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Impact of conversion from rice farms to oil palm plantations on socio-economic aspects of ex-migrants in Indonesia

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Abstract: This paper aims to investigate the impact of land conversion from rice farming to oil palm plantations on the socio-economic aspects of ex-migrants in the South Sumatra tidal swamp, Indonesia. Land conversion from rice farming to oil palm plantations is a form of adaptation for ex-migrant farmers and will increase food deficits in Indonesia. Ex-migrant farmers initially cultivated food crops with conventional technology. This pattern has been changing, which have led to the formation of two large groups of farms, namely rice-based farms implementing mechanisation, and oil palm-based plantations. The results showed that changes from rice farming to oil palm plantations did not make the economy of farm households better. Between the two groups of farmers, there is no difference in arable land, the labour allocation for agriculture and the farmers' income. In addition, there is not much difference between farmers' participation in on-farm and out-farm activities. The area of arable land owned, the husbands'age, and family size variables are determinants of farmers' choice to participate in other jobs activities and influence farmers' income. Thus, changes in crops from rice to oil palm have no impact on cultivation area, labour allocation, income, on-farm and out-farm activities.

Keywords: household; migrant; socio-economic; tidal swamp

Rural development in Indonesia has been carried out including the government-sponsored transmigration program, which has moved Javanese populations to areas outside Java. The first program of transmigration to the tidal swamp in Indonesia was implemented in 1969, namely to Delta Upang in South Sumatra Province. After that time, there was a massive population movement to the tidal swamp that lasted until the 1990s. The transmigration program was fuelled by developing rice-based agriculture as a new livelihood in the destination area. Not all migrant farmers have succeeded to manage rice farming in new areas and their lives are partly marked by poverty (Adriani et al. 2017). According to Zahri et al. (2018) and Wildayana and Armanto (2018), some rice farms, therefore, converted into oil-palm plantations. Farmers are attracted to oil palms because they want to improve their standard of living, they expect their income to increase and their use of labour to decrease and the risk of failure is low. At that time, farmers consider the conversion to oil palm plantation to be the most profitable choice, as compared to other crops. Smallholder oil palm plantations in Indonesia grow rapidly. In 1980, their

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total area was only 6 175 ha, while in 2010 the area has reached 3 077 629 ha.

Oil palm plantations in the tidal swamp have contributed to the development of oil palms in Indonesia, and this has raised a number of issues. Developing oil palm plantations in Indonesia has caused deforestation, which has an impact on increasing carbon dioxide emissions (Vijay et al. 2016) and affects biodiversity (Wilcove and Koh 2010, Krishna et al. 2016). Oil palm farmers are also faced with issues regarding their large dependence on oil palm companies in terms of processing and marketing of products, and farmers get a small marketing margin. So far, farmers have been selling products to companies in the form of fresh fruit bunches. Companies process the products and sell the processed products on the spot and futures markets. Go and Lau analysis (Go and Lau 2019) showed that the sale of processed palm oil in the futures market is better than its sales in the spot market.

Based on the above description, this study was carried out with the aims: (1) to describe the productive economic business structure of those ex-migrant farmers in tidal swamp that consistently carry out rice farming and those who convert land into oil palm plantations, and (2) to analyse determinant factors and the impact of change in cropping patterns on the income structure of ex-migrants in tidal swamp areas.

RESEARCH METHODS

The research method used was a survey method with primary data. The sampling method used was Multi Stage Random Sampling with tidal swamp areas from 3 districts, namely Banyuasin Regency, Musi Banyuasin Regency and Ogan Komering Ilir Regency. From each regency, we chose five villages. Around 50 respondents chosen by random sampling were interviewed in each village because the average population of each village in South Sumatra was about 500 households, meaning that in each village as much as 10% of the population on average were chosen as respondents. All respondents were ex-migrants from Java who moved to this location in the period from 1982 to 1985. Demographic characteristics of the farmer household sample can be seen in Table 1. The age of the husband was on average 46.44 years, the number of family members was around 3 persons. There are on average 1.5 active male workers both on rice farms and oil palm plantations.

