Plant Archives Vol. 21, No. 2, 2021 pp. 221-229 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no2.035

SUSTAINABILITY OF APPLE PRODUCTION IN THE TROPICS USING LAND RENT ANALYSIS IN BATU CITY INDONESIA

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(Date of Receiving-28-01-2021; Date of Acceptance-11-05-2021)

ABSTRACT

Apples have gone through a long process of adapting to the Indonesian climate. Limited availability of non-renewable land creates fierce competition for land use. The purpose of this study was to a) determine the history and condition of apple farming, b) to analyze the land rent value of apple plants with plants that have the potential to replace them, namely oranges, guava, and seasonal plants, c) to determine the factors that affect the land rent value of citrus, guava, and seasonal plants. Data obtained through interviews with selected informants using a questionnaire and analyzed using land rent analysis to determine the value and factors that influence it. The results showed that apple plants' introduction has resulted in several varieties that have successfully adapted to the Indonesian climate. Indonesian apples' development is still 99.81% centered in East Java, with bad apples' sustainability because the land rent value is much lower than other commodities.

Keywords **:** land rent, tropical apple, apple sustainability

INTRODUCTION

The agricultural sector is an integrated sector that depends on natural resources, especially land. Land as the primary input is an irreplaceable and essential factor for economic growth (Li, 2014 and Czyżewski and Matuszczak, 2016). Otherwise, farmland is the most efficient wealth-producing asset (Muyanga *et al*., 2013 and Sitko and Jayne, 2014 and Jager, 2009). Even degraded land that unable to sustain their livelihoods, Ethiopian farmers still maintain their land (Moreda, 2018). Its shows that the paradigm of sustainable agriculture through a "land-based approach" faces a new challenge, where land is expected to provide more environmental facilities that ensure food security and profitable production at the same time (Gliesman and Rosemeyer, 2010).

Since the beginning of human civilization, the land has resulted in certain benefits that meet the community's needs. One of the bases for applying such a paradigm to agricultural economics is that developed countries' natural environment is almost entirely anthropogenic. In such conditions, how to use natural resources must also be changed. Land availability is limited and can not be updated fierce competition of land use, which occurs between agricultural commodities (Rondhi *et al*., 2018). To maximize economic benefits, farmers tend to over-exploit land by cultivating high-value crops, although sometimes they are not under the land's characteristics (Kutywayoa *et al*., 2014). However, land quality will decline in the long term or require agricultural infrastructure support (Sitorus *et al*., 2007a). For example, the conversion of 1,521 ha of paddy fields into oil palm in Lampung Indonesia (Daulay *et al*., 2016a) shows a reduction in fertile land devoted to crops (Vignola *et al*., 2015) amid increasing alternative fuel (Wheeler and von Braun, 2013).

Based on traditional location theory, agricultural land conversion is caused by relatively higher rents generated from urban land use than agricultural land use (Irwin and Bockstael, 2007). The conversion of agricultural land in developing countries is rapid and unplanned. Uncontrolled conversion directly reduces food production and provides ecosystem goods and services (Foley *et al*., 2005). Moreover, according to United Nations estimates, the world's population will reach 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100 (United Nation, 2019) driving up prices. Food, especially in developing countries, will trigger urbanization (McIntyre *et al*., 2009). Encourage scarcity of agriculture labor (Satterthwaite *et al*., 2010 and Jiang and Zhang, 2016), in addition to the higher demand for land as a place to live (Waddell and Moore, 2008). Research on land rents is still helpful for comparing each commodity's land rent value because the land rent gap between commodities encourages land-use change (Daulay, 2016). But combining land rent with another variable like the price of land by (Střeleček *et al*., 2011), which is usually the selling price of land is influenced by location, size, and purpose of use. The results show a significant increase, also impact from land rent to migration that's positively correlated (Di Suo *et al*., 2016).

