THE INTEGRATION OF THE AGRICULTURAL SYSTEM CASSAVA INDUSTRIALIZATION IN TRENGGALEK REGENCY, EAST JAVA PROVINCE, INDONESIA

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Abstract: Agribusiness systems are the main driver of agricultural industrialization; thus, there must be coordination and integration between interrelated subsystems. The study aims to analyze the relationship between the agribusiness subsystems to encourage the success of cassava industrialization. Respondents were chosen using the simple random sampling technique and 200 people were involved in the study. The analytical method was the Tobit Regression Model. The results of the study show that the agribusiness Sub-system must involve various agribusiness subsystems. Industrialization of agriculture is said to be successful with the linkages between the subsystems, including the input subsystem, production subsystem, processing subsystem, marketing subsystem, and supporting subsystem.

Keywords: Integration, Agribusiness System, Cassava, Industrialization, Tobit Model

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INTRODUCTION

Indonesia is one of the second largest cassava producers in Asia-Pacific. In 2012, the national cassava production reached 24 million tons with a production area of 1,129,688 hectares (Gabriel, Wijaya and Kumalaningsih, 2014). In addition, in 2012, the export value of fresh cassava was US$ 169,000 and US$ 17,683,000 for processed cassava; and it increased to US$ 632,000 for fresh cassava and US$ 11,989,000 for processed cassava in 2016 (Agricultural Statistics, 2017). As such, cassava is potential to help maintain food security, improve nutrition, and create wealth (Sanni, Alenkhe et al., 2007). Cassava has an important role in ensuring food security, especially among the poor (Ogaraku, ME and Ekine, 2014), besides being developed for industrial use such as animal feed and flour-based products (Howeler and Hershey, 2001). Therefore, cassava and its products have become an important factor in developing the industry as well as in creating a source of income for farmers, for agricultural processors, and for traders (Falade and Akingbala, 2008).

Rural agricultural households process cassava as one way to develop socio-economic strategies and policies needed to stimulate the growth of industrialization in rural agricultural products (Oluwasola, 2010). Cassava farmers provide raw materials for better resource allocation and this enables them to be more efficient and effective at work (Anyaequunam, Okoye et al., 2010). Low levels of infrastructure development and market integration as well as poor productivity of cassava...
causes high transaction costs; this has been providing an advantage in increasing small-scale agricultural processing (Goletti and Samman, 2000). Another cause is the technology used, which is not effectively helping farmers to improve their income yet. The not optimal use of natural resources and human resources, the competitive market cassava deals with other raw materials, as well as the quantity and quality of cassava products for various purposes have also added to high transaction costs. (Roja, 2008; Dixon and Semakula, 2008).

Cassava is still considered an inferior commodity that the government has not provided a stimulus for the development of locally based food like this (Hapsari et al, 2013). This is worrying considering the potential cassava has to help the country get foreign exchange (Nkang, Udom and Obang, 2006). Cassava is resistant to all conditions and can be processed for food and feed at affordable prices as well as for industrial raw materials as it produces carbohydrates not inferior to rice or corn. (Ezedinma, Kormawa et al, 2007; Tonukari, 2015).

The agricultural product processing industry is an economic activity using technology for conservation and for agricultural products that it can be used as food, feed, fiber, fuel, or industrial raw materials (Kachru, 2010). The industry has the potential and important role in reducing poverty and maintaining economic growth (Watanabe, Jinji and Kurihara, 2009). Therefore, the scope of the industry includes all from the harvest time until the material reaches its final use in the desired forms, packaging, quantity, quality, and prices; the industry is expected to facilitate the relationship between agribusiness and small farmers.

The problem of cassava industrialization is a long chain of marketing, inefficient supply of raw materials, low skills for risk taking due to lack of institutional support, and so on. Cassava industrialization does not yet have an efficient system because most are small and medium industries (Mukhopadhyay and Chakrabarti, 2016). Therefore, the purpose of this study is to review the integration of upstream to downstream aspects of the agribusiness system in the industrialization of cassava.

RESEARCH METHODS

Sampling and Study Area

Respondents in this study were chosen using a simple random sampling technique. The unit studied was individuals working as a cassava farmer dealing with agribusiness sector policies. The completeness of the data needed in the study also included questionnaires and literature review.

The population in this study was 8,562 cassava farmers. The sample size was determined using the Slovin formula and a sample of 200 cassava respondents was obtained. The study site was Trenggalek Regency in East Java Province, Indonesia. This research was conducted from August to December 2018.

