter Agro-climate Zona](image1)

![Diagram 2: Distribution of Technical Efficiency in Total](image2)

![Figure 1: Distribution of Technical Efficiency inter Size of Farming (< 1 ha and ≥ 1 ha)](image3)
3.2 Sources of Technical Inefficiency Citrus Production Keprok SoE

Factors that affect the level of technical efficiency of respondent farmers were simultaneously analyzed by using model technical inefficiency effects of frontier stochastic production function. The estimation results of the model are presented in Table 3. The negative estimate coefficient showed a positive effect on technical efficiency. In total, the experience and methods of sales shows significant and positive effect on the level of technical efficiency of JKS production. The more experienced the JKS farmers are in dry farming areas, the higher the level of efficiency is. While the other sources of income shows negative and significant effect on technical efficiency of JKS production. The greater the income obtained from other sources (other than JKS farming), the more inefficient the level of technical efficiency of JKS production is. In the highlands all factors have positive affect on the efficiency, except the education factor of respondent farmers. The experience factor shows positive relationship and significant affect to the lowland zone with the farming size <1 ha. In the wider farming size, some variables, such as: experience, contacts with the field agricultural officials, and farmers' group membership relate positively and significantly. Meanwhile, education and age of the farmers show negative and insignificant relationship. This indicates that the variables are not important factors in increasing the efficiency of JKS farming. While the experience, KPPL and KKt are internal factors and important issues for JKS farming. The internal factors that are contrary to the theory, such as education and observation are as the results of uncertainty in decision making on JKS farming (Chambers, 1988). Meanwhile, SPL indicates whether or not the respondent farmers are serious in managing JKS farming. The farmers have high motivation if the JKS farming gives higher economic value compared to that of other sources of income in their household economic life. The contact frequency of farmers with the agriculture field official is relatively a little bit estimated to have caused insignificant affect on the JKS production in the study area.

Table 3. The Difference Explanation of Production Technical Efficiency of SoE Keprok

<table>
<thead>
<tr>
<th>Variabel (Parameter)</th>
<th>Inter Agro-climate Zone</th>
<th>Inter Farming Size</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>highland</td>
<td>Lowland</td>
<td>Total</td>
</tr>
<tr>
<td>Intercept (δ₀)</td>
<td>2.726</td>
<td>0.793</td>
<td>0.187</td>
</tr>
<tr>
<td>Education (δ₁)</td>
<td>0.188</td>
<td>0.917</td>
<td>0.060</td>
</tr>
<tr>
<td>Experience (δ₂)</td>
<td>-0.464</td>
<td>-1.4**</td>
<td>-0.352</td>
</tr>
<tr>
<td>KPPL (δ₃)</td>
<td>-0.202</td>
<td>-1.32**</td>
<td>0.168</td>
</tr>
<tr>
<td>Age (δ₄)</td>
<td>-0.114</td>
<td>-0.126</td>
<td>-0.018</td>
</tr>
<tr>
<td>KUP (δ₅)</td>
<td>-0.229</td>
<td>-0.402</td>
<td>0.037</td>
</tr>
<tr>
<td>SPL (δ₆)</td>
<td>-0.608</td>
<td>-1.6**</td>
<td>0.326</td>
</tr>
<tr>
<td>MP (δ₇)</td>
<td>-0.249</td>
<td>-1.4**</td>
<td>0.033</td>
</tr>
<tr>
<td>KKT (δ₈)</td>
<td>-0.287</td>
<td>-1.5**</td>
<td>0.039</td>
</tr>
</tbody>
</table>

*: nyata pada α = 5%; **: nyata pada α = 10%.

KPPL: Kontak Petugas Pertanian Lapangan (contact with field officials); KUP: Kuadrat umur petani (age quadrate) ; SPL: Sumber pendapatan lain (other income resources); MP: Metode penjualan (selling method) ; KKT: Keanggotaan Kelompok Tani (farmer group membership).
IV. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

There are at least three conclusions drawn from the findings and discussion formerly presented. First, the low income of the JKS farmers is the impact of inefficiency allocation of production inputs. Second, in general, JKS farming in areas of dry lands in West Timor is not efficient. The farmer respondents selected from the highlands is more efficient if compared with that of lowlands. The size of farming $\geq$ 1 ha has higher level of technical efficiency than that of $< 1$ ha. Third, the model of technical efficiency effect suggests that, in total, variables of experiencer, contact with field officials, other income sources, selling method, and farmer group membership are important and able to decrease or reduce the technical inefficiency of production of SoE keprok in West Timor.

4.2 Recommendation

The chance to increase JKS production efficiency is still open. Thus, the use of a higher quality of production inputs needs to be done with intensive assistance system by the field officials and through field school approach. The level of inequality of the individual farmer needs to be overcome by sharing their experiences, knowledge and skills among others. That is a good way to empower farmer groups as well as a means of information resources and services within the farmers. Increasing the level of JKS farming is also a need to increase technical efficiency of its production, since 71% of farmer respondents have land $< 1$ ha. The government need to formulate a program of development and expansion of planting area of JKS by preparing grafting seedlings labeled blue and other technological changes for farmers in the study area.

REFERENCES


