Impact of Land Conversion on Oil Palm Production and Income

Edison

Abstract: ***Objective of study was to evaluate impact of land conversion on oil palm production, evaluate its impact on income of oil palm, and explore effect of social-economic aspects to land conversion of oil palm. Research used cross section data of 200 respondents. Data was analysed using qualitative and quantitative method. Results showed that a significant factors affected oil palm production which included land acreage, labour and capital. Significant factors affected income were selling price and capital. Then, socio-economic factors affected land conversion of oil palm such as education, income and saving. It found that paddy fields are more converted to oil palm fields, in which paddy fields were more in dryland than technical irrigation. Then, in terms of farming analysis, efficiency smallholder oil palm was higher than efficiency paddy (B/C on paddy was of 1.02 and B/C on oil palm was of 1.71).***

Keywords: land conversion, oil palm, production, income

I. INTRODUCTION

Agricultural sector is a very crucial sector of its role in economy in most of developing countries. It can be found from role of agricultural programme in supporting people as well as providing employment opportunities to people, contributing national income and supporting to various product. Various data explored that in some developing countries over 68% of people is in agricultural sector and over 45% of national income is come from agricultural sector and almost all exports are agricultural commodity (Todaro, 2008).

Development and modernization of agriculture in developing countries can contribute to increase production, increase farmer income and provide markets for industrial sector production, expand employment opportunities, increase exports and create savings for development. Agricultural and rural development actually contains many dilemmas (Wildayana and Armanto, 2018). On the one hand agricultural production and productivity must be improved. Increased production and productivity is a must because it is the basis and prerequisite for the process of industrialization (De Vos, 2016).

If high growth rates of the agricultural sector can be achieved, changes in production structures that reduce the level of relative productivity and even then will not be avoided unless the employment structure can also be changed following changes in the production structure. In the meantime, productivity improvement should not be done by using more efficient technology, biological technology, mechanical technology and social technology. However, this technology certainly leads to savings of labour in the sector concerned (Adriani et al. 2017).

In agricultural business, production is obtained through a long and risky process. The time gap required is not the same depending on the type of commodity being cultivated. Not only time, the adequacy of production factors also contribute as a determinant of production achievement. In terms of time, the plantation business requires a longer period compared to food crops and some horticultural crops. Each type of plant also has a different periodization of each other (Edison, 2020).

The new production process can run if the required requirements can be met, this requirement is better known as the production factor. Input contain four components, i.e. land, labour, capital, and skill or management (Daniel, 2012). Each of these factors has different functions and they are related to each other. If one factor is not available, then the production process will not run, especially the three factors mentioned above. These factors of production are something that absolutely must be available that will be more perfect if sufficiency requirements can be met. The capital production factor is partially allocated to provide the input of physical production, i.e. seeds, fertilizers and pesticides. Production input is one of the determinants of production activities, because plants need it to grow and develop well (Asni, 2015).

Production activities are activities in a rather narrow scope and therefore discuss the micro aspects. In studying this aspect, the role of input production and output (output or production) relationships gets the main concern. The role of input can not only be viewed in terms of its kind or availability in a timely manner, but also can be reviewed in terms of efficiency of its use (Alwarritzi et.al. 2015). Because of these factors the productivity gap (yield gap) between productivity and productivity produced by farmers is required. In many cases, as long as this productivity occurs because of factors that are difficult to overcome by human (farmers) such as the existence of technology that can not be moved and the existence of environmental differences, such as climate. Since these two factors are very difficult to overcome by farmers, the resulting differences caused by these two factors lead to the productivity gap from the experimental results and from the potential of a farm. (Soekartawi, 2006).

II. REVIEW OF LITERATURE

Land as one of the factors of production is a factory of agricultural products which is the place of the production process and the production is obtained. In agriculture, the factor of land production has a very important position. According to Schwarse et al. (2005), the change of function of land is the change of one land use to another, so that many problems arise related to land use policies.

