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Assessing Determinants of Farmer's Participation in Sugarcane Contract Farming in Indonesia

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ABSTRACT

The integrated value chain is a prerequisite for the successful industrialization of the agricultural sector. Contract farming (CF) is a useful instrument to integrate the agricultural value chain in developing countries such as Indonesia. The purpose of this study was to identify the determinants of farmer participation in sugarcane contract farming. The data utilized in this study was obtained from the Indonesian Plantation Farm Household Survey 2014 for Sugarcane. The data consists of 8.831 farmers distributed in 8 provinces. Logistic regression was used to estimate the determinants of farmer participation in sugarcane CF. The result shows that age, education, and type of cultivated land negatively affect farmer participation in sugarcane CF. Meanwhile, land tenure, cultivation area, cropping system, certified seed, membership in a cooperative, access to extension services, and membership in farmer's association positively affect farmer participation in sugarcane CF. The policy implication for increasing farmer participation in CF is to intensify the information of CF to the farmer with a large cultivation area. Since these farmers tend to participate in CF to anticipate marketing risks.

Keywords: contract farming, sugarcane, Indonesian plantation farm household survey

INTRODUCTION

The integration of agricultural value chains is one of the prerequisites for the success of agricultural industrialization. An integrated value chain enables a smooth flow of goods and information so that the agricultural sector can respond and meet market needs precisely and quickly (OECD/WTO, 2013). Contract farming (CF) is an instrument used to integrate agricultural value chains since it solves high transaction costs, limited access to finance, limited regulatory transparency, and issues related to value chain governance (Bellemare & Lim, 2018). CF aims to link small-scale farmers to high-value markets (exports and supermarkets) or processing companies. Linking small-scale farmers to export markets and supermarkets is the most effective alternative to reduce poverty in developing countries (World Bank, 2008).

Empirically, participation in CF has proven to be beneficial for farmers and companies. Participation in CF reduces the risk of farming for small-scale farmers in India (Mishra, Kumar, Joshi, D'Souza, & Tripathi, 2018). CF also plays a role in minimizing the costs of providing farm capital for farmers and labor costs for companies (Oya, 2012). For farmers, the main benefits of CF are increased income and welfare, such as contract farmers in Ghana, India, Madagascar, Mozambique and Nicaragua (Barrett et al., 2012), corn farmers, rice farmers and broiler breeders in Indonesia (Simmons, Winters, & Patrick, 2005), and contract farmers in several other developing countries (Bellemare & Bloem, 2018). Moreover, CF is the beginning of a structural transformation of the agricultural sector because it encourages the transition from semi-subsistence agriculture to commercial agriculture (Barrett, Christiaensen, Sheahan, & Shimeles, 2017). These results indicate the importance of farmer participation in CF for the economy of developing countries, such as Indonesia.

The rate of participation of CF in Indonesia is quite low compared to developed countries. The rate of participation of CF in Indonesia based on sub-sectors and commodities are livestock subsector: broiler 55.65%; dairy 12.15%; beef cattle 0.28% (BPS, 2014), horticulture subsector: cayenne pepper 7.67%; red chilies 8.03%; shallots 3.05%; mango 6.24%; banana 5.09% (BPS, 2015a), plantation subsector for all commodities 2.9% (BPS, 2015b). This figure is relatively low when compared to developed countries like the United States, where the rate of participation in CF reaches 97% (MacDonald & Korb, 2012). Under these conditions, increasing the participation in CF for strategic agricultural commodities has a vital role in agricultural industrialization in Indonesia.

One of the strategic agricultural commodities in Indonesia is sugar cane. Sugar cane is the primary raw material for the Indonesian sugar industry. Currently, the Indonesian sugar industry is only able to supply 2.19 million tons of sugar out of a total demand of 5.7 million tons (Iswara, 2017). Accelerating the process of industrialization of sugar cane plantations is a crucial step to achieve national sugar self-sufficiency. Increasing the participation of sugar cane farmers in CF is a possible solution to accelerate this process. The participation of sugarcane farmers in CF has several positive impacts. For example, CF between Jati Tujuh Sugar Mills (PG) and sugar cane farmers in West Java increases farmers' empowerment through access to capital, the provision of production facilities, and marketing (Fadilah & Sumardjo, 2011), CF also increase production and profits per hectare for sugar cane farmers in Jember (Lestari, Fauzi, Hutagaol, Hidayat, & Hidayat, 2016). An effective strategy is needed to increase farmer participation in CF. The strategy needs to be based on factors that determine sugar cane farmer's participation in CF.

