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The determinants of cassava profitability and cost under the ranchers' coordinated effort with the rising cassava processors: A contextual analysis in East Lampung, Indonesia

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Abstract

This study identified the impact of the emerging cassava processors to the cassava production in Sukadana, East Lampung, Lampung, Indonesia. 80 cassava farmers in Sukadana were surveyed to know their relationships with processors, production cost structures and cultivation practices. Regression analysis showed that harvesting age was a critical factor to determine the cassava yield and price in the study area. Three types of farmers were observed in the study area, namely, farmers joining collaboration with a foreign food company, collaboration with local processors and farmers who have no collaborations with processors. The technical support provided by the emerging processing companies which tried to break into the current oligopsonistic cassava market had a positive impact to optimize the plant management. The increasing demand for cassava induced by biofuel production would attract more companies to the processing business and the tightening competition among the companies would motivate the companies' investment in supporting activities for farmers. This in return would contribute to the farmers' welfare through improved profit of cassava production. These findings can be used as practical information for formulating effective cassava marketing policies in the study area.

Keywords: Biofuel, farmers' welfare, oligopsonistic market.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a woody plant with a height between 1 - 3 m, and most parts of the plant can be used for food and industrial purposes (Pakpahan and Gunawan, 1992). Introduced in the 1650s with imported roots from Mexico, cassava has acquired a significant place in the agricultural system of South-East Asia (Mougeot and Leveng, 1990). Cassava production in Indonesia makes up about 30% of the production of Asia and the Pacific, and Indonesia is the forth largest cassava exporter in the world. The total amount of production is almost the same as Thailand's, the world largest cassava exporter, however Indonesia's cassava export is less than 10% of Thailand's (based on FAOSTAT, http://faostat.fao.org/). Production can be observed all over the country but the major production area is located in the islands of Sumatra and Java. Lampung Province in Sumatra is the largest production area. In 2005, it produced 4,768 thousand tons of cassava, 25% of the total production in Indonesia (BPS, 2006). East Java Province in Java is another production area. It produced around 20% of the national output.

In many developing countries, cassava is thinly traded and/or traded informally. The lack of established marketing channels and poor infrastructure and market information has been among the main factors constraining trade in cassava (FAO and IFAD, 2000). The most commonly identified bottleneck to develop cassava market opportunities was the lack of a reliable supply of cassava. In Zimbabwe, there was also a lack of good planting material. Lack of equipment, mechanization and power were also mentioned on several occasions as

bottlenecks to developing the industry.

Some less frequently mentioned bottlenecks, but perhaps as important as those above, are infrastructure, consumer acceptance, education and training of key actors in the industry, and good weather for drying cassava (IFAD and FAO, 2004). Although there is no government intervention in the cassava market in Indonesia, the cassava market has some oligopsonistic characteristics. This situation is more typical in Lampung than East Java. In East Java, the number of cassava processors is high and the size of each processor's production is relatively small. Therefore, the cassava market in East Java can be considered competitive, making marketing more efficient (Pakpahan and Gunawan, 1992). On the other hand, in Lampung, the number of cassava processors is limited and this makes the cassava market in Lampung oligopsonistic (Pakpahan and Gunawan, 1992).

Under such imperfect market conditions, the farmers are forced to accept unfavorable treatment by the processors. For example, in most cases when the buyer weighed the cassava sold by the farmers, the farmers were not allowed to see the measuring procedures. Another example relates to pricing the cassava is that the processors usually reduce the cassava price according to the deviation from a specified standard such as starch content (called *rafaksi*). However, many processors don't disclose the standard and how they test the cassava to check its quality. In order to overcome the unfavorable market conditions for cassava farmers, the local government of Lampung Province implemented the development of the Community's Tapioca Processing Unit or ITTARA (Industry Tepung Tapioka Rakyat) in 1997. The project aimed to diversify cassava market channels through establishing small scale cassava processing units. Though the ITTARA program had a positive impact on the price of cassava, many tapioca processing units of ITTARA have gone bankrupt because of managerial incompetence and inadequate monitoring and control (Siregar et al., 2006).