Revised Manuscript Received on February 08, 2020.
Edison, Dept. of Agricultural Economics, Universitas of Jambi, Indonesia. E-mail: ediedison950@yahoo.co.id

This transfer of land functions generally involves transformation in allocating land resources from one use to another. Change of function of agricultural land is an issue that needs attention because the community's dependence on the agricultural sector, especially food. In land conversion activities, it is very closely related to land demand and supply, where supply or supply is very limited while land demand is not limited (Krishna et al, 2016). Factors affecting land supply are natural physical characteristics, economic factors, economic factors, and institutional factors. Besides the factors that demand for land are the population, technological developments, habits and traditions, education and culture, tastes and goals, and changes in attitudes and values caused by age development (Irawan, 2012).

According to Pastusiak et al. (2017), land use change generally involves transformation in the allocation of land resources from one use to another. According to Vijay et al. (2016), changes in land use patterns are essentially permanent and can also be temporary. If the technically irrigated paddy field turns into a residential or industrial area, then land conversion can be permanent. However, if the rice fields are turned into plantations, then the conversion of land can be temporary, because in the coming year it can be turned into fields again. The conversion of permanent land functions is usually greater than the temporary transfer of function. Irawan (2012) revealed that the negative impact of the conversion of paddy land is the degradation of the carrying capacity of national food security, declining agricultural income, and increasing poverty of local communities. In addition, other impacts are the destruction of paddy ecosystems, as well as cultural changes from agrarian to urban culture, causing crime.

According Wuepper et al. (2018) that land use change that occurs has both direct and indirect impacts. The direct impacts caused by land conversion include loss of fertile agricultural land, loss of investment in irrigation infrastructure, natural damage to the landscape, and environmental problems. From the studies mentioned above, it can be seen the factors that influence the decision of farmers to switch from rice to non-paddy rice. In this study the factors that caused farmers to change their land use include the area of land owned by farmers in the study area, the adequacy of irrigation water for wetland rice, differences in revenue from rice farming with cocoa and oil palm, and trends in the development of prices for lowland rice, cocoa, and palm (Hadi, 2014). There are several causes of the high land use change including low profitability of lowland rice farming, non-compliance with spatial regulations (weak law enforcement on spatial planning), desires to get short-term benefits from the conversion of paddy land, and low coordination between institutions and departments related to use planning land (Amurtiya et al., 2016).

Land is a strategic resource and has economic value. The area of agricultural land continues to decline each year, especially paddy fields. Extensive paddy fields are very important to obtain maximum production results. But along with the land use change that occurred, the area of wetland rice has declined. In addition there are some losses that must be calculated as a negative impact of the function of rice fields, such as the loss of potential rice production, loss of employment opportunities, and the increasingly damaged environment (Saswattcha et al. 2016). Based on previous studies, in this study it is suspected that there are factors that influence the decision of farmers to transfer land functions. These factors are the area of land with adequacy irrigation water, difference in revenue from rice farming with cocoa and oil palm, the tendency of the development of paddy, cocoa and palm oil prices.

III. OBJECTIVES

Objective of research was to evaluate impact of land conversion on oil palm production, evaluate its impact on income of oil palm, and explore effect of social-economic aspects to land conversion of oil palm.

IV. RESEARCH METHODS

Research method conducted using a survey method. Research area was identified purposively in Tanjab Timur District and Muaro Jambi District. Because Jambi becomes one of best production of oil palm in Indonesia. Tanjab Timur District and Muaro Jambi District had high number land conversions to oil palm in Jambi.

Cluster Sampling methods was used to identify respondents. In order to cover attentions from varies aspects, number of samples are 200 households (65 respondents on paddy farmers, 65 respondents on oil palm farmers and 70 respondents on paddy with oil palm farmers). Study was evaluated in 2019.