EMPIRICAL MODEL SPECIFICATION

Becker (1965) stated that every household will maximise production and consumption behaviour, and Nakajima (1986) developed this idea further by a subjective balance model for households that produce many products. Vemminem et al. (2002) state that if the main farm provides (on-farm) income that is too small for each person in it, then in order to meet their needs other sources of income are needed outside of their farming (off-farm and out-farm income). As stated by Pastusiak et al. (2017), agriculture is one of the riskiest businesses. Farmer households, therefore, try to diversify their sources of income and carry out other strategies that aim to stabilise their income by off-farm and out-farm income. Krishna et al. (2016) said that oil palm farmer households need less labour and this allows more labour to be allocated to off-farm activities or to expanding their agricultural land. The concept of on-farm, off-farm, and out-farm income is further referred to as business diversification, as revealed by Ellis (1998) finding that farm diversification is due to quantitative variables, namely land area,

Table 1. Characteristics of demographic aspects of farmer's households

Variable	All sample (N = 300)		Rice (n = 150)		Oil palm (n = 150)		*p*-value
	mean	SD	mean	SD	mean	SD	
Husband's age (year)	46.44	11.85	45.69	12.39	47.19	11.29	0.165
Wife's age (year)	41.09	12.58	39.90	13.92	42.27	10.99	0.041
Family size (persons)	3.46	1.19	3.76	1.13	3.15	1.17	0.214
Active man worker (persons)	1.56	0.70	1.59	0.70	1.53	0.70	0.872
Active woman worker (persons)	1.49	0.69	1.52	0.70	1.45	0.67	0.398
Education (year)	7.51	3.50	6.50	2.51	8.53	4.02	0.000

Source: own processing

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experience (age), and health. Poor households have fewer opportunities to carry out off-farm activities. It is likewise with education: educated family heads have higher participation than others. Opportunities for off-farm and out-farm activities have an influence on income. In general, researchers have analysed variables including respondent status, family size, gender, land area, education, access to capital, number of productive workforce, and experience, as determinants of household income (Schwarze and Zeller 2005; Bhattacharyya 2008; Amurtiya et al. 2016).

Based on theoretical framework, we develop Equations (1–2) to analyse in more depth the second purpose about the determinants of participation of farmers in other jobs (other on-farm and out-farm activities, except main jobs as rice and/or oil palm farmers) and determinants of income factors of farmers. Equation (1) is the logistic regression model, to measure the effect of probability on an event. Equation (2) is a non-linear multiple regression model.

The model is compiled as follows in Equations (1–2). In Equations (1–2):

K – ratio of the probability of having and not having other jobs;
i – sample number 1, 2, 3, ..., n;
α_i – constant;
β_{1-19} – beta regression coefficients which explain the effect of independent variables on the dependent variable;
e_{ij} – error terms;
P_i – probability of having other jobs;
$(1-P_i)$ – probability of not having other jobs;
INC – income (USD/year);
LPL – arable land (ha);
USU – husbands' age (years);
JAK – family size (persons);
TKP – male active labourers (persons);
TKW – female active labourers (persons);
EDU – education (years);
D_1 – dummy variable for main work (1 for rice farmers and 0 for oil palm farmers);
D_2 – dummy variable for other on-farm activities (1 for having other on-farm activities and 0 for not having other on-farm activities);
D_3 – dummy variable for out-farm activities (1 for having other out-farm activities and 0 for not having other out-farm activities).

RESULTS AND DISCUSSION

Productive economic business structure for ex-migrant farmers

Farm size. The arable land owned by each farmer is on average 1.96 ha, and the area of arable land owned is not significantly different with regards to different cropping patterns. On average, rice farmers have 1.96 ha of arable land while oil farm farmers have 1.95 ha of arable land. With such a cultivated area, the agricultural business of ex-migrant farmers is classified as small farmers (Table 2).

In the tidal swamp, farmers adopt oil palm cultivation by replacing their rice farming on the same land and there is a tendency not to allow expanding their planting area except by buying another land. Thus, it is natural that the cultivated area of rice farmers is not much different from the area of oil palm plantations. The conversion of land from rice farming to oil palm cultivation, therefore, does not cause an increase in the scale of farmers' businesses.

