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RESEARCH ARTICLE

Technical Production Efficiency of Small-scale Cassava Processed in Rural Lampung, Indonesia

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ABSTRACT
This study aimed to explore the performance of production efficiency of local cassava processed in rural. The field survey conducts at the center of local cassava processed in Lampung Province, Indonesia. Sampling method design by the case study approach. Data analysis used descriptive statistical analysis and frontier production efficiency. Based on the investigation, the frontier production efficiency showed that the local cassava processed operated under the potential production. It was not efficient yet. The value of the mean efficiency was 0.59. It denoted that the cassava home industries only achieved 59% of the potential frontier production. The sector performed under development because they operate lower than the potential output. This fact also informed that the cassava home industries still can increase productivity. The productivity could enhance by adequate input allocation and technology improvement. Strengthen the local cassava processed is necessary to improve their productivity. The revenue structure analysis showed that local cassava was beneficial as a source of family income in rural higher than regional minimum wages. The existence of the local cassava processing has the potential to employ rural labor.

INTRODUCTION

Food and beverage agroindustry at Lampung's GRDP contributes 12.50%, with a growth of 4.2% year^{-1}. The workforce involved in large agroindustry enterprises reached 48,735 people in 2014 from 222 existing companies (Anonymous, 2016). Food agroindustry provides a multiplier effect on the local economy through increased value addition, diversity of income sources, availability of business, increasing welfare, and ensuring food security for households, and reducing poverty.

Agroindustry that develops in rural areas hah generally carried out by micro, small and medium scale business actors (SMEs). The SMEs have become the primary driver of the local economy in Indonesia (92%). They are the leading entity in the people's economic empowerment, mainly in labor absorption and income enlargement. However, the development of small-scale agroindustry in rural areas generally faces complex problems related to access to capital, markets, technology, and institutions. It means that local cassava processed industries are still under developed. It has resulted in the sector's contribution not being optimal in increasing labor absorption, increasing income, and rural communities' welfare. Therefore, SMEs' performance to be able to survive and enhance the capacity is essential. At the farm, the level is necessary to design the diffusion and adoption of new technology to improve productivity. Empirical studies indicate that the potential of new technologies has not been adopted due to inefficient decision-making processes at farms. The most critical factor responsible for not fully utilizing the possibility of new technologies was management practices (Sajjad and Khan, 2013).

In the downstream line of foodstuff agroindustry, it is essential to direct the people-scale processing industry's growth through women farmers' empowerment in the rural agroindustry chain. SMEs of rural agroindustry will become a necessity chain to increase the source of farmer's income. Promotion and incentives for the development of foodstuff processing businesses need to be continuously carried out by stakeholders. The existence of SMEs in poverty alleviation is essential. The poor are still over 13%, with human development index of 66.94, indicating that some people, especially in rural areas living on an agricultural basis, are not prosperous (Anonymous, 2015). Relevant stakeholders undeniably often overlook rural communities. They also faced the lack of access to capital, no assistance from skilled trainers, and access to narrow land (smallholders and farm laborers) were a part of the low income that welfare farmers couldn't reach yet (Fitriani et al., 2014).

The cassava agroindustry faced business management and marketing because sustainable business orientation and market networking have not been built yet. They have not met the market needs at the level of volume, quality, time, and place continuously (Novia et al., 2013; Pahlevi et al., 2014; Rangkuti et al., 2015). They also face the limitations of modern production technology, the quality of human resources is not sufficient (Caesarina and Estiasih, 2016). On the capital side, micro-small scale business has not been accessing by the finance institution, so the business scale is not economic (Fitriani et al., 2010; Ismono et al., 2011; Indarwanta and Pujiastuti 2011).

