Technical Efficiency of Coconut Sugar Agroindustry in Pangandaran District, West Java Province, Indonesia

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Abstract
The study was carried out with the aim to determine the factors that influence production, the level of technical efficiency achieved, and the factors that influence technical inefficiency in coconut sugar agroindustry in Pangandaran District, West Java Province, Indonesia. Research samples were 100 agroindustry. Data analysis was carried out using a stochastic frontier production function where data processing used Front41 with TE effect model. The results of the study show that raw materials, firewood and labor have a positive and significant effect on coconut sugar production in Pangandaran District. The efficiency level achieved ranges from 0.59 to 0.99 with an average of 0.70. Education, experience, family size, and number of tapped coconut trees have a significant effect on technical inefficiency; while age has no significant effect.

Keywords: Coconut sugar, Agroindustry, Technical Efficiency, Technical Inefficiency

1. Introduction
The sugar industry development program based on coconut plants is very appropriate and strategic to be developed in centers of coconut plants in all regions of Indonesia (Supomo, 2007). One potential of agroindustry in Pangandaran District is coconut sugar agroindustry. More than 70 tons of coconut sugar are sent to big cities on the island of Java (Anonymous, 2015). Coconut sugar agroindustry has a relatively simple technology characteristic, labor intensive and production does not depend on market demand but based on the availability of raw materials (Maharani, et al., 2011).

Some studies show that the factors that influence technical inefficiency are: education, age, off farm income (Diamini, et al, 2010), education, experience (Taru, et al, 2011), family income, education, experience (Saptana, 2012), age, education (Hussain, et al, 2014), farming size, education, age, extension (Supaporn, 2015).

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2. Research Methodology
The study was carried out in Pangandaran District, West Java Province, Indonesia. Pangandaran District consists of 10 subdistricts, namely Parigi, Cigugur, Cijulang, Cimerak, Kalipucang, Langkaplancar, Mangunjaya, Padaherang, Pangandaran, and Sidamulih. The whole subdistrict has coconut sugar agroindustry. Each subdistrict took 10 coconut sugar agroindustry, so the sample size was 100.

The study utilized stochastic production frontier, and the model is defined by:

\[
\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \nu_i - u_i 
\]

where: \( Y \) = production (kg), \( X_1 \) = raw material (liter), \( X_2 \) = firewood (m³), \( X_3 \) = labor (workday), \( \beta \) = coefficient of regression, \( \nu_i \) = random error, and \( u_i \) = technical inefficiency effects in the model.

Inefficiency model was defined to estimate the influence of some farmer's socio-economic variables on the technical efficiency of the farmers. The model is defined by:

\[
\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 D_1 + \delta_6 D_2 + \delta_7 D_3 
\]

where: \( \mu_i \) = technical inefficiency, \( Z_1 \) = age (years), \( Z_2 \) = education (years), \( Z_3 \) = experience (years), \( Z_4 \) = family size (persons), \( Z_5 \) = number of tapped coconut trees (trees), \( \delta \) = regression coefficient.

3. Results and Discussion
Factors that influence production and the level of technical inefficiency in coconut sugar agroindustry in Pangandaran District can be seen in Table 1.
Table 1. Maximum Likelihood Estimates and Inefficiency Functions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>0.4457</td>
<td>0.0763</td>
<td>5.8391a</td>
</tr>
<tr>
<td>Raw material</td>
<td>$\beta_1$</td>
<td>0.3550</td>
<td>0.0547</td>
<td>6.4948a</td>
</tr>
<tr>
<td>Firewood</td>
<td>$\beta_2$</td>
<td>0.1772</td>
<td>0.0351</td>
<td>5.0521a</td>
</tr>
<tr>
<td>Labor</td>
<td>$\beta_3$</td>
<td>0.6875</td>
<td>0.1333</td>
<td>5.1566a</td>
</tr>
<tr>
<td><strong>Inefficiency function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$\delta_0$</td>
<td>-0.0309</td>
<td>0.2660</td>
<td>-0.1160</td>
</tr>
<tr>
<td>Age</td>
<td>$\delta_1$</td>
<td>-0.1550</td>
<td>0.1359</td>
<td>-1.1401</td>
</tr>
<tr>
<td>Education</td>
<td>$\delta_2$</td>
<td>-0.2539</td>
<td>0.1318</td>
<td>-1.9257c</td>
</tr>
<tr>
<td>Experience</td>
<td>$\delta_3$</td>
<td>0.0495</td>
<td>0.0339</td>
<td>1.4583d</td>
</tr>
<tr>
<td>Family size</td>
<td>$\delta_4$</td>
<td>-0.1182</td>
<td>0.0619</td>
<td>-1.9085c</td>
</tr>
<tr>
<td>Number of tapped coconut trees</td>
<td>$\delta_5$</td>
<td>0.4099</td>
<td>0.1180</td>
<td>3.4721a</td>
</tr>
<tr>
<td><strong>Sigma square</strong></td>
<td>$\sigma^2$</td>
<td>0.0036</td>
<td>0.0006</td>
<td>6.2521a</td>
</tr>
<tr>
<td><strong>Gamma</strong></td>
<td>$\gamma$</td>
<td>0.3961</td>
<td>0.1548</td>
<td>2.5582b</td>
</tr>
</tbody>
</table>