The majority of research on sugar cane CF are case studies (Agiesta, Widjaya, & Hasanuddin, 2017; Fadilah & Sumardjo, 2011; Lestari et al., 2016). These researches can provide a detailed picture of the conditions of CF in an area. However, this research is insufficient as the basis to formulate policies on a national scale. Based on these conditions, this study aims to identify the factors that effect sugar cane farmer's participation in CF in Indonesia. Using data from the Sugarcane Plantation Farm Household Survey with a total

sample of 8831 farmers, this study provides a nationally-representative analysis that suitable for the formulation of national sugar cane policies.

METHODS

Data

The data used in this study is the data of the 2014 Indonesian Plantation Farm Household Survey (IPFHS) of sugarcane produced by the Central Statistics Agency (BPS) of the Republic of Indonesia. IPFHS is part of the 2013 Agriculture Census (ST2013) and covers the entire territory of Indonesia. Plantation commodities in the IPFHS are divided into two categories, national plantation commodities (cocoa, rubber, palm oil, coffee) and provincial plantation commodities. Sugar cane is a provincial plantation commodity. The IPFHS field data were collected from May 26 to July 7, 2014 (Sub-Directorate of Plantation Crop Statistics, 2016). Figure 1 shows the distribution of smallholder sugarcane farmers respondents and contract-farmer in IPFHS.

FIGURE 1. THE DISTRIBUTION OF RESPONDENT SMALLHOLDER SUGARCANE FARMERS IN INDONESIAN PLANTATION FARM HOUSEHOLD SURVEY

The sampling method used in the IPFHS was *two-stage random sampling*. The first step is taking random sample blocks from the census block framework. The systematic proportional to size was used in the selection of sample blocks. The intended size for each census block is the number of plantation farm households (PFH). The framework for the selection of sample blocks is twofold, namely ordinary census blocks and census blocks containing the results of ST2013, which have been stratified by primary crop. The eligible sample block is a census block that has a minimum of 10 PFH. After the sample block is determined, the second step is to determine the PFH sample. Systematic sampling was used to determine the PFH sample with consideration of the types of primary plantation crops, the amount of planting area in m^2, and the number of plants produced at the time of enumeration. The framework for PFH selection is the list of PFH in selected blocks that have

been sorted by the planting area. The eligibility of the PFH sample for sugar cane is PFH with a minimum planting area of 650 m^2 (BPS, 2015c).

TABLE 1 DESCRIPTIVE STATISTICS OF RESEARCH DATA

Variable	Code	Information	Average and Frequency	Elementary school
		Dependent Variable		
Participation in contract farming	*Y*	Binary category variables (0 = independent farmers; 1 = contract farmers)	1: 3036 (34.4%) 0: 5795 (65.6%)	
		Independent Variable		
Age	X1	Age of sugar cane PFH head (years)	51.59	11.82
Education	X2	Length of formal education (year)	5.85	4.46
Gender	X3	Dummy Variable (1 = Male, 0 = Female)	1: 7974 (90.3%) 0: 857 (9.7%)	
Land Tenure	X4	Dummy Variable (1 = Self-owned, 2 = Rent, 3 = Sharecropping)	1: 7163 (81.1%) 2: 1098 (12.4%) 3: 570 (6.5%)	
Land area	X5	Sugar cane planting area (ha)	0.9	3.15
Land Type	X6	Dummy variable (1 = Paddy farmland, 0 = Non paddy farmland)	1: 3006 (34%) 0: 5825 (66%)	
Planting System	X7	Dummy variable, planting system applied to sugar cane (1 = Single, 2 = Intercropping, 3 = Mixed)	1: 8740 (98.9%) 2:58 (0.7%) 3:33 (0.4%)	
Seeds	X8	Dummy variable, type of seed used (1 = Certified seed, 0 = Uncertified seed)	1: 1430 (16.2%) 0: 7401 (83.8%)	
Dependency ratio	X9	The ratio between the number of sugar cane farmers in the family and the number of family members	0.32	.17
Membership in KUD / Cooperatives	X10	Dummy variable (1 = KUD / Cooperative member, 0 = Not a KUD / Cooperative member)	1: 1347 (15.3%) 0: 7484 (84.7%)	
Access to agricultural extension	X11	Dummy variable (1 = getting counseling, 0 = not getting counseling)	1: 1383 (15.7%) 0: 7448 (84.3%)	
Membership in the Sugar Cane Farmers Association	X12	Dummy Variable (1 = Associate member, 0 = Non-associate member)	1: 466 (5,3) 0: 8365 (94.7%)	
		Distribution of sample farmers		
Distribution of sugar cane RTUP		Distribution of sugarcane RUTP in each province (1 = North Sumatra, 2 = Lampung, 3 = West Java, 4 = Central Java, 5 = Yogyakarta, 6 = East Java, 7 = South Sulawesi, 8 = Gorontalo)	1: 3 (0.03%) 2:88 (0.99%) 3:75 (0.84%) 4: 3146 (35.6%) 5: 0.5 (12.2%) 6: 5281 (59.8%) 7: 104 (1.2%) 8:86 (1.0%)	