It should be noted that recent changes of global and local economic conditions provide cassava farmers with a unique opportunity to break the bottlenecks of current cassava production. The rapid integration of East Asian economy which is typified by the implementation of FTAs (Free Trade Agreements) will provide good opportunities for expanding regional trade. Before the Second World War, Indonesia (then the Netherlands East Indies) was by far the world's greatest exporter of processed cassava (Nelson, 1984). Though Indonesia's exports were surpassed by Thailand, the potential of cassava product exports is still large, which is shown by the lower DRC (Domestic Resource Cost) in the starch making process, indicating a comparative advantage in the world market (Nelson, 1984).

The other noteworthy movement is an increasing demand for biofuels. Biofuels are liquid fuels for vehicles, which are made from various kinds of biomass. The most common types of biofuels are bio- ethanol made from carbohydrates and bio-diesel made from vegetable oil. Food crops which are rich in carbohydrates or oil are used as raw materials for biofuel. Cassava is one of the promising raw materials for bio-ethanol due to its high yield of starch, adaptability to low-fertility soil and drought resistance. The Government of Indonesia formulated a roadmap for biofuel development in 2006. The roadmap is targeting a 10% reduction in the country's consumption of petroleum-based fuel by 2010, by developing 5.25 million hectares of energy crop plantation including cassava, oil palm, sugar cane and Jatropha (*Jatropha curcas*) (Tim Nasional Pengembangan BBN, 2006).

Various companies have shown interest in producing biofuel, and the emergence of the newcomers could be an opportunity to breakthrough the current oligopsonistic cassava market.

The emergence of the newcomers in cassava production area like Lampung is anticipated to motivate the conventional cassava processors to change their current business practices which are sometimes disadvantageous to the farmers. Considering this background, the present study first describes the features of the processor- farmer collaboration observed in the study area. Second, it identifies the factors which determine the cassava yield and price in the study area. Finally, it identifies the impact of the emerging cassava processors to the cassava production.

MATERIALS AND METHODS

Sukadana district, East Lampung Regency, Lampung Province was selected as a study area. Cassava production in Lampung is spread in the whole province and East Lampung is one of the production centers. It is new regency which separated from Central Lampung Regency in 1999 according to Law No.12, 1999. The office of East Lampung Regent located in Sukadana district. Sukadana is around 50 km from Bandar Lampung, the provincial capital, connected with a paved road. The road condition is relatively good and it takes around 2 h from Bandar Lampung to Sukadana by car. The total area of Sukadana district is 76 thousands hectares, 14% of East Lampung Regency, and the altitude of Sukadana is around 25 m above sea level (BPS Kabupaten Lampung Timur, 2006). There are 16 villages (11 *Desa* and 5 *Kelurahan*) in the area. Sukadana was selected as a study area because the estimated cassava planted area in Sukadana in 2007 was 13,285 hectares (Pemerintah Kabupaten Lampung Timur, 2006), which was the largest in East Lampung Regency. In addition, a foreign food processing company had implemented a technical collaboration project in Sukadana since 2005. It seemed useful to observe the effect of the project.

A total of 80 cassava farmers in Sukadana were surveyed from February - March, 2007. The sampling method was random sampling. Information was collected from each farmer concerning their household structure, income, operational farm land, cultivation history, cassava production costs and relationships with processors. Descriptive analyses and statistical analyses were applied to the data. Regression analysis was performed to estimate a cassava yield determination function, a cassava price determination function and a harvesting age determination function. The exchange rate of

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Table 1. Characteristics of processors - farmers collaborations in the study area.

	Type I Colaborations with a foreign food company	Type II Collaborations with local processors	Type III No-collaborations with processors
Cassava price determination	Defined by market price	Defined by market price. Sometimes not very transparent.	Defined by market price
Floor price	Partly available	Available	Not available
Access to credit	Available with no interest	Available with interest	Not available
Source of input	No restriction	Compulsory purchase from the processors	No restriction
Channels of sales	No restriction	Compulsory sales to the processors	No restriction
Other services	Technical support. Tractor service with lower price	Technical support (not all the processors)	Not available

Source: Interview survey, 2007.

Indonesia rupiah was US$ 1 = 9,150 rupiah at the time of the survey period (March, 2007).