The various production group producers have potential access to an array of production technologies. Depending on specific circumstances, they may choose a particular technology, such as regulation, the environment, production resources, and relative input prices. The technology production gap is the difference between the best technology and the chosen sub-technology, i.e., the group-specific frontier (Huang et al., 2014). The efficiency measurement of production has been an important research area over the last two decades (Hossain et al., 2015). As a fundamental tool, Technical Efficiency (TE) is for seeing which determinants slow down product development. Frontier methods calculate the firm's distance to the best practice industry frontier. The efficient frontier is estimated directly through the observed input(s) and output(s) of each firm (Chen et al., 2015). Furthermore, this study aimed to explore the technical efficiency of local cassava processed performance through the frontier method.

MATERIALS AND METHODS

The field study was conducted from February to May 2017 at the local cassava center in Pesawaran, Central of Lampung, East of Lampung, and Pringsewu Districts (Fig. 1). The location of Small-Medium Enterprise (SMEs) displays in Table 1.

The case study considers the performance of the SMEs and the representation of the cassava proceed form. The sampling method was conducted by a case study approach involving 59 home industries. The information related to the SME's producer treasure as snowball sampling from the retail/grocery trader, intermediary trader until the production center location.

Data analysis used descriptive statistical analysis and frontier production efficiency. The technical efficiency of production of each respondent can be calculated by comparing actual production (Qa) with frontier production (Qf). If the actual production of the respondent farmers compared to reaches technical efficiency is less than 100%, it means that the actual production of the business can still be increased until it reaches its potential production (Sajjad and Khan, 2013; Manongga, 2014; Chen et al., 2015; Iliyasu et al., 2016; Nakamura, 2017). The Stochastic frontier model was used as defined by Hossain et al. (2015):

$$\ln Y_i = \beta_o + \sum_{i=1}^{n} \beta_j \ln X_{ji} + E_i \text{.......................................(1)}$$

Information:
Yi: Physical production (kg)
X1: material (kg)
X2: machinery (IDR)
X3: worker (man day work)
X4: Technology adoption (dummy; 1=semi modern; 0=traditional)
β_o : Intercept
β_j : Parameter coefficient
Ei: Error

Each farmer's frontier output is obtained by inputting actual production factor into frontier production function, ie:

$$Qf = ao + \sum_{i=1} bj\ Xji \text{..(2)}$$

The technical efficiency for each farmer calculate formula:

ET = Qa / Qf x 100% .... (3)

Information:
ET: Technical efficiency
Qa: Actual output
Qf: Output frontier

RESULTS AND DISCUSSION

Based on the treasury of cassava SCM's industries in Lampung, it revealed that Central Lampung was the most, represented by 37 SME's, Pesawaran represented by 16 SME's and East Lampung 6 SME's. The demographic information of cassava SME's displays in Table 2. On average, the owner categorizes in productive age. The education was an adequate and well experience.

Production function analysis was run by the stochastic frontier model. The result was formulated as follows:

Y = 0,094 + 0,763 X1 + 0,181 X2 - 0,145 X3 + 0,127 D
S = 0.623603 R-Sq = 72,1% R-Sq(adj) = 70,1%

Information:
Yi: Physical production (kg)
X1: material (kg)
X2: machinery (IDR)
X3: worker (man day work)
D: Technology adoption (dummy; 1=semi modern; 0=traditional)

Table 1: The location area of SME's processing cassava in Lampung

No	Product	Region/District	Sub-district
1	*Kelanting*	Pesawaran	Gedung Tataan
		Central Lampung	Negeri Katon
			Punggur
2	Chips	Pesawaran	Gedung Tataan
		Central Lampung	Punggur
		East Lampung	Way Jepara
3	Cracker (kerupuk)	Central Lampung	Kalirejo
4	Analog rice/Tiwul/beras siger	East Lampung	Way Jepara
		Central Lampung	Rumbia

Table 2: The demographic condition of cassava SME's industries (year)

	Average	Minimum	Maximum
Age	47.0	27.0	70.0
Education	7.5	3	15
Experience	14.7	1	40

