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Analysis of Household Economic Behavior on the Palm Oil Smallholder in South Kalimantan – Indonesia

Hamdani1, Nuri Dewi Yanti[1], Nina Budiwati[1], Ahmad Yousuf Kurniawan[1,2]

[1]*Faculty of Agriculture, Lambung Mangkurat University, Banjarbaru, Indonesia*
[2]*Agricultural Economics and Rural Development, Justus-Liebig Universität Giessen, Giessen, Germany*

ABSTRACT

Palm oil plantation has played an important role in the Indonesian economy and livelihood. However, the implementation of PIR/NES palm oil partnership still encounters many problems and obstacles, even it brought drawback on environment and farmer livelihood. We assume the problem occurred because of failure to understand the economic behavior of smallholder which similar to household's. This paper aimed to analyze the behavior of production, labour use, input use, and household expenditures on palm oil smallholders in South Kalimantan. The results shows that in any real linkages, there is a significant relation between the production and the consumption behavior through the income palm oil variable. Furthermore, consumption behavior (i.e.: food consumption and health expense) influences the behavior of fertilizer use. Our simulation reveals that the increase of palm oil price will increase the input use and lead to palm oil productivity. On the other hand, the increase of input price causes drawback on smallholder performance and reduce hired labour use. This will lead to the increase of unemployment in the area. The palm oil area expansion will lead to the increase of input use and palm oil productivity, but it will shift the family labour use from food crop to palm oil.

Keywords: palm oil, household economics, PIR/NES, two-stage least square.

INTRODUCTION

Plantation plays an important role in the economy of Indonesia and has the highest contribution to the total export value compared to the others agricultural products. Based on agricultural trade balance during 2006-2010, the plantation experienced a trade surplus with an average growth of 22.43 percent per year (Dirjenbun 2011). This sub-sector also plays an important role through its contribution to GDP, export earning, employment, poverty reduction, and development in the outer. The Indonesian Ministry of Agriculture, for 2010-2014, has set several commodities (including palm oil) as national commodities for export, as well as to substitute imported products, and fulfil domestic demand (MoA, 2007). Palm oil in Indonesia has grown rapidly since the 1980s. Data from Dirjenbun (2012) showed that the total area of palm oil increased from 294,560 ha in 1980 to 8,385,394 ha in 2010. Approximately 52.07 percent was owned by PBS (large private plantation), 40.39 percent by PR (smallholder) and 7.54 percent was owned by PBN (large state plantation). During 1980 - 2012, palm oil production growth 10.13 percent per year, where 2006 was the highest growth rate (31.64 percent) and 2009 was the lowest (-0.71 percent). In 2007, Indonesia has contributed up to 44% of the world palm oil market. It also estimated that 3.3 million family members depended on the palm oil industry (Richter, 2009).

Introduced in 1848, palm oil has been cultivated commercially since 1911 in Indonesia (Jelsma et al., 2009). In the late of 1970s, the government initiated large estate and smallholder partnership into *Perkebunan Inti Rakyat* or Nucleus Estate Smallholder Scheme (PIR/NES) (Budiharsono et al., 2013). In this scheme, smallholder and farmer who join cooperative is provided with an area for plantation (*plasma*) which is located around a nucleus (*inti*) of the plantation. The nucleus gives technical support to smallholder from implanting stage and transfers the land ownership to the smallholder after 3 – 4 years (Maryani and Irawati, 1998). Since then, the development of palm oil plantation has

increased rapidly due to fast conversion of crops area or forest into plantation (Colcester, et al., 2006; Maryani and Irawati, 1998). Farmer prefers to palm oil in NES scheme because of direct profitability, require less labour, high investment return, and partnership with large estate and bank (Belcher et al., 2004; Jelsma et al., 2009; Feintrenie et al., 2010). The NES scheme also significantly increased the technical efficiency among smallholder farmers (Alwarritzi et al., 2015). On the other hand, the implementation of NES raised critics to its effectiveness to reduce poverty and to increase smallholder capacity. Later on, a number of NES brought several drawbacks to the environment and farmer livelihood (Colcester, et al., 2006; Richter, 2009; Rist et al., 2010). Even, more than 28% of total palm oil area are on the peatland area which is supposed to be protected area (Miettinen et al., 2012). Conflicts and clashes between farmers and large estate also occurred in some places in Indonesia (Richter, 2009; Rist et al., 2010). The clash also happened between food crop and palm oil farmer related to the ecology and sustainable of palm oil industry (Orsato, 2013).