RESULTS AND DISCUSSION

The processor farmer collaboration in the study area

The characteristics of the processor-farmer collaborations in the study area are shown in the Table 1. A foreign food company, whose major products were synthetic seasonings and used cassava as one of the ingredients, implemented a collaborative project to support the cassava farmers in the study area (Type I in the Table 1). The project (hereinafter called "cassava project") started in 2005. The company provided a project fund and technical support. The project was implemented under the close collaboration among the company, the local governments and the farmers. A part of the fund was used to establish "revolving funds" in each farmers' group formulated by the farmers who joined the project. The fund was used to purchase fertilizers before the planting season and the member farmers could receive fertilizers without payment. The amount of fertilizers was decided by the planting area of the farmers with reference to the standard dosage (ZK^+ , a local brand of potassium fertilizer containing 34% K_2O at 200 kg per hectare, urea at 200 kg per hectare and rock phosphate at 150 kg per hectare) recommended by the company. After the harvest, each farmer should return the money which amount was equivalent of the fertilizers received, determined by the market price at the harvest season. Though no interest was charged, the amount of reimbursement might fluctuate because the reimbursement was defined by the fertilizer price in the harvest season, not in the planting season. If the fertilizer price increased between planting and harvesting, then the farmers needed to pay back at a higher price. Farmers were also requested to pay an administration fee to the group they belonged, the value of which was determined by each group. In one group, the fee was 1 rupiah per kg of cassava. In the other group, the members pay 10,000 rupiah per hectare of planted land. The extension staffs in the local extension office of the local government were hired by the company as technical advisors and the farmers were able to get technical advice for their production and marketing. The farmers could also use a tractor service with a subsidized cost. The company donated one tractor to the project and the members of the farmers' group were able to use the tractor by only paying the operational cost (fuel and wage of operators), which was cheaper than the other tractor services in the area. The project was carried out as a Cooperate Social Responsibility (CSR) project of the company and the farmers didn't have any financial obligation to the company such as an obligation to sell their harvest to the company.

The above mentioned conditions provided by the company were quite attractive to the farmers comparing to the support given by the local cassava processors in the study area. Some surveyed farmers joined collaboration with the local processors called "partnerships (*kemitraan*)" (Type II in the Table 1). This partnership was a kind of contract farming in which the processors provide input (mainly chemical fertilizer such as urea and SP36, a kind of superphosphate containing 36% P_2O_5) to the farmers before the planting season. The farmers should reimburse the cost of the inputs when they sold cassava to the processors. The nominal interest rate was usually around 0.7% per month. However, the input price determined by the processors was 3 - 17% higher than the market price. Therefore, the real interest was possibly much higher than the nominal interest. Interest rates differed from one agent to another. One of the surveyed farmers reported that he borrowed 120,000 rupiah in the last cropping season for purchasing fertilizer and returned 150,000 rupiah after eight month, a loan in which the annual interest was 38%. The farmers had obligations to sell all the harvested cassava to the processors which provided the loan. The floor price was assured by the processors, which was 280 - 290 rupiah per kg at the time of the survey. When cassava price was low, the floor price would be useful to support farmers' income.

However, considering the actual farm gate price of cassava (above 300 rupiah per kg at the time of the survey), this option was not very attractive for the farmers. Moreover, some farmers complained that the practices of some processor to determine the cassava price were not very transparent. Cassava price could fluctuate according to the quality, especially the content of starch. For example, a processor in the study area increased the cassava price by 4% for every 1% excess of the standard starch content (25%). On the other hand, the company reduced the cassava price by 4% for every 1% decrease of the starch content below the standard. The processor usually measured the starch content every time when they receive cassava from farmers. Some processors didn't show their measuring process to farmers and it was suspicious if the disclosed cassava weight and starch content was accurate.

Factors determining cassava yield and price

The profiles of the surveyed households and the cost structures of cassava production are shown in the Table 2 and the Table 3 respectively. Cassava income formed 43% of the total household income and 57% of the total agricultural income of the surveyed households. The average cassava yield of the surveyed households (21.8 ton per hectare) was higher than the average yield in Lampung Province, which was 19.0 ton per hectare in 2005 (BPS Lampung, 2006). The higher observed yield reflects the fact that the study area is the cassava production center of the province.