The Tobit Model

The examination of significance regression model and parameters is performed to examine the linkages between agribusiness Sub-system toward the success of industrialization of cassava using Tobit regression model. Tobit regression model is generally as follows (Fair, 1977):

\[ Y_i^* = \beta + \beta_i X_i + \ldots + \epsilon_i, \quad i = 1, 2, \ldots, N \]  (1)

The regression Tobit model in specific function as follows (Ramasamy et al., 1998):

\[
\begin{cases}
Y_i = \beta_i X_i + \epsilon_i, & jika \ Y_i^* > \bar{Y} \\
Y_i = 0, & jika \ Y_i^* \leq \bar{Y}
\end{cases}
\]

Where:

- \( Y_i \): The dependent variables that can be observed but it is censored in the measurement of income in order to determine the success and development of the industrialization of cassava.
- \( Y_i^* \): The dependent variable which shows that the success and development of the industrialization of cassava can or can’t be observed directly. Therefore, the income is above average if \( Y_i^* > 1 \) and revenue below the average if \( Y_i^* \leq 0 \)
- \( \beta_i \): Vector parameters estimated
- \( \beta_i X_i \): The scale of the product of two vectors
- \( X_i \): Independent vector
- \( \epsilon_i \): The error normally distributed and independent with value of 0 and variant constants \( \sigma^2 \)
- \( N \): Total observations

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Tobit regression model was used to identify the elements of the Association to encourage agribusiness Sub-system the success of industrialization of cassava as follows:

a. Input sub-system Model

\[ Y^*_i = \beta_1 + \beta_2 X_{1.1} + \beta_3 X_{1.2} D + \beta_4 X_{1.3} D + \beta_5 X_{1.4} D + \varepsilon_i \]

Where:
- \( Y^*_i \): Income is affected by input
- \( \beta_1 \ldots \beta_5 \): The Regression coefficient
- \( \varepsilon_i \): The error normally distributed
  \[ \sim N(0, \sigma^2) \]
- \( X_{1.1} \): The total of seed cassava (tree)
- \( X_{1.2} \): Dummy use fertilizer (0 = don’t use fertilizers; 1 = use fertilizer)
- \( X_{1.3} \): Dummy use pesticide (0 = don’t use pesticide; 1 = use pesticide)
- \( X_{1.4} \): Dummy use farming tools (use tool such as hoes, sickle, rake and others=1; not using the tools = 0).

b. The production Sub-system Model

\[ Y^*_i = \beta_1 + \beta_2 X_{2.1} D + \beta_3 X_{2.2} + \beta_4 X_{2.3} + \beta_5 X_{2.4} + \varepsilon_i \]

Where:
- \( Y^*_i \): Income affected by production subsystem
- \( \beta_1 \ldots \beta_5 \): The Regression coefficient
- \( \varepsilon_i \): The error normally distributed
  \[ \sim N(0, \sigma^2) \]
- \( X_{2.1} \): Dummy variable farmers cultivating cassava (monocultur = 0; intercropping = 1)
- \( X_{2.2} \): Quantity production (Rp/kg)
- \( X_{2.3} \): Cultivated area cassava (Ha)
- \( X_{2.4} \): The distance to the market (km)

c. Processing Sub-system Model

\[ Y^*_i = \beta_1 + \beta_2 X_{3.1} D + \beta_3 X_{3.2} D + \beta_4 X_{3.3} D + \beta_5 X_{3.4} + \beta_6 X_{3.5} D + \beta_7 X_{3.6} + \varepsilon_i \]

Where:
- \( Y^*_i \): Income affected by the processing subsystem
- \( \beta_1 \ldots \beta_7 \): The Regression coefficient
- \( \varepsilon_i \): The error normally distributed
  \[ \sim N(0, \sigma^2) \]
- \( X_{3.1} \): Dummy variable of working capital
  (0 = No working capital; 1 = the working capital)
- \( X_{3.2} \): Dummy variable saving raw materials
  (saved = 1; direct selling =0)
- \( X_{3.3} \): Dummy variable processing technology
  farmers (mechanical = 1; traditional = 0)
- \( X_{3.4} \): Production capacity (ton/ha)
- \( X_{3.5} \): Dummy variable supply of cassava
  farmers (continuous =1; No continuous = 0)
- \( X_{3.6} \): The price of raw materials (Rp/Kg)

d. Marketing Sub-system model

\[ Y^*_i = \beta_1 + \beta_2 X_{4.1} D + \beta_3 X_{4.2} + \beta_4 X_{4.3} + \beta_5 X_{4.4} D + \varepsilon_i \]