In South Kalimantan, the NES partnership also encounters many problems and obstacles from both internal and external factors. Internal constraints include: (1) lack of product development ability, (2) low professionalism of the farmers as land managers, and (3) low capital and technology. Meanwhile, the external constraints are associated with: (1) unpredicted economic situation, (2) inappropriate and unconducive government policy (3) inadequate transport infrastructure, and (4) low optimality of management, training and extension service.

Several studies related to the palm oil small holder have been conducted to tackle those obstacles. Those studies are related to the farmer intention to cultivate palm oil (Feintrenie et al. 2010), the problem and solution of several NES cases in Indonesia (Rist et al., 2010), the technical efficiency of NES farmer (Alwarritzi et al., 2015). However, those are more related to the macro-policy evaluation, social, and cultural behaviour. The evaluation of NES project is presented by Jelsma et al. (2009) which suggest on strengthening farmer participatory in the NES.

We suppose that the drawback of NES in several places is could be caused by the failure to understand the economic behaviour of smallholder which is different from large estate. While the large estate is more on profit oriented and focused on income maximization, smallholder's economic behaviour is more and less similar to the household's. Despite of seeking the profit, smallholders more focus on utility maximization. In this case, they combine production, consumption and family labour allocation to achieve maximum utility. In other word, production and consumption activity are not separable and should be conducted simultaneously. Furthermore, the external and internal factors, not only change the production, but also change consumption, family expenditure, and family labour allocation simultaneously.

As far as our knowledge, the study focussed on the economic behaviour of smallholder is not done yet. Therefore, the study tries to understand the smallholder's economic behaviour in a NES scheme. Specifically, this study analyses of behaviour of palm oil production, labour use, inputs use, and expenditures of palm oil smallholders in South Kalimantan. We also simulate the effects of internal and external changes on smallholder performance.

The result will comprehend the understanding of smallholder's economic behaviour. Therefore, the policy maker and large estate are able to draw appropriate policy to sustain smallholder and large estate partnership.

RESEARCH METHODS

Research Location and Data Source

The research was carried out Tanah Laut Regency, South Kalimantan, Indonesia. Geographically, it is located on 114°30'20" - 115°23'31" East Longitude and 3°30'33" - 4°11'38" South Latitude. It has a tropical climate with temperature ranged 20.0^{O}C – 35.2^{O}C and humidity ranged 77.1% - 85.2%. The region has 43,139.87 hectares of palm oil area. Tanah Laut regency, especially PTPN XIII area, was purposively selected as the result of focused group discussion with the experts and the officer of the Plantation Agency of South Kalimantan. PTPN XIII South Kalimantan is one of the largest state

plantations and it has the largest plantation which has a partnership scheme with farmers/smallholder (2,230 hectares dedicated for NES). In addition, the *plasma* cooperative is managed well and has well-recorded documents.

The study used secondary data which included cross section and time series data. Cross section data were gathered from the survey by the research team of the Department of Social Economics of Agriculture, Faculty of Agriculture, Lambung Mangkurat University in 2015. This survey involved 60 households of farmers as respondents which were purposively selected.

The data were analysed to estimate the economic model which formulated through simultaneous regression and exogenous factors. Then, it was followed by simulation stage using a simulation model constructed by SAS v9.0 software.

Model Specification and Validation

We use an econometric model as it is a special form of algebraic models, with the stochastic element of one or more confounding variables (Intriligator, 1978). In the smallholder situation, all variables related to each other in more than one equation and they should be determined simultaneously to avoid inconsistent estimation (Gujarati, 2004). In order to do so, we use two stage least square (2SLS) regression analysis. It is a statistical technique for the analysis of structural equations, where the error terms of dependent variables are correlated to the independent variable (Amemiya, 2006; Dhanasekaran, 2006). The model is able to describe the real word if it meets economics, statistics, and econometrics criteria, the (Koutsoyiannis, 1978).