Batu City is a producer area for various agricultural commodities, especially horticulture. The city's rapid development has shifted from an agropolitan city into a tourist city in the last ten years. Tourism can contribute significantly to Gross Regional Domestic Product (GRDP), so development aims to develop tourism-supporting sectors (Rahayu *et al*., 2013). On the other hand, the large number of tourist visits encourages road infrastructure, homestays, hotels, villas/rest areas, and restaurants which causes pressure on land values (Hardjowigeno and Widiatmaka, 2007). The area of tropical apple plantations in Batu City has decreased by> 70% from 2008 to 2019, and there are 903 ha remaining. Based on (Yudichandra *et al*., 2020) research, the Batu area can still develop apple plants. But if viewed from the current challenges of apple cultivation, it is difficult for farmers to expand their land. Therefore, this research was conducted to determine the vulnerability of the apple crop. Through a long process of adapting to Indonesia's tropical climate, even apple has become part of the community's ethnobotany towards other commodities that are considered beneficial for farmers, especially in certain areas. This study aims to (1) determine the history and condition of apple farming; (2) to analyze the apple land rent value with commodities such as guava and oranges and seasonal crops; and (3) to determine the factors that affect the land rent value of apple, guava, orange and seasonal crops in Batu City, East Java.

MATERIAL AND METHOD

Time and Location

Field research activities were carried out from March to July 2020 during the Covid 19 pandemic. The location of the research was carried out in Batu City, East Java, Indonesia. The research area's focus was on Bumiaji District as an agricultural center in the City of Batu area, while in other districts, apple plants no longer exist.

Data collection

Data collected in the form of primary data and secondary data. Secondary data in the form of Statistic center data, Agriculture Service, and literature review. Primary data includes interviews with researchers for apple history in Indonesia and farmers by interviewing selected farmers using a questionnaire.

Data Analysis

Regarding apple farming history and condition, an informant was determined from apple plant researcher ICSFRI Batu. Then, check and disseminate information to the Indonesian agricultural extension network to determine and verify the data through the apple land coordinates. Respondents for land rent were determined by grouping the number of farmers based on the potential commodity to replace apple crops such as citrus, guava, and seasonal crops in each village, then the number of respondents was determined using the Slovin formula.

$$n = \frac{N}{1 + N(e)^2} \qquad ...(1)$$

Information:

n = sample size

N = population size

e = percentage of leeway in not careful sampling

The analysis stage includes a descriptive analysis of the history and current conditions of apple farming. Meanwhile, analysis of land rent and analysis of factors affecting the value of land rent is carried out in the following stages: (a) multiple correlation analysis to know the closeness of the relationship between the explanatory variables; (b) multiple linear regression analysis is carried out to determine the factors that significantly influence the value of land rent and ensure that there is no multicollinearity of data (classical model test), and (c) multiple determination coefficient analysis (R).

Operationally land rent can be measured as the net income received by a plot of land per square meter per year due to carrying out an activity on that plot of land. Mathematically, land rent can be formulated as follows (Sitorus *et al*., 2007b):

$$\text{Land rent} = \frac{\text{income} - \text{Production cost}}{m^2} \qquad ...(2)$$

or

$$\text{Land rent} = \frac{\sum_i^n p_i H_i - \sum_i^n B_j C_j}{m^2} \qquad ...(3)$$

Information:

P_i = the i^{th} volume product output
H_i= the i^{th} output price
B_j= the j^{th} production input
C_j= the j^{th} input price/cost

Multiple linear regression was carried out using the Ordinary Least Square (OLS) approach. Multiple linear regression equation with variables:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + e \qquad ...(4)$$

From the equation above, β_0 is the intercept and slope coefficient β_1 variable, independent variable coefficients. β_1 measures the average change in Y against the change per unit variable X1 (production) by assuming the other variable X is constant (partial regression coefficient). The variables analyzed are presented in Table 1.