Cobb-Douglas production function model used in this study. Mathematically, expression of Cobb-Douglas production function model is: (Soekartawi, 2009)

$$Q = \alpha_0 I_1^{\alpha 1} I_2^{\alpha 2} .. I_m^{\alpha m} v \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

And it can be expressed in logit form as:

$$\text{Log } Q = \log \alpha_0 + \alpha_1 \log I_1 + \alpha_2 \log I_2 + ... + \alpha_m \log I_m + e \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where, Q is yield, I_1 ... I_n are inputs component, and α_1 ..... α_n = regression coefficient.

Input used consists land acreage, input labour, and input capital. There are factors that affect income assumed including yield, price, input labour, and input capital. Linkage input that affects yield and income is expressed in Cobb-Douglas production function (Gujarati, 2008).

Cobb-Douglas production function will be used to know effect input on paddy production as:

$$Q = \beta_0 I_{11}^{\beta 1} I_{12}^{\beta 2} I_{13}^{\beta 3} u_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots 3$$

Through logarithmic formulation, equation (3) is stated to linear equation using Ordinary Least Square (OLS) method as:

$$\text{Log } Q_1 = \text{Iog } \beta_0 + \beta_1 \log I_{11} + \beta_2 \log I_{12} + \beta_3 \log I_{13} + u_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where, Q_1 is yield, I_{11} is land acreage, I_{12} is labour, I_{13} is capital, and β_1 - β_3 = regression coefficient.

Equation model that expressed paddy income is as follows:

$$\text{Log } Q_2 = \log \Psi_0 + \Psi_1 \log I_{21} + \Psi_2 \log I_{22} + \Psi_3 \log I_{23} + \Psi_4 \log I_{24} + u_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where, Q_2 is paddy income, I_{21} is yield, I_{22} is price, I_{23} is input labour, I_{24} is input capital, Ψ_1-Ψ_4 is regression coefficient.

Input model that explain oil palm yield is expressed as:

$$\text{Log } Q_3 = \log \gamma_0 + \gamma 1 \log I_{31} + \gamma_2 \log I_{32} + \gamma_3 \log I_{33} + u_3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

Where, Q_3 is oil palm production, I_{31} is land acreage, I_{32} is labour used, I_{33} is capital, γ_1-γ_3 is regression coefficient.

Furthermore, input model that explain income of oil palm is expressed as:

$$\text{Log } Q_4 = \log \delta_0 + \delta_1 \log I_{41} + \delta_2 \log I_{42} + \delta_3 \log I_{43} + \delta_4 \log I_{44} + u_4 \ldots\ldots\ldots\ldots\ldots\ldots 7$$

where, Q_4 is oil palm revenues, I_{41} is yield, I_{42} is selling price, I_{43} is labour used, I_{44} is capital, δ_1-δ_4 is regression coefficient.

Finally, equation input model that affect area paddy that convert model to oil palm plantation is as:

$$\text{Log } Q_5 = \log \eta_0 + \eta_1 \log I_{51} + \eta_2 \log I_{52} + \eta_3 \log I_{53} + \eta_4 \log I_{54} + \eta_5 \log I_{55} + \eta_6 \log I_{56} + u_5 \ldots.. 8$$

Where, Q_5 is oil palm income, I_{51} is yield, I_{52} is price, I_{53} is input labour, I_{54} is input capital, I_{55} is land acreage, I_{56} is water availability, η_1-η_6 is regression coefficients.

V. RESULT AND DISCUSSION

Characteristics of Respondents

Farm size. Farm size each farmer was in average 2,00 hectare, and area farming owned was generally unity in different cropping patterns. In average, farm size of rice farmers was 1,58 hectare while farm size of oil farm farmers was 1,69 hectare. With variation cultivated land, agricultural activity is classified as small farmers. In research area, respondents plant oil palm by changing their paddy in the existing land and it was not allow to extent their cultivation land only if they buy other land. Therefore, cultivated paddy area is usually little bit different from oil palm cultivated area. Land conversion from paddy to oil palm, did not cause much different in their farming land. Before farmers change to use new technology, farmers were not successful on paddy cultivation. Some of them move to do other job to look for new better life. Others leave their land to inheritance of land cultivation to their children.