Correspondingly, this study applied household economic model of the palm oil smallholder. The model used cross section data, where the explanatory variables are only in the form of exogenous variables and without any time difference variable (lagged variable). On the other hand, endogenous variables are determined by the exogenous.

We formulated 14 structural equations and 18 identity equations and grouped these into four blocks, i.e: block of production; block of labour allocation; block of production costs and revenue, and block of household expenditures. Those variables are cofounding each other through structural equations and any change in one variable will affects others, directly or indirectly. See Appendix for variable relationships.

We use Root Mean Square Percentage Error (RMSPE) and Theil's Inequality Coefficient (U-Theil) with its decompositions (i.e.: UM, US, and UC) to validate the model whether the model is valid for scenario analysis. Our estimation reveals that the RMSPE values are small, UM and US are close to 0.00, and UC close 1.00. Those mean that the model is appropriate for simulation and has better prediction capability (Pindyck and Rubinfeld, 1991).

By those features, we applied scenarios to see the impact of any changes in internal and external factors. The scenarios include: the increase of fresh palm oil (TBS) price, labour cost, cooperative fee, fertilizer and pesticide price as external factors; and the expansion of the palm oil area, family labour increase and hired labour decrease as internal factors.

RESULTS AND DISCUSSION

The Economic Behavior of Palm Oil Smallholder Households

Household economic model of palm oil smallholder used a system of simultaneous equations. In this model, specification was carried out repeatedly to obtain meaningful models according to economic criteria and satisfactory according to statistical criteria.

Re-specification result was expected to generate the best model, both theoretically and empirically. Model formulation, estimation, and simulation used SAS version 9.

Palm Oil Production

Behavior of palm oil production was described into two behavioral equations and one identity equation. Behavioral equation was the total area of palm oil (LAKP), and palm oil productivity (PROVKS).

Table1. *Elasticity Equation and Parameter Estimation of the palm oil production in Smallholder Households in 2015*

Variables		Parameter Estimate	Standard Error	Pr > |t|
Dependent Variable: palm oil (plasma) area (LAKP) in hectare				
Land asset value (IDR)	LAHAN	8.601226	0.241862	<0.0001
Palm oil income (IDR per year)	REVKS	9.684E-09	3.036E-09	0.0017
Food crops income (IDR per year)	REVPANGAN	-0.262960	0.055959	<0.0001
Non-farming income (IDR per year)	REVNUT	0.296109	0.057365	<0.0001
Dependent Variable: Palm oil productivity (PROVKS) in kg per hectare				
Palm oil price (IDR per kg)	PTBS	0.006661	0.000211	<0.0001
Family labour use (man-day)	TTKDK	0.015683	0.003503	<0.0001
Number of tree (trees per hectare)	POHON	2.623116	0.248534	<0.0001
Labour productivity (kg per man-day)	PROVTK	0.017452	0.025430	0.4936

All parameter estimation has a different effect to the palm oil area (LAKP) at the significance level of 1%. The positive values of the estimated parameters mean that the changes in estimated explanatory variables were in line with the changes palm oil area (LAKP). The larger of land assets (LAHAN), palm oil income (REVKS), and non-farming income (REVNUT), then the larger the total area of palm oil (LAKP) will be. The negative value of food crops income (REVPANGAN) implied the food crop farming competes with palm oil farming, especially in the use of inputs and land use. This result is in line with Brandi et al. (2013) who state that the high economic profitability of palm oil brings economic competitiveness of land use.

Likewise LAKP equation, all sign of estimation parameters on behavioral function palm oil productivity (PROVKS) also have appropriate expectations to the economic criteria. The positive sign on parameter estimation means that the changes in variables explanatory in line with the change in the behavior of the palm oil productivity. Therefore, the higher fresh palm oil price (PTBS), family labour (TTKDK), hired labour (TKLK), the number of palm trees per plot (POHON), and labour productivity (PROVTK) cause the raise in productivity (PROVKS), and vice versa.

Behavior of Family Labour Use

Labour use behavior of palm oil smallholder was organized into four behavioral equations and four identities equations. Behavioral equations of family labour use in palm oil included to the husband (TKDKS), wife (TKDKI), and family labour use for non-palm oil activity for husband (TKLKS) and wife (TKLKI).