Before the change in rice technology, there were farmers who were less successful in rice farming. Some moved to other areas to look for a better life, so their land was bought by local villagers. Another cause has been the inheritance of cultivated land by children from their parents.

Use of family labour. The use of family labour for rice farming averages 19 workdays/planting season on the average cultivated land of 1.96 ha, which is very little. This is due to the development of mechanisation in rice farming activities. This is especially true for rice harvesting: when performed using human labour only, each hectare takes about 25 workdays, while when using a harvesting machine, each hectare takes only about 4 hours. The development of mechanisation has increased the ability of farmers to work on a wider area, which is now on average 1.96 ha per family. In tidal swamps, with the development of agri-

$$\mathrm{Ln}\,K = \mathrm{Ln}\left[\frac{Pi}{1-Pi}\right] = \mathrm{Ln}\,\alpha_i + \beta_1 \mathrm{Ln}\,LPL_i + \beta_2 \mathrm{Ln}\,USU_i + \beta_3 \mathrm{Ln}\,JAK_i + \beta_4 \mathrm{Ln}\,TKP_i + \beta_5 \mathrm{Ln}\,TKW_i + \beta_6 \mathrm{Ln}\,EDU_i + \\ + \beta_7 \mathrm{Ln}\,D_{1i} + \beta_8 \mathrm{Ln}\,D_{2i} + \varepsilon_i \quad (1)$$

$$\mathrm{Ln}\,INC_i = \mathrm{Ln}\,\alpha_9 + \beta_{10} \mathrm{Ln}\,LPL_i + \beta_{11} \mathrm{Ln}\,USU_i + \beta_{12} \mathrm{Ln}\,JAK_i + \beta_{13} \mathrm{Ln}\,TKP_i + \beta_{14} \mathrm{Ln}\,TKW_i + \beta_{15} \mathrm{Ln}\,EDU_i + \beta_{16} \mathrm{Ln}\,D_i + \\ + \beta_{17} \mathrm{Ln}\,D_{1i} + \beta_{18} \mathrm{Ln}\,D_{2i} + \beta_{19} \mathrm{Ln}\,D_{3i} + \varepsilon_i \quad (2)$$

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Table 2. Characteristics of farmer's household

Variables	All sample (N = 300)		Rice (n = 150)		Oil palm (n = 150)		*p*-value
	mean	SD	mean	SD	mean	SD	
Land size (ha)	1.96	1.23	1.96	1.40	1.95	1.03	0.02
Labours (workdays)	–	–	19.09	9.11	18.00	5.67	–
Farm cost (USD/ha/year)	228	84	237	101	266	66	–
Rice productivity (t/ha/planting season)	–	–	4.80	1.78	–	–	–
Oil palm productivity (t/ha/year)	–	–	–	–	11.04	6.18	–

Source: own processing

cultural mechanisation, it turns out that rice farming is changing from labour intensive to capital intensive. Hand tractor has been used in land cultivation. Seedlings are no longer being used because they have been replaced by tabela (direct seed planting without seedlings). Combined harvesters are used for harvesting. This is in line with Brhanu (2018) who claims that adoption of mechanical technology by rice farmers could increase productivity.

The use of the labour of oil palm cultivation is not much different in numbers compared to rice farming. Oil palm farmers partnering with core estates do not use labour for their plantations because all activities are carried out by officers from core estates. The average labour requirement for each 2 ha of oil palm plantations for every 6 months is only around 18 workdays, namely 12 workdays for harvesting, 2 workdays for seedling planting, 2 workdays for fertilising, and 2 workdays for other activities. Because of this, the farmers' leisure time is very large, allowing farmers to develop other productive economic businesses. This finding is in line with Krishna et al. (2016) stating that oil palm farmer households need less labour than households cultivating rubber which is the main alternative crops.