Labour Use. Labour use in paddy was in averages of 27,9 workdays/cultivation season on per existing land. This is rather high because they did not use mechanization. This condition can be seen when they worked on land preparation and harvesting. If they used only human labour, it took around 25 workdays per hectare. When it used machine to harvest, it needed only around 4 hours per hectare. Mechanisation can increase farmers ability to operate their land. On research area, considering movement agricultural mechanisation, it had changed paddy farming from labour intensive to capital intensive. Mechanization has been used in land cultivation i.e. hand tractor. Doing seedling did not also used because of existing of *tabela* (direct seed planting without seedling method). It also used Combined harvesters for harvesting. Condition was the same as Brhanu (2018) who stated that applying mechanical technology could increase productivity significantly.

Labour on oil palm cultivation is not really different from paddy. Oil palm joining to private plantation do all activities for their activities. Oil palm used labour was only about 18 workdays for every 6 months for 2 ha. Therefore, farmers' leisure time is high, allowing farmers to work on other activities. Result was the same as Krishna et al. (2016) expressed that oil palm needed few labour than rubber plant which became one of crucial plants.

Agricultural Production Costs.

In traditional paddy farming, some costs are linkage labour costs from preparation till harvest. Meanwhile, improvement in paddy cultivation using machinery, paddy becomes more expensive. Production costs paddy was 2 million IDR/ha/year per planting season. It covered fertiliser costs (26%), land processing and harvest costs (74%). Furthermore, cost on oil palm is about 3 million IDR/ha/year. It covered fertiliser costs (38%), and harvesting costs (62%). Cost for cultivation and harvesting in paddy was about 68% of production costs.

Paddy and Palm Oil Productivity.

Paddy productivity is about 5.5 tons/ha/time, then when farmer cultivates twice in a year, productivity is 11 tons/ha/year. However, farmers grow mostly one each year with productivity about 2,75 tons/ha/year. This condition caused paddy farmers had small income than oil palm farmers. Indonesian Central Bureau of Statistics data (2018) showed that productivity of dryland paddy was 5.31 tons/ha/year. This meant that paddy productivity carried out in research area is smaller than paddy productivity in Indonesia. Meanwhile, oil palm productivity on averages was 22.5 tons of fresh fruit bunches/ha/year in research area. When, It was compared to other plantations results about 24 tons/ha/year, that result was closed to 1 ton/ha/month.

Input Affecting Production and Income on Paddy

(a). Analysis Input Affecting Production on Paddy

To test Hypothesis in this research, it is used quantity model from cross-section data about 65 samples. Estimation of input affecting paddy production was

Table 1. Estimation of Paddy Production

Item	Coefficient	Std. Error	t- value	Probability
Constanta	-12.672			
Log I_{11}	0.489	0.129	3.78	0.0007
Log I_{12}	0. 012	0.015	0.78	0.0782
Log I_{13}	0. 594	0.120	4.93	0.0002
R^2 adj	0.8142			
F-stat	74.25			

From estimation, it found that adjusted R^2 equals of 0.8142. It had meaning that input of land acreage, input labour and input capital was to explain paddy production. Model can explain problem about 81.425 and about 18.58% was influenced other problems not included in model. F-test was 74,25. It had a meaning together (simultaneously) among land acreage, input labour, and input capital affected variation paddy production.