Table2. *Parameter estimation and elasticity equation of family labour use in the smallholder*

Variables		Parameter Estimate	Standard Error	Pr > |t|
Dependent Variable: Husband work time on palm oil (TKDKS) in man-day				
Palm oil area (hectare)	LAKP	0.100673	0.009963	<0.0001
Children labour (man-day)	TKDKA	-0.287890	0.077547	0.0003
Hired labour use (man-day)	TKLK	0.003983	0.003071	0.1967
Age of the owner (year)	UMURS	-1.998510	3.114031	0.5220
Farming experience (year)	US	2.284190	0.338840	<0.0001
Dependent Variable: Wife work time on palm oil (TKDKI) in man-day				
Palm oil area (hectare)	LAKP	0.668387	0.097777	<0.0001
Age of palm oil tree (year)	UTKS	4.545405	1.122207	<0.0001
Children labour (man-days)	TKDKA	-0.663310	0.937475	0.4804
Farming experience (year)	US	2.170508	6.743635	0.7480
Dependent Variable: Husband worktime on non-palm oil (TKLKS) in man-day				
Area for non-palm oil (hectare)	LALKS	0.301094	0.090318	0.0011
Farming experience (year)	US	2.388544	0.411954	<0.0001
Formal education of the owner (year)	PNDFRM	0.337076	0.106163	0.0018
Dependent Variable: Wife worktime on non-palm oil (TKLKI) in man-day				
Non-farming income (IDR)	REVNUT	0.019604	0.003935	<0.0001
Labour wage for palm oil (IDR per man-day)	UPAHKS	-1.776840	0.366241	<0.0001
Area of non-palm oil (hectare)	LALKS	0.611914	0.035731	<0.0001
Farming experience (year)	US	2.317818	0.248947	<0.0001

All parameters of estimation meet the economic criteria. Child labour as a supplement factor tends to unsubstituted. They only help at a specific time, such as harvesting and crops collecting. Hired labour use (TKLK) has a significant effect on husband's workload (TKDKS).

Husband and wife workload in the palm oil area was determined by palm oil area (LAKP), age of palm oil tree (UTKS), children labour use (TKDKA), husband age (UMURS), and farming experience (US).

Most of the explanatory variables on the behavior of husband worked on non-palm oil activity (TKLKS) are significantly affected by non-palm oil area (LALKS). In addition, the husband's motivation to work on non-palm oil area is its compensation received could cover the family expenses. In line with this, farming experience (US) and formal education (PNDFRM) have a significant effect on the husband worktime for non-palm oil (TKLKS).

Farmer wife's decision to devote her time on non-palm oil activity (TKLKI) is to save hired labour costs for palm oil (UPAHKS) and earn additional income from non-farm activities (REVNUT). Another factor is farming experience (US). Beside, employment opportunities for non-farm activities are quite open to who have expertise and skill.

Behavior of Input Use in Palm Oil Production

Block input use was organized into four behavioral equations and 12 identity equations. Behavioral equations are nitrogen fertilizer use (NITROGEN), phosphate fertilizer use (POSFAT), potassium fertilizer use (KALIUM), and pesticide use (PEST).

Table3. *Parameter estimation and elasticity equation of input use behavior in smallholder*