Where:
- \( Y^*_i \): Income affected by marketing sub-system
- \( \beta_1 \ldots \beta_5 \): The Regression coefficient
- \( \varepsilon_i \): The error normally distributed and
  independent with value of 0 and variant constants \( \sigma^2 \)
- \( X_{4.1} \): Dummy variables are processed (0 = No processed; 1 = processed of flour, srowol and others)
- \( X_{4.2} \): Production of refined (Rp/kg)
- \( X_{4.3} \): The price selling of refined (Rp/Kg)
- \( X_{4.4} \): Dummy variable the total processed
  market (0 = No; 1 = other)

e. Supporting Sub-system Model

\[ Y^*_i = \beta_1 + \beta_2 X_{5.1} + \beta_3 X_{5.2} + \beta_4 X_{5.3} D + \varepsilon_i \]

Where:
- \( Y^*_i \): Income affected by supporting sub-system
- \( \beta_1 \ldots \beta_4 \): The Regression coefficient
- \( \varepsilon_i \): The error normally distributed
  \[ \sim N(0, \sigma^2) \]
- \( X_{5.1} \): power extension (people)
- \( X_{5.2} \): Training (minute)
- \( X_{5.3} \): Dummy variable use credit (use credit = 1; No use credit= 0)

RESULTS AND DISCUSSION

Tobit regression model consists of 2 independents variables of the production Sub-system and processing Sub-system against income are explained as follows.

Production Sub-system on income

Economic activities in the production Sub-system are produce primary agricultural products. The indicator of the production Sub-system consists of dummy cultivation methods, cassava production, land area, and distance to the market. Table 1 shows that the variable has significant effect on the income level.
Table 1. Production Sub-system on income in Trenggalek Regency 2019

<table>
<thead>
<tr>
<th>Variable</th>
<th>MLE</th>
<th>Standard Error</th>
<th>Probability Change in $\frac{\partial F(z)}{\partial x}$</th>
<th>Marginal Effect $\frac{\partial E_y}{\partial x}$</th>
<th>Change among adopters $\frac{\partial E_y}{\partial x}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3225055</td>
<td>0,03</td>
<td>-0,18</td>
<td>-158154</td>
<td>-113035</td>
</tr>
<tr>
<td>Cultivation method (dummy)</td>
<td>1148557*</td>
<td>0,03</td>
<td>0,06</td>
<td>563419</td>
<td>402686</td>
</tr>
<tr>
<td>Cassava production</td>
<td>313*</td>
<td>40,23</td>
<td>0,17x10^-4</td>
<td>154</td>
<td>110</td>
</tr>
<tr>
<td>Land area</td>
<td>-225</td>
<td>234,89</td>
<td>0,12x10^-4</td>
<td>-110</td>
<td>-79</td>
</tr>
<tr>
<td>Distance to the market</td>
<td>-1,04*</td>
<td>149,33</td>
<td>0,58x10^-4</td>
<td>-512</td>
<td>-366</td>
</tr>
</tbody>
</table>

Log likelihood: -1352
Censored observ: 75
Uncensored observ: 125
Pseudo $R^2$: 0,05

Source: Primary Data 2019, (processed)
Note: * significant at 5%

Table 1 Tobit regression test showed that the production system with indicators of how to cultivate method (dummy), cassava production, and distance to the market had a very significant effect on the level of income. Farmers mostly use intercropping, as to minimize the risk of decreasing prices of cassava; yet, some practice a monoculture system. Other studies Awerije, Brodrick (2014) show that the monoculture and intercropping system in Nigeria results in relatively low productivity at 40%, so there is still a 60% chance to be improved by using available inputs, technology, and counselors. The cassava production and the cultivation method has a very significant effect on the level of income, as previous studies also suggest Girei et al (2013); Nkang dan Ele (2014). The distance to the market has a significant effect on income level. However, good transportation facilities will help to reduce production cost and indirectly reduce prices. The conclusion that production Sub-system has opportunity to increase the income of cassava farmers in Trenggalek Regency.

Processing Sub-system on income

Processing subsystems are economic activities that process primary agricultural product into processed product, both initial products and final products. Indicators in the processing Sub-system include the use working capital (dummy), storing cassava (dummy), use machine (dummy), production cassava, amount of cassava (dummy), and price of cassava. Table 2 shows that the variable has significant effect on the income level.

Table 2 explains that in the use of working capital has a probability change value of 0.08 which means that every additional 1% working capital will decrease the chances of changing revenue by 8%. Neonbota and Simon (2016) explain that capital has a real impact on income generation, it is interpreted that every increase in the capital increases farmers’ income.

Nandi et al. (2011) describes the capital directly related to the production of cassava output so that cassava's revenue is increased. The value of the probability of changing the shelf power of cassava raw material by 0.11 is interpreted each additional 1 day of cassava saving power will increase the chance of 11% revenue change. Because the industry does not have to wait for harvest to do production, so continuity of raw materials is maintained. In addition, cassava plants should not be stored within 30 days because it can reduce the quality of cassava (Sunghongwises et al., 2016). The use of the machine has a probability value of 0.03 means that every additional 1 machine unit for the processing of cassava will increase the chances of change of income by 3%. In line with Ajieh and Chucks Research (2014), the adoption of technology will increase revenues, but the adoption constraints there is limited information in the utilization of technology and increase production costs.