(b). Analysis of Input Affecting Paddy Income

Paddy income covers income earned from paddy after deducting cost incurred to get paddy. Estimation of input affecting paddy income was

Table 2. Estimation Income on Paddy

Item	Coefficient	Std. Error	t- value	Probability
Constanta	31.113			
Log I_{21}	3.903	1.297	3.01	0.0001
Log I_{22}	3.284	0.623	5.27	0.0009
Log I_{23}	0.924	1.593	0.58	0.0000
Log I_{24}	0.884	0.902	0.98	0.0028

R^2 adj	0.8269
F-stat	91.78

It found from estimation that adjusted R^2 equal of 0.8269. It had meaning that input quantity, price, input labour and input capital was to explain paddy income. Model can explain variation paddy earnings about 82,69%. And about 17.31%, was influenced other variables not included in model. F-test was 91,78. It had a meaning together (simultaneously) among production, price, input labour and input capital affected variation paddy income.

Input Affecting Oil Palm Production and Income

(a). Analysis Input Affecting Oil Palm Production

Estimation production on oil palm used cross-section data about 65 samples. Estimation input affecting oil palm production can be seen as follows:

Table 3. Estimation Production on Oil Palm

Item	Coefficient	Std. Error	t-value	Probability
Constanta	21.618			
Log I_{31}	0.589	0.125	4.73	0.0001
Log I_{32}	0. 972	0.190	5.11	0.0009
Log I_{33}	1.002	0.138	7.26	0.0000
R^2 adj.	0.8293			
F-stat	41.94			

It found that from estimation that adjusted R^2 equal 0.8293. It had meaning that land acreage, input labour and input capital was to explain oil palm production. Model can explain variation oil palm production about 82.93%. And about 17.07% was influenced not included in model. F-test was 41,94. It had a meaning together (simultaneously) among land acreage, input labour and input capital affected variation oil palm production.

(b). Estimation of Input Affecting Oil Palm Income

Income is oil palm earned from production of oil palm minus costs incurred to get production. Estimation of input affecting oil palm income can be seen as follows:

Table 4. Estimation Income of Oil Palm

Item	Coefficient	Std. Error	t- value	Probability
Constanta	4.249			
Log I_{41}	0.642	0.253	2.54	0.0001
Log I_{42}	0. 997	0.216	4.61	0.0009
Log I_{43}	0. 926	0.857	1.08	0.0000
Log I_{44}	1. 121	0.143	7.82	0.0028
R^2 adj	0.7528			
F-stat	32.89			

Result found that adjusted R^2 was about 0.7528. It had meaning that production, price, input labour and input capital was to explain income of oil palm. Model can explain variation of oil palm about 75.28%. And, about 24.72% was influenced not included in model. F-test was 32,89. It has a meaning together (simultaneously) among production, price, input labour and input capital affected variation oil palm income.

Analysis Input Causing Paddy Converting to Oil Palm

It found that estimation of input affecting paddy converting to oil palm can be seen as follows:

Table 5. Estimation Input in Oil Palm Conversion

Item	Coefficient	Std. Error	t- value	Probability
Constanta	18.254			
Log I_{51}	0.712	0.172	4.13	0.0001
Log I_{52}	0. 538	0.217	2.48	0.0009
Log I_{53}	0. 607	0.116	5.78	0.0000
Log I_{54}	0. 671	0.227	2.96	0.0028
Log I_{55}	0. 328	0.388	1.87	0.0046
Log I_{56}	- 0.209	0.127	1.64	0.0053
R^2 adj	0.8109			
F-stat	46.32			

Result found that adjusted R^2 was about 0.8109. It had meaning education factor, social factor, income factor, money factor, land suitability, water factor was to influence land conversion of oil palm. Model can explain variation of oil palm about 81.09%. And, about 18.91% was influenced not included in model. F-test was 46.32. It has a meaning together (simultaneously) among social factor, income factor, money factor, land suitability, water factor affected converting oil palm.

Therefore, social factors (such as education, interested), economic factors (such as income, money), and land factors (such as land, water) have impact significantly in conversion paddy to oil palm. Specifically, factors caused land conversion paddy to oil palm which was economic factor and social factor.