Variable		Parameter Estimate	Standard Error	Pr > |t|
Dependent Variable: Nitrogen fertilizer use (NITROGEN) in kg per year				
Age of palm oil tree (year)	UTKS	1.187465	0.437012	0.0074
Non-farming income (IDR per year)	REVNUT	4.107294	0.511944	<0.0001
Food crops income (IDR per year)	REVPANGAN	9.348774	0.339157	<0.0001
Health expense (IDR per year)	KESEHTN	-3.119420	0.622354	<0.0001
Dependent Variable: Phosphate fertilizer use (POSFAT) in kg per year				
Phosphate price (IDR per kg)	HIPP	-1.220760	0.648119	0.0616
Palm oil area (hectare)	LAKP	0.029998	0.005148	<0.0001
Age of palm oil tree (year)	UTKS	0.335227	0.087156	0.0002
Non-farming income (IR per year)	REVNUT	0.020531	0.004435	<0.0001
Health expense (IDR per year)	KESEHTN	-0.007600	0.007141	0.2890
Farmer status (1=NES farmer, 0=others)	DPIRKS	0.384236	0.095116	<0.0001
Dependent Variable : Potassium fertilizer use (KALIUM) in kg per year				
Potassium price (IDR per kg)	PPPK	-5.762700	0.622304	<0.0001
Palm oil price (IDR per kg)	PTBS	0.000243	0.000092	0.0090
Palm oil area (hectare)	LAKP	0.035441	0.011114	0.0017
Non-farming income (IDR per year)	REVNUT	0.100428	0.000526	<0.0001
Dependent Variable: Pesticide use (PEST) in liter per year				
Pesticide price (IDR per liter)	HIPD	-2.207600	0.719618	0.0026
Palm oil area (hectare)	LAKP	0.410166	0.074547	<0.0001
Age of palm oil tree (year)	UTKS	6.277553	0.746292	<0.0001
Non-farming income (IDR per year)	REVNUT	0.208841	0.074446	0.0057

The use of nitrogen fertilizer (NITROGEN) is determined by age of palm oil tree (UTKS), nor farming income (REVNUT), food crop income (REVPANGAN), and health expense (KESEHTN). This indicates that the nitrogen is mandatory fertilizer in the area, whereas the acreage and price are. There is an interesting fact that fertilizer use is significantly affected by non-farming and crop farming income. A fact that health expense (KESEHTN) has negative value means that fertilizer use and health expense has competitive relation in budget allocation.

Meanwhile, the use of phosphate (POSFAT), potassium (KALIUM), and pesticide (PEST) will increase if their respective price (HIPP, PPPK, and HIPD) declined although the response to changes is in a low effect. The potassium use (KALIUM) will increase if the price of fresh palm oil (PTBS) also rises. This means that the farmer will increase the use of potassium if they get additional incentives.

A negative value of the health expense (KESEHTN) in POSFAT equation reflects the change in both variables in opposite directions. The cost of fertilizers and household expenditure has competing relationship in the household budget allocation. The positive sign of non-farming income (REVNUT) on fertilizer and pesticide use indicates that non-farming activity has a contribution on palm oil activity.

Household Expenditure and Credit Repayment

Household spending behavior consists of five behavioral equations and an identity equation. The behavioral equations are expenditure for food consumption (CONSUMPTION), education expenditure (PENDDKN), health expenditure (KESEHTN), and period of credit repayment (KREDIT) (see Table 4).

Table4. *Parameter Estimation and Elasticity Equations Behavior of household expense in smallholder*

Variable		Parameter Estimate	Standard Error	Pr > |t|
Dependent Variable: Household Consumption (KONSUMSI) in IDR per year				
Family size (person)	JAKP	27.604430	3.560870	<0.0001
Palm oil income (IDR per year)	REVKS	1.04E-09	5.19E-10	0.0471
Food crops income (IDR per year)	REVPANGAN	0.160257	0.042813	0.0003
Farmer origin (1=transmigrant, 0=local)	DADPP	5.714495	0.558381	<0.0001
Dependent Variable: Education expense (PENDDKN) in IDR per year				
Number of schooled child (person)	JASEKL	473.221200	101.443600	<0.0001
Non-farming income (IDR per year)	REVNUT	0.715184	0.081984	<0.0001
Livestock income (IDR per year)	PDPTTRNK	0.056064	0.009183	<0.0001
Production investment (IDR per year)	INVSPROD	-6.823910	0.858700	<0.0001
Dependent Variable: Health expenditure (KESEHTN) in IDR per year				
Family size (person)	JAKP	36.028350	6.339630	<0.0001
Number of children (person)	CHILDREN	60.819780	5.811702	<0.0001
Education expense (IDR per year)	PENDDKN	-0.291550	0.077867	0.0003
Livestock income (IDR per year)	PDPTTRNK	0.025977	0.007709	0.0010
Dependent Variable: Credit repayment (KREDIT) in year				
Amount of credit (IDR)	NKKS	0.046465	0.002809	<0.0001
Cooperative fee (IDR)	FEEKOP	0.031559	0.004619	<0.0001
Hired Labour allocation for non-palm oil (IDR)	CTKLKS	0.355012	0.034398	<0.0001

Overall, the estimation indicates that the whole sign of parameter estimation is accordance with expectations and economic criteria. Statistically, most of the estimated parameters are different from zero at the significance level of less than 10%.