Table 3: The coefficient variable of the cassava stochastic frontier model

Predictor	Coef	SE Coef	T	P	VF
Constant	0.095	0.7067	0.13	0.895	
X1	0.763	0.08750	8.72	0.000	1.920
X2	0.181	0.2396	0.75	0.454	1.478
X3	-0.145	0.1398	-1.04	0.305	1.366
D	0.127	0.2113	0.60	0.550	1.517

Table 4: Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	54.331	13.583	34.93	0.000
Residual Error	54	21.000	0.389		
Total	58	75.330			

Based on Table 4, the production function model of cassava SMEs was significant to explain by all the independent variables simultaneously. The variation of cassava processed production can be explained significantly by variable raw materials (X1), equipment (X2), labor (X4), and technology (D), while the rest is influenced by others factors out of the model. Based on the significance of partial influence analysis, the raw material variables are very significant. Based on the sign of variable coefficients, it is known that there was one variable that has a negative sign. The facts in the field could explain this phenomenon. Processed cassava is done by rural labor, generally women, with the high time variation. Generally, SMEs provide job access to neighbors, so consideration of social aspects in helping the surrounding influenced the labor decisions. This additional labor usage has not resulted in additional optimal output. Additional use of inputs results in an additional output with a lower trend.

The value of the elasticity of production (EP) was the summary of the coefficient variables. The sum of EP was 0.92659 or less than 1. Accordance to the value of Elasticity EP number 0.915, or EP <1 means that the

Fig. 1: Map indicating the research location.

local cassava processed industry is in a rational area for production (Region II) or in decreasing returns to scale position. In this area, production efficiency is technically possible achieved. This means that the cassava processed business runs on decreasing business return to scale. In additional conditions, the input causes additional products that continue to decline. Enterprises that operate on a range of business scales on decreasing return to scale, also indicate that production operations are inefficient. There was an excess of input allocation usage. It can also be seen from the amount of frontier efficiency value of each business actor on average only reach 59% (Table 5). However, because the cassava processed in rural areas prioritize the principle of mutual help and provide benefits, then still producers use labor which generally comes from the environment of relatives and nearest neighbors.

The grouping of the form of cassava products collected. The technical efficiency (TE) of the SME's firm was various within the product and the firms. The highest value of TE was reached by firm C1 (cracker), with the value attaint to 87%. Three firms performed more than 80%, i.e., O2 (opak) and Ch3 (chip). On average, the value of TE was different within the product. The value of TE for each firm showed that most of them were not-efficient yet. The high variation of TE value come up on cracker clusters with five firms were performed under 50% and then, followed by kelanting group with three firms. On average, the technical efficiency of the cassava cluster reached 59%. This value indicated that the cassava SMEs in Lampung operate at not optimum capacity yet.

Figure 2 showed the value of TE for each cassava product group on average. Cracker (kerupuk) and Opak were in similar technical efficiency conditions. The description of the technical efficiency of the firm

Table 5: Frontier technical efficiency of cassava cluster SMEs in Lampung

Firm	FTE	Firm	FTE	Firm	FTE	Firm	FTE
K1	70%	C1	87%	A1	41%	O1	28%
K2	59%	C2	65%	A2	44%	O2	86%
K3	59%	C3	38%	A3	59%	O3	73%
K4	65%	C4	69%	A4	71%		
K5	62%	C5	81%	A5	71%	Ch1	73%
K6	16%	C6	51%	A6	60%	Ch2	55%
K7	78%	C7	65%	A7	51%	Ch3	82%
K8	52%	C8	76%	A8	64%	Ch4	76%
K9	62%	C9	65%	A9	71%		
K10	40%	C10	65%				
K11	73%	C11	64%				
K12	51%	C12	67%				
K13	57%	C13	64%				
K14	28%	C14	64%				
K15	27%	C15	72%				
K16	58%	C16	58%				
K17	67%	C17	79%				
		C18	76%				
		C19	65%				
		C20	61%				
		C21	22%				
		C22	67%				
		C23	26%				
		C24	38%				
		C25	41%				
K: Klanting		C:Cracker		A: Analog rice		Ch: Chips	O=Opak