Source: 2014 Indonesian Plantation Farm Household Survey

In total, 8831 sugar cane PFHs were interviewed in the IPFHS. These farmers are located in the primary province of sugar cane production. Table 1 contains the distribution of PFH and descriptive statistics of the variables. In general, sugar cane farmers in Indonesia are on Java island with the most substantial proportion located in East Java and Central Java, accounting for 59.8% and 35.6%, respectively (see figure 1). Other regions with the number of sugarcane farmers sorted from the largest to the smallest proportion are Yogyakarta, South Sulawesi, Gorontalo, Lampung, West Java, and North Sumatra.

Based on the information in Table 1, the number of sugarcane farmers participating in CF is 34.4%. This amount is much higher compared to CF participation in the plantation sector, which is only 2.9%. The average sugar cane farmer is 51.59 years old, with an average level of education being elementary school (average length of education is 5.85 years). The majority of sugarcane farmers are men, with only 9.7% who are female farmers. The average dependency ratio of sugar cane PFH is 0.32, which means that each sugar cane farmer has an average of two dependents.

Most of the sugarcane farmers cultivated their land (81.1%), while the rest cultivated on leased land (12.4%) and sharecropping (6.5%). Most farmers cultivated sugar cane on nonpaddy farmland (66%) while the rest cultivated on paddy farmland. Sugarcane planting generally cultivated by single cropping system, and a small portion is cultivated by intercropping and mixed cropping. The use of certified seed is still relatively low, and most farmers still use uncertified seed.

The rate of participation of sugarcane farmers in agricultural extension, cooperatives, and agricultural associations is still relatively low. The number of sugar cane farmers in Indonesia who are members of the KUD / Cooperative is 15.3%. Similarly, sugar cane farmers with access to an agricultural extension are 15.7%. The membership of sugarcane farmers in the farmers association has a meager value of 5.3%.

Analytical Procedure

Logistic regression was used to estimate the factors affecting farmer's decision to participate in CF. Logistic regression is a regression method used to estimate the effect of several independent variables on the independent variables in the form of binary variables (Field, 2005). Twelve independent variables were expected to affect farmer's participation in CF. The logistic regression model is shown in Equation 1.

$$Logit(P) = \beta_0 + \sum_{i=1}^{12} \beta_i x_i + \varepsilon \quad (1)$$

Maximum Likelihood Estimation (MLE) method was used to estimate the model. Omnibus Test of Model Coefficients and pseudo-R2 values were used to test the robustness of the model. The effect of each independent variable was estimated using the regression coefficient and the odd-ratio.

RESULT AND DISCUSSIONS

Logistic regression estimation results

The results of logistic regression analysis show that the estimated model is robust. There are ten of twelve independent variables that have a significant effect on farmers' decisions to participate in CF. The logistic regression model has a Chi-square value significant at 1% level. It shows that adding independent variables in the model significantly increases the ability of the model to explain the variance of farmers' decisions to participate in CF.

Farmer's age and education have a negative effect and significant to the decision of sugarcane farmers to participate in CF, while the gender variable does not have a significant effect. Land tenure has a positive and significant effect on the farmer's participation in CF,

while farmers who manage the production on sharecropping land tend not to participate in CF. The land area has a positive and significant effect on farmer's participation in CF. Meanwhile, farmers who cultivate sugar cane on paddy fields tend not to contract. Single cropping and intercropping systems have a positive effect on farmer's participation in CF while the mixed cropping system has a negative effect.