The estimation result of cassava yield determination functions is shown in the Table 4. Cassava yield was explained by material cost and harvesting age (the period from planting to harvesting) positively. Labor cost didn't affect cassava yield, which is controversial with the earlier studies such as Onu and Edon (2009), which identified positive contribution of labor to cassava yield. It is known that the harvesting age affects both the yield and the starch content of cassava. Cassava can be harvested at the age of 6 months, but the best harvesting age is 10 - 12 months, with variation according to variety (Pakpahan and Gunawan, 1992). If the farmer harvests too early, cassava is still young, and the starch content and yield are low (Hershery et al., 2001). According to observations in the study area, the farmers tended to harvest their cassava earlier than the recommended period due to the urgent need for cash income. Therefore it is rational that the estimated cassava yield determination function showed that yield was explained by harvesting age positively. Material cost was used as a proxy of input use in this study, which consisted of fertilizers, pesticides and seedlings, because the variety of input was very large among the respondents and it was difficult to adopt an amount of input as a factor to determine the yield. For example, the majority of the respondents used chemical fertilizer as a nutrient source of their crops. On the other hand, a significant number of farmers used rock phosphate as a source of phosphate instead of SP36. Some farmers didn't apply chemical fertilizers at all while they use a liquid organic fertilizer made from food factory liquid waste. It is rational that yield was explained by material cost since the fertilizer application in the study area was still low comparing to the recommended dosage and the plants would response positively to the increase

Table 2. Profiles of surveyed households.

	Mean	STD
Sample size	80	
Number of HH[a] members (person)	4.3	1.3
Education of HH head (year)	7.9	3.1
Operational farm land (ha)	1.32	0.94
Total Income (1,000rupiah/year)	11,848	6,835
Cassava production (1,000rupiah/year)	5,197	3,046
Rice production (1,000rupiah/year)	1,347	2,350
Other crops (1,000rupiah/year)	798	2,728
Farm labor (1,000rupiah/year)	1,181	1,624
Other agricultural income (1,000rupiah/year)	661	1,477
Non-agricultural income (1,000rupiah/year)	2,666	3,937

[a] HH = Household; [b] STD = Standard deviation. Data source: Interview survey, 2007.

Table 3. Cassava production cost and returns (1,000 rupiah/ha).

	Mean	S T D[a]
Sample size	80	
Harvested area (ha)	0.91	0.54
Yield (ton/ha)	21.8	5.5
Harvesting age (months)	9.3	1.3
Cassava price (rupiah/kg)	303	50
Output (1)	6601	1969
Current inputs:		
Seedlings	210	100
Fertilizer	721	330
Pestiside	100	72
Subtotal (2)	1,031	339
Labor costs:		
Hired	1427	765
Family	388	469
Subtotal (3)	1,815	774
Others(4)	623	739
Total costs (5)=(2)+(3)+(4)	3469	1196
Operator's surplus (6)=(1)-(5)	3132	1744

[a] STD = Standard deviation. Data source: Interview survey, 2007.

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Table 4. Estimation results of cassava yield determination function.

	Standardized coefficient	T-value
In Labor cost [a]	-0.073	-0.686
In Material cost [b]	0.257	2.394 *
In Harvesting age [c]	0.287	2.616 *
Adjusted R^2	0.149	
F-value	5.600	
Number of samples	80	

[a] Total labor cost including farm labor; [b] Total material cost including seedlings, fertilizers, pesticides and other materials; [c] Harvesting age (months) in the respondents' fields; * Significant at 5% level. Data source: Interview survey (2007).

Table 5. Estimation results of cassava price determination function.

	Standardized coefficient	T-value
In Labor cost [a]	0.393	3.771 *
In Material cost [b]	-0.060	-0.607
In Harvesting age [c]	0.222	2.144 *
Partnership with processor [d]	-0.144	-1.296
Cassava project [e]	0.238	2.167 *
Adjusted R^2	0.310	
F-value	8.103	
Number of samples	80	

[a] Total labor cost including farm labor; [b] Total material cost including seedlings, fertilizers, pesticides and other materials; [c] Harvesting age (months) in the respondents' fields; [d] Respondent joining partnership (kemitraan) with a processor = 1, not joining partnership = 0; [e] Respondent joining the project = 1, not joining the project = 0; * Significant at 5% level. Data source: Interview survey (2007).

of the input.