As expected, the household consumption (KONSUMSI) is positively and significantly affected by family size (JAKP), palm oil income (REVKS), food crop income (REVPANGAN) and farmer origin (DADPP). Transmigrant farmer seemingly has more variety of consumption compared to their counterparts.

Education expenditure (PDNDDKN) is significantly and positively affected by palm oil income (REVKS), non-palm oil income (REVNUT), livestock income (PDPTTRNK) and negatively by palm oil investment (INVSPROD). The success of smallholder will determine the ability to finance their child's education and investment, and in return, it will increase the household ability in managing the future palm oil business.

Behavior spending on health (KESEHTN) is significantly determined by family size (JAKP), number of children (CHILDREN) and livestock income (PDPTTRNK). Education expenditure (PENDDKN) has a negative sign, indicating that education has substitute correlation with health expenditure (KESEHTN).

On credit repayment behavior (KREDIT), all signs of estimated parameters meet economic criteria. Positive values of estimated parameters suggest that the increase of credit amount value (NKKS), cooperative fee (FEEKOP), and hired labour allocation for non-palm oil (CTKLKS) will delay the credit repayment (KREDIT).

Impact of Changes in External Factors

The impact of changes in external factors can be seen from the changes palm oil price, the price of fertilizer and pesticide, hired labour wages, and cooperative fee. Changes in external factors may affect the variable individually or simultaneously (see Table 5). Based on the domestic crude palm oil (CPO) price trend over a period of 30 years, the prices are likely to rise to an average of 13.00% (Indexmundi, 2016). It subsequently affects the fresh palm oil (TBS) price at the farm gate level and it is expected to increase by 15.00%. The price increase will improve the palm oil productivity by 10.43%. The increase motivates family members to work more on the palm oil area by reallocating the wife working time on non-palm oil to palm oil activity. Besides that, production cost also rising by 3.87%.

If the labour wage (in *plasma* or nucleus) rise by 15%, it will have an impact on the economic performance of farm household is a decline in fertilizer use, although with the response, especially phosphate at 6.71% and potassium fertilizer by 3.13% and the impact on delaying loan repayment by 2.4%.

Table5. *Impact of external factors on household economic performance of palm oil smallholders in South Kalimantan (in percentage change)*

Variables	Palm oil prices rise by 15%	Labour wage rise by 15%	Cooperative fee rise by 10%	Fertilizers and pesticides price rise by 25%
Area of palm oil	10.43	0.00	0.00	0.00
Urea fertilizer use	0.00	0.00	0.00	0.00
Phosphate fertilizer use	0.00	-6.71	0.00	0.00
Potassium fertilizer use	0.00	-3.13	0.00	0.00
Pesticide use	0.00	0.00	0.00	0.00
Cost of hired labour	0.00	0.00	0.00	-6.04
Production costs palm oil activities	3.87	0.00	0.00	16.88
Total cost of smallholder	0.00	0.00	0.00	5.59
Duration of credit repayment	0.00	-2.40	-17.20	0.00

The increase of cooperative fees by 10% only affects the credit repayment by 17.2%, while others unchanged. This can be explained as we assume that credit repayment is not determined by land area, but more than to the value of land area. Thus, the equation of credit repayment duration (KREDIT) is related to others equations only by identity equation.

The increase in prices of fertilizers and pesticides will impact on the use of hired labour by 6.04%. Farmers try to reduce costs by lowering hired labour use and replace with family labour. In line with this, the production cost increase by 16.88% and total cost by 5.59%. This result indicates that the change of fertilizer and pesticide price have a huge impact on smallholders and people surrounding who depend on hired labour activity. The sharp price increase will increase unemployment in the rural area.

Impact of Changes in Internal Factors

The impacts of changes in internal factors are expressed in percentage change in household economic performance of palm oil smallholders. The internal factors include the expansion of the palm oil area and the increase family labour in response to the fell of hired labour (see Table 6).