Production capacity with probability value 0.22x10^-5 that every addition of 1 kg of cassava production will increase the chances of change in
revenue by 2, 2x10-4%. In line with research Leasa et al., (2018) where the development of business is significant and positive influence on its production capacity. This means that the higher the active in processing, the higher the production capacity. The value of the change in the amount of cassava probability of 0.11 means that each additional 1 kg of cassava supply will increase the chances of changing revenue by 11%. Suvittawat et al. (2014) explained that proper planning is needed in the process of procurement of raw materials as it will increase production efficiency and reduce production costs, simultaneously will maintain the consistency of supply of raw materials to the factory. The price of cassava with a probability change value of 0, 12x10-3 that with each additional price of cassava 1% will lower the chance of a revenue change of 0.012%. Another study of Omolara et al., (2017) implies that the price of cassava raises revenues, because the processed industry will search for a number of cassava available from farmers thus causing the price of cassava to increase and farmer's income also increases.

### Table 2. Processing Sub-system on income in Trenggalek Regency 2019

<table>
<thead>
<tr>
<th>Variable</th>
<th>MLE</th>
<th>Standard Error</th>
<th>Change in Probability</th>
<th>Marginal effect</th>
<th>Change among adopters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constanta</td>
<td>862776</td>
<td>0.31</td>
<td>-0.02</td>
<td>772187</td>
<td>-140835</td>
</tr>
<tr>
<td>Use working capital</td>
<td>-4081667*</td>
<td>0.22</td>
<td>-0.08</td>
<td>-3653104</td>
<td>666268</td>
</tr>
<tr>
<td>Storing Cassava</td>
<td>544680*</td>
<td>0.27</td>
<td>0.11</td>
<td>4873004</td>
<td>-888759</td>
</tr>
<tr>
<td>Use machine (dummy)</td>
<td>-1459559*</td>
<td>0.26</td>
<td>0.03</td>
<td>1306310</td>
<td>-238250</td>
</tr>
<tr>
<td>Production cassava</td>
<td>107*</td>
<td>29.56</td>
<td>0.22x10^-5</td>
<td>96</td>
<td>-18</td>
</tr>
<tr>
<td>Amount of cassava</td>
<td>5212447*</td>
<td>0.25</td>
<td>0.11</td>
<td>4665155</td>
<td>-850850</td>
</tr>
<tr>
<td>Price of cassava</td>
<td>-5600*</td>
<td>561.89</td>
<td>-0.12x10^-3</td>
<td>-5012</td>
<td>914</td>
</tr>
<tr>
<td>Log likelihood: -1367</td>
<td>1.25</td>
<td>F(Z)= 0.9</td>
<td>σ = 8.755.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Censored observ: 75</td>
<td>1</td>
<td>F(Z)</td>
<td>2.08e^8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncensored observ: 125</td>
<td>1</td>
<td>[F(Z)/σ]</td>
<td>-0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudo R²: 0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $F(Z) = \text{Normal density function.}$  
$F(z) = \text{Scale factor for marginal effect or total marginal effect (cfd).}$  
$[F(z)/\sigma] = \text{Fraction of mean probability of agribusiness system.}$  
$[E(y^*)] = \{1-Z \cdot f(Z)/f(Z) \cdot F(Z) / F(Z) - F(Z) / 2\} = \text{The fraction of total effect due to the effect above the limit.}$  
$\partial F(z)/\partial x = \text{The change in the probability of income for every unit change in the explanatory variable. This is equivalent to } f(z)\beta/\sigma.$  
$\partial Ey/\partial x = \text{The marginal effect of the explanatory variables against the expectation value } E(y) \text{ of the income. This is computed by multiplying } \beta \text{ and } F(z).$  
$\partial Ey^*/\partial x = \text{The effect of variable change clarity on the value expectations above average income. This was computed by multiplying } [E(Y^*)] \text{ and } \beta.$

### CONCLUSION

Industrialization of cassava is the linkage between the production Sub-system and the processing subsystem. On the production sub-system the biggest opportunity to increase revenue is the cultivation way, in addition to the largest opportunity processing Sub-system to increase the income of dummy power save raw materials. The importance of agribusiness subsystems are interconnected, in order to successfully go to the Cassava industrialization area. But cassava farmers in Trenggalek district are still at the level of the production subsystem, so that the industrialization of cassava has not happened. This is because the network of agribusiness systems require knowledge to increase the added value in farming cassava.

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