The estimation result of cassava price determination function is shown in the Table 5. Labor cost, harvesting age and participation into the cassava project significantly affected cassava price. It is rational that harvesting age positively affected cassava price, because the cassava price is usually determined by the starch content. Though labor cost and participation into the cassava project showed positive effect to cassava price, both didn't show significant effect to yield. It is supposed that the intensified farm management could contribute more to the cassava root quality, rather than the yield. Sahat et al. (1992) classified the processes of price formation in cassava marketing into free transaction (a direct bargaining between farmers and traders), contract transaction (farmers receive credit from traders and are obliged to repay in the form of cassava) and un-free transaction (a price formation between farmers and a large factory, in which farmers are not given the opportunity to bargain). Even in the free transaction where farmers can do a bargaining process, their bargaining power is very weak. This observation is consistent with the finding in the present study that partnership with processor, which obliges farmers to sell their cassava to the creditors, didn't show the significant effect to the cassava price.

Harvesting age was a crucial factor in the cassava production because it determined both yield and price. The estimation result of cassava harvesting age determination function was shown in the Table 6. Participation into the cassava project and cassava income ratio significantly affected the harvesting age. As mentioned, the participants into the cassava project could receive technical supports by the extension staffs. Since the extension workers recognized the shorter harvesting age as a constraint factor of cassava production in the area, their extension works to optimize the plant management were supposed to be effective to increase the harvesting age of the project participants. Cassava is planted as a supplementary crop with upland rice and corn as the main crop (Nasution et al., 1992) and according to the interview to the extension staffs, farmers usually pay less

Table 6. Estimation results of cassava harvesting age determination function.

	Standardized coefficient	T-value
Partnership with processor [a]	0.136	1.154
Cassava project [b]	0.270	2.285 *
Cassava income ratio [c]	0.239	2.092 *
Adjusted R^2	0.135	
F-value	5.101	
Number of samples	80	

[a] Respondent joining partnership (kemitraan) with a processor = 1, not joining partnership = 0; [b] Respondent joining the project = 1, not joining the project = 0; [c] Ratio of household income from cassava production to total household income; * Significant at 5% level. Data source: Interview survey (2007).

attention to cassava than other main crops. It is supposed that this tendency would be stronger for the farmers who get less income from cassava production. On the other hand, the farmers who rely more on cassava as income source would pay more attention to their plant management and would try to maximize the yield and starch content. This is supposed as a reason why the cassava income ratio showed positive impacts to the harvesting age.

Conclusion

As mentioned before, the cassava market in Indonesia, especially in Lampung Province, has been dominated by several large scale cassava processors. In spite of the efforts by the government such as the ITTARA project, it has been difficult to change the oligopsonistic characteristics of the market to improve the welfare of cassava farmers. In the present study, it was observed that harvesting age was a critical factor to determine cassava yield and price. It was also clear that the technical support provided by the emerging processing company had a positive impact to optimize the plant management. It can be concluded that the increasing demand for cassava will attract more companies to the processing business.

In the study area, it was observed that an ethanol company based in East Java province was constructing a new ethanol plant in East Lampung Regency, Lampung Province. Since the company was a newcomer in

Lampung, they were carrying out various efforts to attract the local cassava farmers in order to secure sufficient raw material for the new factory, which had a processing capacity of 1,000 ton of cassava per day. The company already succeeded in concluding production contracts with 1,000 farmers within a 50 km radius of the factory. The total production area of the farmers was around 1,200 hectares. The company offered farmers not only similar support provided by the other processors such as assuring a cassava floor price and providing credit, but also various other services to attract the farmers. They were disseminating grafting seedlings which graft two cassava varieties. The upper part of the seedlings is Karret variety (a variety of tree cassava, *Manihot glazovii*), which has a high photosynthesis ability, while the lower part is Kasetsart variety (a variety of true cassava, *Manihot esculenta*), which has a good root quality. The technical support included monthly meeting with contract farmers and providing the growing guidelines which included ploughing three times, fertilizer application (basal and twice topdressing) and manure application. Their credit covered the cost of seedlings, pesticide, tractor service fees and fertilizer. They also gave the farmers price incentives for high quality cassava. These services were supposed to be the major reasons why the company could conclude the contracts with so many farmers within a limited time.

With the tightening competition among the companies, the positive impacts of the support to the farmers like the cassava project to the cassava production in the study area will raise the companies' confidence that the investment in supporting activities for farmers will result in an improved output, thus ensuring it is worthwhile for the companies to take these costs. This in return will contribute to the farmers' welfare through improved profit of cassava production.

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