TABLE 2 LOGISTIC REGRESSION ESTIMATION RESULTS

Variable	Coefficient	Sig.	Odds Ratio
Intercept	–2,965	.001 ***	0.052
Age	–0,014	0,000 ***	.986
Education	–0,047	0,000 ***	.954
Gender	0.090	0.313 ns	1,094
Land Ownership			
One's own	0.462	0,000 ***	1,587
Rent	0.527	0,000 ***	1,693
Land area	.119	0,000 ***	1,126
Land Type (Paddy farmland)	–0,145	0,000 ***	0.865
Planting System			
Single	2,164	0.009 ***	8,709
Intercropping	2,398	0.007 ***	11,000
Seedlings (Certified)	0.832	0,000 ***	2,297
Dependency ratio	–0.230	0,131 ns	0.795
Membership in KUD / Cooperatives (Members)	1,537	0,000 ***	4,651
Access to agricultural extension	1,025	0,000 ***	2,788
Membership in the Sugar Cane Farmers Association	1,751	0,000 ***	5,759
Model Robustness			
Omnibus Tests of Model Coefficients (Chi-square)	1952,186	0,000 ***	
Cox and Snell R2	.198		
Nagelkerke R2	0.274		
N	8831		

Note: ***, **, and * states are significant at 1%, 5%, and 10% respectively.

Source: Author's analysis, 2019

Discussion

The logistic regression estimation results show that age has a negative effect with an odd-ratio value of 0.986. It shows that the probability for farmers to contract decreased by 1.14% in line with the addition of age by one year. These results indicate that contract farmers tend to be younger than independent farmers. The average age of sugar cane contract farmers is 50.81 years, while independent sugar cane farmers are 52 years. Age is a factor that describes the experience and ability of farmers. This result is different from the results of research by corn and potato contract farmers in Okara District, Pakistan, where farmers who participated in CF tended to be older because the partner companies preferred farmers with longer farming experience (Khan, Nakano, & Kurosaki, 2019). The reason for this difference is because age is not a company priority in choosing farmers. Also, young farmers are more proactive in gaining institutional access (Rondhi, Pratiwi, Handini, Sunartomo, & Budiman, 2018).

Farmer education has a negative impact with an odd-ratio of 0.954, which shows that sugar cane farmers with high formal education tend not to participate in CF. Several studies indicate that farmer education tends not to have a significant effect on farmers' decisions to participate in CF. A study on corn and potato CF in Pakistan shows that education does not

have a statistically significant effect (Khan et al., 2019). Similar results were also found in broiler CF in China (Mao, Zhou, Ifft, & Ying, 2019). In general, the sugarcane farmers in Indonesia have low formal education. Most farmers (71.2%) had the highest education at the elementary school level, 25.5% had junior/senior high school education, while less than 5% had high education. Meanwhile, the gender of farmers does not have a significant impact on farmers' decisions in partnering.

The land aspect consists of three factors: land ownership, type, and area. Land ownership is a categorical variable with three categories, owned land, rented land, and sharecropping. Estimation results show that farmers who cultivate sugar cane on owned and rented land tend to participate in CF with odd-ratio values of 1.587 and 1.693. Land ownership status has an important role in farm decision making, such as decisions related to the use of production inputs (Rondhi & Adi, 2018), land management (Rondhi et al., 2018), and adaptation and mitigation of the impacts of climate change (Rondhi, Khasan, Mori, & Kondo, 2019). Land ownership status determines the incentives that farmers will get from farming decisions taken. The security of land tenure will encourage farmers to make farming decisions that have the probability of providing benefits. Thus, farmers who manage their owned and leased land tend to participate in CF because they have secure land tenure.

The land area has a positive effect on farmers' decision to participate in CF with an odd-ratio value of 1.126. It indicates that the probability for farmers to partner will increase by 12.6% along with the addition of 1 hectare of land. Similar results were also found in research on partnership oil palm plantations in Ghana, where large tracts of land tend to join CF to minimize price risk (Väth, Gobien, & Kirk, 2019). The area of land affects the risk of farming faced by farmers. An increase in the land area will increase farming production, which then increases the value of a significant loss if the price at harvest is low. This risk can be anticipated by participating in CF, where farmers will get certainty about the sale of their products. Meanwhile, farmers who cultivate sugar cane on paddy fields tend not to partner. Odd-ratio value of paddy land is 0.865, which shows that farmers who cultivate sugar cane on paddy fields have a 14.5% less probability of contracting compared to farmers who cultivate sugar cane on non-paddy fields.