Based on estimation, it found that water factor showed negative effect but not significant. It meant that paddy that convert to oil palm was not technical irrigation land. Result also explored that level education of farmers, paddy acreage had impact to switch to oil palm plantation as well as income factor and money factor. Good education factor caused farmers to be better knowledge in use technology or innovation and conversion to be more valuable crop.

On economic point of view, oil palm had better economic aspect than paddy which can be seen on oil palm efficiency (B/C value) better than paddy. Oil palm is a prospect crop that creates better guaranteed income than other crop i.e. paddy. Good economic value oil palm creates farmers interest to grow oil palm, rather than to paddy. Based on economic analysis, it found that it has good opportunity cost of conversion from paddy to oil palm. Expenditure cost paddy was IDR. 1,658,500, - per hectare each year and it created income of IDR. 1,667,250, - per hectare per year. Meanwhile, oil palm cost was IDR. 4,612,625, - per hectare every year and it got income IDR. 7,824,148, - per hectare per year. So, difference between cost of oil palm and paddy per hectare was IDR. 3.295,625, - and income gap was of IDR. 6.156.898, -. It had meaning that each additional cost IDR. 3.295,625, - from paddy, farmers got more income of IDR. 6.156.898, - from oil palm. Therefore, opportunity cost of land conversion paddy to palm oil was IDR. 6.156.898. This analysis showed that B/C ratio paddy was 1.02 and B/C ratio oil palm oil was 1.71.

VI. CONCLUSION

Land acreage, labour and capital affect paddy yield. In particular, variable land acreage and capital has significant effect to paddy yield, where crucial effect is capital. Income of paddy is significantly affected by variables of quantity yield, price, input labour and input capital. Purposely, income of paddy is affected by yield and price. Land acreage, input labour and capital together influence palm oil yield. Partially, all variables significantly affect oil palm yield, where crucial effect is input capital. Yield, price, input labour and capital together affect income of oil palm farmers. Partially, price and input capital have a significant effect to income of oil palm, and crucial effect is input capital. Socio-economic factors and physical factors of land affect conversion of paddy to oil palm. Partially, factors affecting extent of land switched function are educational factors, farmers' income and saving. It is that paddy fields that are more likely to be changed to oil palm plantations are dryland rather than technical irrigation. Based on farming analysis, B/C ratio of dryland paddy farming was 1.02 and B/C ratio of oil palm was 1.71. This means that the efficiency of oil palm farming is higher than efficiency of paddy farming.