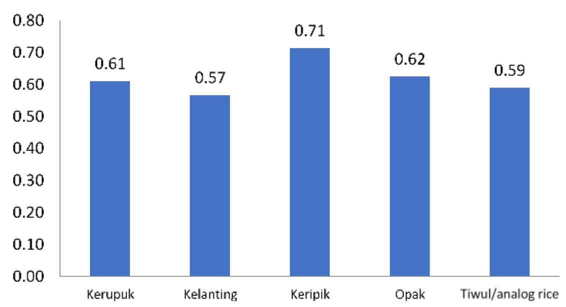

Fig. 2: Technical efficiency of local cassava processed.

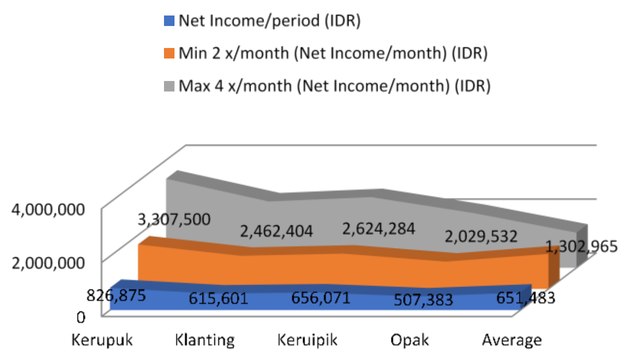

Fig. 3: Net income of local SMEs cassava processed.

informed the relation between input and output production. Optimum input allocation affected the optimum output. If the technical output efficiency is not reachable, it could link to a lack of input allocation and technology.

Factors influencing inefficiency are input data such as the soybean availability, production expenses, the width of production place, and the number of employees. Hence, the inefficient SMEs can refer to the efficient one-by lessening input data and improving or maximizing output data to be more efficient overall (Manongga, 2014). This condition was similar in the testing of returns to scale, that decreasing returns have been identified in 29.1% of cases. Some countries, such as Japan, France, Italy, and the Netherlands, found for all or almost all considered years. There was a tendency of decreasing returns becoming more widespread in more recent years (Growiec et al., 2015).

Supporting the local cassava processed is necessary to improve their productivity. Access to technology and also the processing method will become an option to achieve better performance. Agricultural development aims to strengthen agricultural communities' welfare through improved production systems, infrastructure, innovation, technology adoption, and reliable agricultural institutions. Efforts to increase agricultural productivity with the principle of orientation on rural society need to carry out. The ongoing economic activities involving the participation of all community members, the communities' results, and the implementation of economic activities under the leadership and supervision of the community are the prerequisites for the work of sustainable agriculture development programs. Based on these principles, the development of agriculture should continue to develop to increase the community's income and welfare by creating employment opportunities that involve the rural community as much as possible (Fitriani et al., 2015).

The association of farmer groups/women farmer association/cooperative/farmer's corporation institutions could arrange the price guarantee and sustainable market of products. The institution must mobilize and become the embryo of integrated rural bio-industry chains and integrated into the more extensive agroindustry market network (Fitriani et al., 2018; Trisnanto et al., 2017). Strengthening through the ongoing capital, technology, and market support to rural bio-industry actors is a key to the growth of rural income sources. The rural agroindustry's development is a gateway to the availability of job opportunities for the rural labor force, reducing unemployment and poverty (Fitriani et al., 2014).