Agricultural production costs. In conventional rice farming activities, many costs incurred are connected to labour wages: from land preparation through planting to harvesting. On the other hand, following the development of rice cultivation using machinery, rice farming has been becoming more capital intensive. The total production costs for rice farming per planting season was 237 USD/ha/year, consisting of fertiliser costs (27%), and land processing and harvesting costs (73%). On the other hand, the costs incurred for oil palm cultivation amount to 266 USD/ha/year, which consists of fertiliser costs (32%) and harvesting costs (68%). The costs of processing land and harvesting in case of rice farming amount to 73% of total production costs. It is the cost of using agricultural machinery and it had been previously covered by using human labour. This shows that rice farming has turned into a capital-intensive business.

Rice productivity. The rice productivity is around 4.80 t/ha/planting season, so if farmers perform a double planting in a year, then rice productivity can reach 9.6 t/ha/year. But most farmers grow corn for the second season, which is between April and July with a productivity of around 7 t/ha/planting season. Most farmers operate with two planting seasons. This condition causes rice farmers to have a higher income than farmers in oil palm plantations. This is caused, as stated earlier, by the fact that farmers in these tidal areas have found efficient farming methods, with good results and little use of labour. Data from the Indonesian Central Bureau of Statistics (2015) shows that the productivity of lowland rice in Indonesia is 5.51 t/ha/planting season. This means that the productivity of paddies carried out by ex-migrants is higher than rice productivity in Indonesia.

Palm oil plantation productivity averages 11.04 t of fresh fruit bunches (FFB)/ha/year. If it is compared with the results of other plantations producing at least 24 t/ha/year, such productivity is very low at less than 1 t/ha/month and varies in a year. The low productivity is influenced by several things, namely the lack of optimal plantation maintenance by farmers such as low fertilisation and pest and disease control is still limited.

Income of farmer's households

Farmer's livelihoods. At the beginning of arrival until around the first 5 years since arrival in the new area, all migrants (100%) had jobs as farmers on-farm rice and other seasonal crops such as vegetables and pulses. After that, changes in the business of farm-

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ers began to occur by adding other types of work, which could be grouped into: (1) main agricultural jobs, namely rice farming and/or oil palm plantations; (2) other agricultural jobs (on-farm jobs, such as vegetable farming, crops, livestock and fisheries; off-farm, such as farm labourers; and out-farm jobs such as employees and carpenters). In Table 3, it can be seen that 43.33% of rice farmers carry out agricultural activities also outside of their main business and 43.33% work on off-farm businesses. In the case of oil palm farmers, 40.67% of those in the sample work in agriculture outside their main business, and 50% work outside agriculture. This condition shows that farmers do not only do a single business but have developed multiple businesses or diversified household businesses.

Impact and determinant factor changes in cropping patterns on structure of ex-migrant income

The income of farmer households is composed of the income from the main rice and oil palm business, income from other agricultural businesses, and non-agricultural income. In Table 3, it can be seen that the average farm household income is 3 607 USD/year, which is the income of rice farmers averaging 3 745 USD/year which is greater than the income of oil palm farmer. The contribution from the main agricultural business to farmer household income is on average 72.94%, in the case of rice farming it is 68.05% and for oil palm plantation farmers it is 77.82%. This figure shows that agricultural business provides the largest contribution to the income of farmer households.

In terms of the source of income, rice farmers derive 18.55% of it from other on-farm sources and 13.06% from out-farm sources, while for oil palm farmers these shares are 9.94% (on-farm sources) and 12.24% (out-farm sources). Oil palm farmers who have another on-farm income account for 40.67% of the sample and those who work outside agriculture account for 50% of the sample, while rice farmers who have other on-farm income accounted for 42.00% of the sample and those with out-farm income accounted also for 43.33% of the sample. This proved that farmers do not only have a single business, but they have developed multiple businesses or diversified household businesses. That is in line with Krishna et al. (2016) and Pastusiak et al. (2017).