Table 1 : Dependent variable (Y) and independent variable (x) to determine the factors that affect the land rent of apples, citrus, guava plants, and seasonal crops.

Variable	Unit	Information
Y	Rp year^{-1}	*Land rent*
X1	Kg ha^{-1}year^{-1}	Production
X2	Rp kg^{-1}	Yield price
X3	Rp kg^{-1}	Production cost
X4	Rp year^{-1}	Distance from city center
X5	Ha	Planted area
X6	year	Age
X7	1=elementary school; 2=junior high school; 3=High School; 4=Diploma/Ba	Education
X8	Years	Farning experience

RESULTS AND DISCUSSION

Apple in Indonesia

Apple crop plants are introduced from subtropical regions, imported from Australia in 1930, and planted in the Tebo Village, Pujon District, Malang as many as 20 varieties (Kusumo, 1974). In 1953 the branch of the Malang Horticultural Research Institute brought in several types of apples from abroad. Furthermore, since 1960 apple plants have been widely planted in the Malang area (now we call it Batu City) to replace citrus plants that have died from the disease. Climatic conditions affect the apple plant, especially by the temperature that causes phenological phase changes, including the induction and differentiation of flowers (Petri *et al*., 2012). But some plant varieties already adapt to regional conditions, as says by (Anggara *et al*., 2017), which states that domesticated plants must adapt to produce. However, in general, cultivation modification steps are carried out, so the plants bear fruit by breaking dormancy either mechanically or chemically to encourage flowering (Anggara *et al*., 2017). In tropical areas, apple plant defoliation can be done twice a year.

The various varieties that have been planted in Indonesia, only five varieties of apple plants have survived, namely Rome Beauty, Anna, Manalagi, Huanglin, and Princess Noble. Meanwhile, the government recommends that farmers cultivate three varieties: Rome Beauty, Manalagi, and Anna, because they can produce high yield and harvest twice a year. In 1981, more than 2 million apple plants were reported (Notodimedjo *et al*., 1981). Until the end of 1990, the apple crop in Batu City experienced its glory and spread widely until 9,043,276 trees in such a small City (Suharyono, 2014). Still, after the year 2000, it continued to decline.

However, even with high productivity of apple in Indonesia, the production costs incurred are also high due to poor management in cultivation (Anggara *et al*., 2017). The low fertility of farmers' apple fields is due to intensive farming and lack of attention to soil conservation. Decreased organic matter is dangerous to fertility and productivity (Boone *et al.,* 2018 and Zhu *et al., 2018*) because the soil's microorganisms are reduced. Overall, the soil hardens, and the soil fertility decreases (Hakim and Siswanto, 2015) and creates dependence on farmers. Soils that are poor in organic matter will be less able to support water and fertilizers.

Through the Indonesian Citrus And Subtropical Fruits Research Institute (ICSFRI), Batu has been made efforts to spread plants to various Indonesian regions by collaboration with ICSFRI-local governments. However, only a few have survived, namely in the areas: (Table 2).

Table 2 : Distribution of Apples Orchard in Indonesia

No	Territory	Large (Ha)	Coordinate point
1	Central Aceh District, Aceh	1.5	4°28'12", 96°50'0", 1560,0m
2	Solok District, West Sumatera	0.6	1°15'18.13"S, 100°51'54.64"E
3	Rejang lebong District, Bengkulu	0,6	-331'5", 102°41'29", 1059,6m, 160°
4	Pasuruan District, East Java	2,427.88	7°53'40.39"S, 112°49'28.36"E
5	Batu City, East Java	903	7°49'55.49"S, 112°31'37.90"E
6	Malang District, East Java	399.75	8° 1'47.70"S, 112°49'11.20"E
7	East Lombok, West Nusa Tenggara	2	8°22'12.16"S, 116°30'45.23"E
8	Kabupaten Bantaeng District, Southeast Sulawesi	0.85	-5°26'3", 119°56'53", 1386,0m, 298°
9	Flores District, NTT	1.5	-8.75879, 121.838923, 970.66, 1.6 m
10	Timur Tengah Selatan District, NTT	spread	-9,60189, 124,20975, 1475,0m, 255°