Agroindustry plays an essential role in increasing the utility, absorption, and productivity of labor institutions and expanding marketing institutions' reach. Rural agro-industrial development requires traditional institutional transformation processes related to labor and marketing, especially in applying innovative postharvest technology to realize agro-based agricultural products (Elizabeth, 2010). The description of technology application on processing cassava could see in Table 5. Table 1 presented the information about machinery equipment that was applied to enhance cassava proceed productivity. Dominantly (86%), mechanical equipment application becomes developed at the production center of cassava processed products. They use to apply the equipment such as a grinder, mixer, slicer, press, stove, scale, and steamer for the production process.

The technology level categorizes as traditional and local machinery adoption. There was 14% of producers still lack access to modern equipment. The leading cause was limited in the capital. Machinery investment is expensive for rural households. The allocation of machinery investment was in the range IDR 1.3 – 5.1 million. The equipment on Klanting production was the highest, followed by Chip SMEs and crackers. Farmers perceived that modern mechanisms were more beneficial for their fields, but socio-economic impediments were playing a vital role in hindering the adoption of modern mechanized ideals (Ashraf et al., 2019).

On average, cassava chip industries have been sufficient at equipment investments. The equipment investment expenditure range is relatively closed each within them. The deep gap in equipment investment had faced by kerupuk, klanting, and opak SMEs. There was no sufficient capital to enhance their equipment technology. Some of them just processed cassava products as a side job. It was just a way to find income resource alternatives in rural. Labor in rural had been facing a problematic situation. The informal sector's rural labor conditions were treated more informally, including in rural agroindustry (Fitriani et al., 2017).

As a comparison, in 2015, the number of decent living needs in Lampung Province was IDR 1.442.898. The wage rate for informal agricultural workers is lower than the Lampung minimum-worthy living needs. Various districts in Lampung still provide a large amount of agricultural labor wage in the range of IDR 35,000 - 45.000 per day. The US $ exchange rate currently means that per capita income was less than 1 US $ or classified under the UN poverty line.

Agricultural development means an improvement in agricultural wage rates. The efforts to improve the agricultural sector's wage rates through the agricultural sector's increased fiscal spending are essential. Capital expenditure needs to focus on enhancing peasant resources' quality and opening new jobs in the farming sector, both labor-intensive and capital-intensive. On the other hand, the incentive stimulus for business actors in agriculture through the ease of permitting, tax incentives, easy access to credit from finance, and the expansion of domestic and international market networks will systematically increase investment in agriculture become an improvement (Fitriani et al., 2015). The revenue structure analysis showed that the cassava processing business was beneficial as a source of family income. The local food processing is the second source of rural income. The net income was around IDR 1.3 million. month^{-1}. Kerupuk was the most profitable. Follow by keripik (cassava chips), klanting, dan opak (Fig. 3).

An opportunity is open to new entrepreneurs in prospective market line networks. The market of processed products of cassava processed is still very wide open. The cassava processed business activity produces an economic multiplier for the actors involved. Government intervention to meet with economic (private) actors is a necessity. So far, the agricultural sector has received minimum attention, minus the development budget allocation, and the neglect and marginalization that caused the development and development of the agricultural sector stagnated if not to be said to resign. The policy has to present in improving agricultural labor's wage by considering the labor multiplier value in the regional economy. The value of the multiplier labor production factor can be the government base in increasing the fiscal expenditure of its development in the agriculture sector. Besides, domestic agricultural actors' primary investment stimulus strategy is a top priority for development policy (Fitriani et al., 2015). Based on the analysis result, it was concluded that local cassava processed business is still underdeveloped because they operate lower than the potential productivity. The elasticity production value was lower than one. It means the production runs on range decreasing economic to scale. The set of input combination optimum was essential to consider by SMEs. Minimizing the input excess allocation was necessary to decide the productivity enhancement in the decreasing economies of scale level.

The revenue structure analysis showed that the cassava SMEs was beneficial as a source of family income. Based on rural labor absorption analysis, the local food processing industry's existence can potentially employ the rural labor force.

Authors' Contribution

All authors contributed equally to this study.

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