Table6. *Impact of internal factors on household economic performance of palm oil smallholders in South Kalimantan (in percentage change)*

Variables	Expansion of palm oil area by 30%	Family labour rose by 25% and hired labour fell by 25%
Palm oil land area	30.00	0.00
Palm oil productivity	0.36	0.89
Husband worktime in palm oil	28.27	0.00
Wife worktime in palm oil	19.04	0.00

Husband work time on non-palm oil activities	-18.26	0.00
Wife work time on non-palm oil activities	-10.13	-25.00
Hired labour costs	-15.96	0.00
Production costs of the palm oil activities	10.80	0.00
The total cost of the smallholder	12.46	0.00
Duration of credit repayment	0.00	-19.19

If the acreage of palm oil grows by 30.00%, it will have an impact on the smallholder economic performance. The smallholder will focus on palm oil activity, reallocate the family labour use from non- to palm oil activities, and reduce hired labour use on non-palm farming. As a result, the increase in production cost of palm oil activity is expected. The expansion of land area is possible because the regency covered by 15,064 hectares of fallowed dry land (CBS, 2015). Moreover, 78% of the regency's area are flat topography with sloop between 0 – 2%. However, the palm oil expansion should be considered properly as it may affect food crop production and create a clash with the food crop farmers (Yemandje, 2012). Therefore, further studies are needed to assess the effect of palm oil expansion to food crop production, labour use, and the local economy, as well as ecological aspect.

The expanding of the *plasma* plantation area will increase the use of family labour in palm oil activity and reduce the hired labour cost. In detail, if there is an increase or expansion of smallholdings by 30%, it would increase the husband worktime to 28.27% and the wife to 19.04%. On the other hand, the husband and wife will reduce their worktime allocation for non-palm activities by 18.26% and 10.13%, respectively. This labour reallocation leads to the decrease of hired labour which is indicated by the decrease of labour cost by 15.96%. The expansion also increases the use of fertilizer and pesticide, and lead to an increase in productivity by 0.36%. However, this increase is preceded by the rise of production cost and total cost by 10.80% and 12.46%, respectively.

If 25% of hired labour is replaced by 25% of family labour, the economic performance of smallholder households will increase through increasing palm oil productivity by 0.89 percent. Increased family labour use in palm oil activity will reduce wife worktime for non-palm oil 25%. This can be explained that the family labour has more care and experience on palm cultivation, while the hired labours are mostly unskilled. It also reveals the wife has a significant role in palm oil smallholder. The productivity improvement will further shorten the credit repayment duration by 19.19%.

CONCLUSION

The household economic behavior of palm oil farmers in all activities (production, labour use, input use, and household expenditure and credit repayment) are in line with the economics criteria. The estimation results indicate that a significant relationship between the production behaviour with consumption behaviour through variable of palm oil income. Furthermore, consumption behaviour (food consumption and health expenditure) influences the behavior of fertilizer use. The household consumption is determined by the budget (family income) and family characteristics (number of family members). In line with this, food consumption is largely determined by palm oil and food crop revenue, while health expenditure is determined by the number of family member, livestock revenue, and education expense. The credit repayment behaviour is determined not only by the amount of credit, but also determined by the behavior of labour supply for non-smallholding's activities and institutional factors (credit fee).

Simulations using several external and internal factors have different impacts on the performance of the household economy. An increase of palm oil price will improve the smallholder performance through the rise of input use and lead to the increase of palm oil productivity. On the other hand, an increase in fertilizer and pesticide prices will reduce production performance by reducing hired labour use to reduce production costs. An increase of labour costs will be compensated by a reduction of the fertilizers use and other inputs, which lead to a delay on credit repayment. An expanding of the palm oil area will raise family labour use and reduce the wage labour. Smallholdings expansion will

increase the inputs use, and lead to the improvement of productivity. On the other hand, an increasing on plantation area and production cost will be compensated by a decrease in hired labour use. Improved family labour use is expected to replace hired labour to improve farm productivity. Then, it will increase the revenues and shorten the credit repayment period.