Log likelihood function $= 151.7384^*$
LR Test $= 13.7595^*$

$a,b,c,d$ significant at 1.5,10,15%

Table 1 shows that raw materials have a positive and significant effect on coconut sugar production. The more raw materials used, the more coconut sugar is produced. The results of this study are consistent with the results of research from Suyudi et al (2007), Indarwati (2009), Rusmiati et al (2011), and Wibisono et al (2012).

Firewood has a positive and significant effect on coconut sugar production which shows that the more use of firewood, the more coconut sugar production. The results of this study are in accordance with the results of research from Aliudin et al (2011). Coconut sugar agro-industry in Pangandaran District uses firewood as fuel in the process of producing coconut sugar.

Labor has a positive and significant effect on coconut sugar production which shows that the labor used in the process of coconut sugar production is a workforce that has competence in the process of producing coconut sugar. The results of this study are in accordance with the results of research from Anggiadita and Sujarwo (2016), and Ali and Jan (2017).

Age has a negative but insignificant effect on technical inefficiency which indicates that increasing age causes more technically efficient. The results of this study are in accordance with the results of research from Ali and Jan (2017), and Ali et al (2013).

Education has a negative and significant effect on technical inefficiency which shows that the higher the level of education causes the higher level of technical efficiency achieved. The results of this study are in accordance with the results of research from Suharyanto et al (2013), Kune et al (2016).

Experience has a positive and significant effect on technical inefficiency which shows that increasing experience will increase technical efficiency. The results of this study are in accordance with the results of research from Isyanto et al (2013), Rivanda et al (2015), and Burhansyah (2016).

Family size has a negative and significant effect on technical inefficiency which indicates that increasing family size will increase technical efficiency. The results of this study are in accordance with the results of research from Yoko et al (2014), Thamrin et al (2015), and Yusuf and Isyanto (2017).

The number of tapped coconut trees has a positive and significant impact on technical inefficiency which indicates that the more number of tapped coconut trees will increase technical efficiency. The results of this study are in accordance with the results of research of Maemunah and Isyanto (2017) which shows that the greater the business scale, the higher the level of technical efficiency achieved.

The level of technical efficiency achieved in the coconut sugar agroindustry in Pangandaran District ranges from 0.59-0.99 with an average of 0.70. Frequency distribution of the level of technical efficiency can be seen in Table 2.
Table 2. Frequency Distribution of Technical Efficiency

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.41 – 0.50</td>
<td>2</td>
<td>2.00</td>
</tr>
<tr>
<td>0.51 – 0.60</td>
<td>20</td>
<td>20.00</td>
</tr>
<tr>
<td>0.61 – 0.70</td>
<td>38</td>
<td>38.00</td>
</tr>
<tr>
<td>0.71 – 0.80</td>
<td>18</td>
<td>18.00</td>
</tr>
<tr>
<td>0.81 – 0.90</td>
<td>16</td>
<td>16.00</td>
</tr>
<tr>
<td>0.91 – 1.00</td>
<td>6</td>
<td>6.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

minimum = 0.59; maximum = 0.99, mean = 0.70

Table 2 shows that the efficiency level is 0.71 as much as 60%, while that above 0.71 is 40%. This shows that most of the agro-industries are not technically efficient in using production factors. Illustration of the level of technical efficiency achieved is presented in Figure 1.

Figure 1. Technical Efficiency

4. Conclusion
Raw materials, firewood and labor have a positive and significant effect on coconut sugar production in Pangandaran District. The efficiency level achieved ranges from 0.59 to 0.99 with an average of 0.70. Education, experience, family size, and number of tapped coconut trees have a significant effect on technical inefficiency; while age has no significant effect.

5. Recommendation
Non-formal education through extension and technical assistance needs to be done in an effort to improve technical efficiency in the coconut sugar agroindustry in Pangandaran District. It is necessary to increase the number of coconut trees tapped through credit assistance from the government.

6. Acknowledgement
Authors say thank you to Directorate of Research and Community Service, Directorate General of Strengthening Research and Development, Ministry of Research Technology and Higher Education, Republic of Indonesia, for funding this research through a scheme of Penelitian Dosen Pemula of the fiscal year 2018.

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