The planting system has a positive effect on a farmer's participation in CF. The planting system is a categorical variable with two criteria, namely single cropping and intercropping. Based on the odd-ratio value, farmers who implement a single cropping system have a smaller probability of participating in CF. The odd-ratio value of a single planting system is 8.7, while the intercropping system has an odd-ratio value of 11. Intercropping systems can be applied to sugarcane and food crops. The application of this system can provide additional results in the first four months of planting sugar cane (BALITTAS, 2016). Meanwhile, the use of certified cane seed has a positive effect on farmers' probability to partner. Farmers who use certified seeds have a 120% greater chance of participating in CF. Furthermore, the use of certified seed increases sugar cane farm productivity and technical efficiency in Indonesia (Suwandari et al., 2020). These results are in line with the function of

CF as an instrument for farmers to obtain quality farm inputs, including seeds (Mishra, Kumar, Joshi, & D'souza, 2016).

Institutional factors have a positive and significant effect on farmers' participation in CF. Membership in cooperatives has an odd-ratio value of 4.651, which shows that sugarcane farmers who are members of cooperatives have a 4.651 times greater probability of participating in CF than those who are not members of cooperatives. A study on pineapple contract farmers in Ghana shows that success in CF is determined by self-efficacy and social capital owned by farmers towards CF. Both of these factors are strongly affected by the membership of farmers in cooperatives, where farmers who are active in cooperative membership have the confidence and strong social capital to partner (Wuepper & Sauer, 2016).

Access to agricultural extension also has a positive effect on farmers' participation in CF with an odd-ratio value of 2.788. Farmers who have access to extension services have a probability of participating in CF 2.788 times greater than farmers with no access to extension services. However, access to the extension might be associated with farmers' participation in CF. As in the organic rice CF in India, where extension services are one of the benefits received by farmers from CF (Mishra et al., 2018). The similar results were also found in broiler CF (Rondhi, Aji, Khasan, Putri, & Yanuarti, 2020) and tobacco CF in Indonesia (Rondhi et al., 2020).

Membership in sugarcane farmers associations has a positive effect on farmers' farmers' participation in CF with an odd-ratio value of 5.759. As is the case with membership in cooperatives, membership in sugarcane farmers associations strengthens social capital and farmer confidence. Farmers' associations in certain cases are implementing CF, such as the corn CF in Ghana formed by the corn farmers association called *Masara* (Lambrecht & Ragasa, 2018). So that association members have a great probability of participating in CF. The association also acts as a price negotiator between farmers and processing plants, as happened between rice farmers and rice mills in Senegal (Soullier & Moustier, 2018). The same condition also occurs in Indonesia between the Indonesian People's Sugar Cane Farmers Association (APTRI), which is an organization that represents farmers in negotiating prices and policies related to sugar cane.

Based on the discussion above, there are factors determining farmer's participation in CF and factors that are the result of CF. The determinants of CF are factors that encourage farmers to participate in CF, such as land area. Land area is closely related to the risks faced by farmers, especially price risk.Small-scale farmers maximize profits by exploiting the selling price. Small-scale farmers get maximum profits when prices are high, and a small loss when prices are low, due to the small amount of sugarcane production. Meanwhile, price speculation is difficult for farmers with large cultivation areas due to the high risk of loss during low prices.

Other factors that determine farmer's participation in CF include age, education, land ownership, membership in cooperatives, and farmers associations. Meanwhile, access to agricultural extension is a result of farmer's participation in CF because extension service is

one of the facilities provided by CF. Another factor which is the result of CFis the certified seed and planting system. Both of these factors are the result because CF facilitates farmers to get access to quality farming inputs and a good planting system.

CONCLUSIONS

This study aims to identify the factors that affect the decision of sugar cane farmers in Indonesia to participate in CF. Based on the estimation results of logistic regression, there are ten of the twelve factors that have a significant effect on the decision of farmers to participate in CF. Factors that have positive and statistically significant effects include land ownership, land area, planting system, certified seedlings, membership of cooperatives / KUD, access to agricultural extension, and membership in farmer associations. Meanwhile, factors that negatively affected include age, education, and type of agricultural land. A factor that strongly encourages farmers to participate in CF is land area because the price risk increases with the increase in land area.

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