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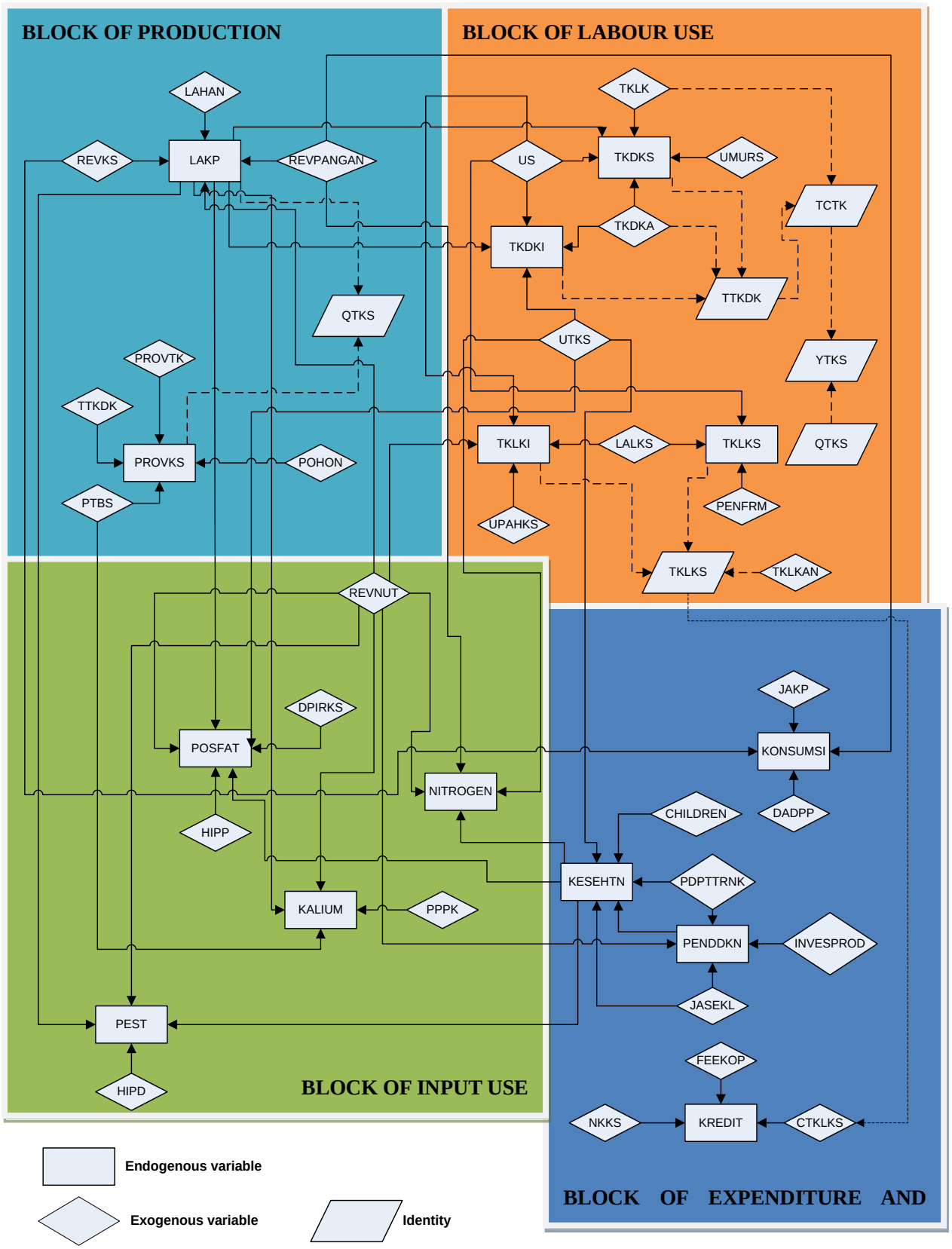
AUTHOR'S BIOGRAPHY

Hamdani, is a Ph.D holder from Brawijaya University – Indonesia, and a senior lecturer at Faculty of Agriculture, Lambung Mangkurat University, Indonesia. He correspondingly works as a researcher and a coordinator of community development in the rural area. His current research focuses on farmer economic behaviour and its relation to environmental-economic change and policy intervention

APPENDIX



Appendix1. *Relation between variables*

Notes: *Some identity equations are excluded in this diagram.*