Conversion of land use from rice farming to oil palm plantations will harm the farmers individually and also reduce food production (rice and corn), thus disrupting the supply of food. Indonesia experienced a rice deficit, similar to that experienced by several countries such as Ghana (Coffie et al. 2016) and Kenya (Atera et al. 2018). If the land conversion from food crops (rice and corn) into plantation crops or other uses continues to occur, it will disrupt food security in Indonesia. The problem of transferring this land must be stopped because it will disrupt Indonesian rice production. According to Euler et al. (2016), concessions that had been allocated by the government to oil palm companies in the past have led to the adoption of oil palm in the small agricultural sector, and the dynamics of subsequent land use are

Table 3. Income of farmer' household

Income type	Unit	All sample (N = 300)		Rice (n = 150)		Oil palm (n = 150)	
		mean	SD	mean	SD	mean	SD
Total income	USD/year	3 607	2 249	3 745	2 793	3 475	1 520
	%	100.00	–	100.00	–	100.00	–
Rice/oil palm income	USD/year	2 627	1 810	2 556	1 956	2 704	1 655
	%	72.94	–	68.05	–	77.82	–
Other on-farm income	USD/year	521	1 007	698	1 333	345	442
	%	14.24	–	18.55	–	9.94	–
Out-farm income	USD/year	459	1 183	491	1 435	425	667
	%	12.65	–	13.06	–	12.24	–
Working on other farm income	%	42.00		42.00		40.67	
Working on out-farm income	%	46.67		43.33		50.00	

Source: own processing

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largely out of government control. The government should have implemented a policy so that the conversion of rice land into oil palm plantations was immediately controlled. Especially after it was discovered that land conversion from food crops to plantation crops did not increase the area of arable land, did not significantly reduce labour use and did not increase farmers' income.

We develop Equations (1–2) to analyse the second purpose more deeply in terms of the determinants of farmer participation in on-farm and off-farm activities and of the determinants of farmer income. The model estimation results show that the model is representative enough to analyse the determinants of farmers participating in other jobs (on-farm and out-farm activities) and the determinants of farmer income. Determination coefficient values (R^2) are 0.510 for Equation (1) and 0.618 for Equation (2). This shows that all explanatory variables in the model can explain the model behaviour well. Together, the explanatory variables in the equation clearly explain the diversity of variables indicated by the λ^2 value of 14.906 for Equation (1) and F-statistic value of 0.987 for Equation (2). The overall model test using Chi square (λ^2) 14.906 on the Omnibus Test shows the significant value of the model of 0.061, which means that the overall model can be used as a prediction tool for Equation (1). The overall model test using F-value 0.987 on the F-test shows the significant value of the model of 0.00, which means that the overall model can be used as a prediction tool for Equation (2). The results of the t-test show several variables that have a significant effect on the dependent variable. The results of the econometric criteria test show that the model does not experience violations of classical assumptions with multicollinearity, autocorrelation and heteroskedasticity. One of the most important things and the main orientation of this study is that all presumptive parameter results in the model are in accordance with expectations based on economic theory and logic.

The estimating logit function, which is used to determine farmer participation in other jobs, can be seen in Table 4. From odds ratio, we concluded that the probability choice of participating in other jobs activities will increase if the percentage of (1) arable land, active man-woman workers, and education are decreasing, and (2) husband age and family size are increasing. This, in line with Zhao (2014); Wuepper et al. (2018) and Eshetu and Mekonnen (2016), shows that the choice between specialisation and income diversification was driven by various interacting factors, such as scale and economic coverage, risk considerations, household characteristics, and stimulated households to carry out various patterns of income diversification.

Table 4. Factors influencing farmer participation in other jobs (dependent variable: Y_2 = work on other jobs activities)

Independent variables	β	Std. error	p-value	Odds ratio (Ψ)
LPL	–0.482	0.223	0.033	1.617
USU	1.892	0.564	0.001	6.594
JAK	0.906	0.441	0.004	2.468
TKP	–0.760	0.387	0.050	2.133
TKW	–0.743	0.389	0.056	2.097
EDU	–0.046	0.282	0.871	1.047
D_1	0.024	0.387	0.951	1.024
D_2	–0.336	0.384	0.382	1.398
Constant	–7.904	2.425	0.001	–
Nagelkerke R^2 = 0.510		λ^2 = 14.906 (significant at p-value = 0.061)		

β – beta regression coefficient which explains the effect of independent variable on the dependent variable; *LPL* – arable land; *USU* – husbands' age; *JAK* – family size; *TKP* – male active labourers; *TKW* – female active labourers; *EDU* – education; D_{1-2} – dummy variables

Source: own processing

Farmer participation in out-farm activities is a form of business diversification carried out by farmer households. Eshetu and Mekonnen (2016) and Zhao (2014) who investigated the determinants of agricultural income diversification in Ethiopia show that age, education, access to infrastructure, livestock ownership, use of credit, and agricultural income are the main determinants of household participation in agricultural activities. The choice between specialisation and income diversification is driven by various interacting factors, such as scale and economic coverage, risk considerations, household characteristics, and stimulated households to carry out various patterns of income diversification.