REFERENCES

1. Adriani D.E., Wildayana Y., Alamsyah I., Hakim M.M. (2017): Technological innovation and business diversification: Sustainability livelihoods improvement scenario of rice farmer household in sub-optimal land. Russian Journal of Agricultural and Socio-Economic Sciences, 9 pp. 77–88.
2. Alwarritzi, W. T. Nnaseki, and Y. Chomei. (2015). Analysis of the Factors Influencing the Technical among Oil Palm Smallholder Farmers in Indonesia. Procedia Environmental Science. 21 pp. 23-31
3. Amurtiya M., Lumbonyi C.A., Abdullahi A., Olaywola S.A., Yaduma Z.B., Abdullah A. (2016): Livelihood diversification and income: A case study of communities resident along the Kiri Dam, Adamaya State, Nigeria. Journal of Agribusiness and Rural Development, 4: pp. 483–492.
4. Asni, (2015). Analysis of Production, Income and Transfer of Land Function in Labuhan Batu Regency, Postgraduate Program, University of North Sumatra Medan pp. 1-67.
5. Brhanu G.A. (2018): Access to land and agricultural based livelihoods in Northwestern Ethiopia: Implications for land use. Journal of Development and Agricultural Economics, 10 pp. 292–297.
6. Daniel, M. (2012). Introduction to Agricultural Economics. Earth Literacy. Jakarta pp. 1-87.
7. Daulay, A. R. Intan E. K. P., Barus, B. and Pramudya B.N. (2016). Rice Land Conversion into Plantation Crop and Challenges on Sustainable Land Use System in the East Tanjung Jabung Regency. Procedia Social and Behavioral Sciences. 227 pp. 174-180.
8. De Vos, R.E. (2016). Multi-Functional Lands Facing Oil Palm Monocultures: A Case Study of a Land Conflict in West Kalimantan, Indonesia. Austrian Journal of South-East Asian Studies, 9(1) pp. 11-32
9. Edison, (2020). The Effect of Price on Meta Profit Function Model: A Case of Western Indonesia Soybean. International Journal of Management Studies 7(1) pp. 20-25.
10. Euler M., Schwarze S., Siregar H., Qaim M. (2016): Oil palm expansion among smallholder farmers in Sumatra, Indonesia. Journal of Agricultural Economics, 67 pp. 658–676.
11. Gujarati, D. (2008). Basic Econometrics. Erlangga Press, Jakarta. Pp. 1-214.
12. Hadi, N, (2014). Replacing Rice with Oil Palm. Forestry and Estate Crops Office of Tanjung Jabung Timur Regency. Jambi. Pp. 1-83.
13. Irawan, B. (2012). Rice Land Conversion Causing Negative Impact to Food Security and Environment. Warta Penelitian dan Pengembangan Pertanian 27(6) pp. 48-57.
14. Krishna V., Eulerb M., Siregar H., Qaima M. (2016): Differential livelihood impacts of oil palm expansion in Indonesia. Agricultural Economics, 48 pp. 639–653.
15. Pastusiak R., Jasiniak M., Soliwoda M., Stawska J. (2017): What may determine the off-farm income? A review. Agricultural Economics – Czech, 63 pp. 380–391.
16. Saswattcha, K. Hein, L. Kroeze C. and Jawjit W. (2016). Effect of Oil Palm Expansion through Direct and Indirect Land Use Change in Tapi River Basin, Thailand. Journal of Biodiversity Science, Ecosystem Services and Management. 12(4) pp. 291-313.
17. Schwarze S., Zeller M. (2005): Income diversification of rural household in Central Sulawesi, Indonesia. Quarterly Journal of International Agriculture, 44 pp. 61–73.
18. Soekartawi. (2006). Basic Principles of Agricultural Economics, Theory and Applications. Revised Edition. Rajawali Press. Jakarta. Pp. 1-68.
19. Soekartawi, (2009). The Theory of Production Economics with the Principles of the Cobb-Douglas Function Analysis. PT Raja Grafindo Persada, First Printing. Jakarta. Pp. 1-116.
20. Sumarga, E. L. Hein. A. Hooijer and R. Vernimmem. (2016). Hydrological and Economic Effects of Oil Palm Cultivation in Indonesia Peat-lands. Ecology and Society 21(2) pp. 52-59
21. Todaro, M. P. (2008). Economic Development in the Third World. Seventh Edition. Erlangga. Jakarta. Pp. 1-109.
22. Vijay V., Pimm S.L., Jenkins C.N., Smith S.J. (2016): The impacts of oil palm on recent deforestation and biodiversity loss. PLoS ONE, 11 pp. 1-12.
23. Wildayana E., and Armanto M.E. (2018): Dynamics of land use changes and general perception of farmers on South Sumatra Wetlands. Bulgarian Journal of Agricultural Science, 24 pp. 180–188.
24. Wuepper D., Ayenew H.Y., Sauer J. (2018): Social capital, income diversification and climate change adaptation: Panel data evidence from rural Ethiopia. Journal of Agricultural Economics, 69: 23–35.

AUTHOR PROFILE

Dr. Ir. Edison, M.Sc. is associate professor from University of Jambi Indonesia. He also a former lecturer in a few private colleges for more than ten years. He also had experience for more than four years as Main Counterpart in CRC990 (Collaboration Research Centre Indonesia – Germany). Currently, he looks forward on teaching, doing research in University of Jambi. He has specializing on Agricultural Economics.