Furthermore, the factors influencing the variation of farmer household income can be seen in Table 5. There are four variables affecting the farmer's income, namely the area of arable land, farmer's age, number of male workers, and on-farm activities besides the main business. The second equation is a non-linear equation where the β coefficient has a value in percentage, for example, the variable of arable land

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Table 5. Factors influencing farmers' income (dependent variable: Y_3 = income of households)

Independent variables	β	Std. error	*t*-value	*p*-value
Constant	4.599	0.572	8.039	0.000
Ln*LPL*	0.225	0.052	4.290	0.000
Ln*USU*	–0.311	0.130	–2.393	0.017
Ln*JAK*	–0.063	0.108	–0.581	0.562
Ln*TKP*	0.306	0.092	3.316	0.001
Ln*TKW*	0.084	0.089	0.942	0.347
Ln*EDU*	0.123	0.089	1.385	0.167
D_1	0.017	0.093	0.178	0.859
D_2	0.180	0.091	1.984	0.048
D_3	–0.171	0.091	–1.873	0.062
R^2 = 0.618	Adj-R^2 = 0.588		*F*-value = 0.987 (significant at α = 0.000)	

β – beta regression coefficient; *t*-value – result of *t*-test to analyse the significant effect of each independent variable on the dependent variable; *LPL* – arable land; *USU* – husbands' age; *JAK* – family size; *TKP* – male active labourers; *TKW* – female active labourers; *EDU* – education; D_{1-3} – dummy variables

Source: own processing

has a β coefficient of 0.225. This means that if the area of arable land increased by 1%, then the income of farmers increased by 0.225%. Judging from the sign and magnitude of the regression coefficient, the age and the area of arable land variables have a significant negative effect on income, while the land ownership and the number of male active labourers variables have a significant positive effect on income. The function of the change of land by changing cropping patterns from rice to oil palm cannot be proven to have an effect on increasing farmers' income, and incomes of oil palm farmers even tend to be smaller.

The situation found in this study differs from the studies of Kanyua et al. (2013) and Eshetu and Mekonnen (2016) who investigated the diversification determinants of agricultural income and their effect on rural poverty in Ethiopia. Estimated results from the logit model show that farmer participation significantly reduces the likelihood of rural agricultural households being poor. The situation shows that agricultural business for ex-migrant causes the average farmer to be above the poverty line and leaves considerable free time. Therefore, food crops need to be pursued in order to have sustainable agriculture with increased productivity. It should also be noted that pre-harvest and harvest technology improvements are accompanied by improvements in the rice marketing system produced by farmers.

CONCLUSION

Changes from rice farming to oil palm plantations did not make the economy of farm households better. Between the two groups of farmers, there is no difference in cultivated land area, the allocation of labour for agriculture and the income of farmers. In addition, there is no large difference between farmer participation in on-farm and out-farm activities. Area of cultivated land, age of farmers, and family size variables are determinants of farmers' choice to participate in on-farm and out farm activities and influence farmers' income. Therefore, changes in crops from rice to oil palm have no impact on cultivation area, labour allocation, income and on-farm and out-farm activities.

Changes in cropping patterns from rice to oil palm need to be inhibited or completely eliminated. It is necessary to increase the development of not only rice farmers, but also oil palm farmers, through agricultural cultivation innovation, so that farmers have the ability to get out of poverty. It is also needed to develop business diversification to give farmers alternative income from off-farm sources, especially for farmers who have a small cultivated land area. Lastly, rice and oil palm need to be pursued to achieve sustainable agriculture with increased productivity.

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