Yield and major constraints

The development of apple plants is still concentrated in East Java Province, with 99.81% plants in the Pasuruan District, followed by Batu City and Malang District (Table 2). The lack of crops spreading to another area because apple is one of the spoiled crops and requires more attention from farmers (Hinman and Ames, 2011). Besides, many pests and diseases potentially harm crops if not controlled, and attacks on five-year-old apple plants can reduce yields by 43% (Malling, 2015). Overview of apple production and apple import rate in Indonesia is presented as follows:

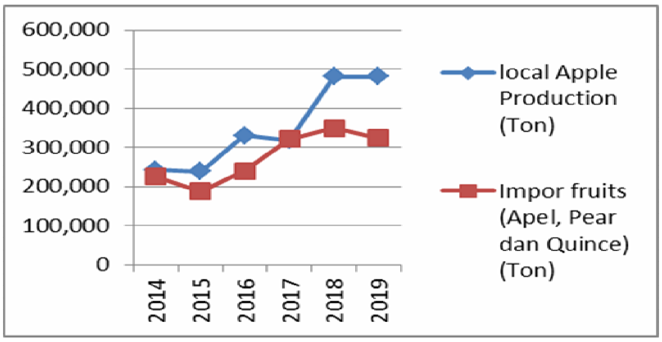

Fig. 1 : Total Apple Production and Imports of Apples, Pears, and Quinces

Based on Figure 1, the number of apple production can not fully supply the community's needs. Lack of interest from farmers in other areas is possible due to high production costs but low selling prices. Another reason is that the apple plants that have existed until now are inherited from old plants, and farmer efforts to replant are less. Event It is evident that currently, the age of apple plants is> 25 years, and some are> 40 years. Indonesian apples produce 481,372 t from a land area of 3,737.68 ha. While China the largest apple producing country produce 41,390,000 t from 2,220,430 ha area, United States produce 5,173,670 t from 130,710 ha, Turkey produce 3,032,164 t from 175,357 ha (FAOSTAT, 2019).

Land rent value

Based on Table 3. the land rent value of apple plants is obtained from the average value of the revenue amount with the average value of expenditure per m^2/year. The research results on 93 respondents of apple farmers in Batu City obtained land rent value IDR. 12,438.30. The value of land rent on non-apple annual crops, with 95 respondents of 52 guava farmers (land rent value of IDR. 17,019.57) and 43 citrus farmers with land rent IDR. 42,068.59. Meanwhile, the analysis of the land rent of seasonal crops with the average cropping pattern of potato-carrots, cabbage-carrots-cabbage, lettuce-andewi-lettuce, and carrots-broccoli-carrots with the highest land rent value of IDR 26,627.28.

The potential for land changing the function of apple land into 55 tangerine land is also a superior option in the Batu area [42]. In addition to citrus crops, alternative commodities were chosen to consider easy in plant care and guava plants, both guava and crystal guava. In this research, vegetable farming is divided into four groups of cropping patterns, namely 1) Lettuce-andewi-lettuce, 2) cabbage-carrots, cabbage 3) lettuce-broccoli-lettuce, and 4) carrots-broccoli-carrots.

Table 3 : Land rent value for Apples, Guava, Citrus, and Seasonal Commodities

No	Plant Commodities	Value of Land rent (IDR meter year^{-1})
1	Lettuce-andewi-letuce	2,382.59
2	Apple	12,438.30
3	Potato-Carrots	13,597.73
4	carrots-broccoli-carrots	15,319.02
5	Guava	17,019.57
6	cabbage-carrots,cabbage	26,627.28
7	Orange	42,068.59

The factor affecting the change in cultivated commodities is the economic value (Sitorus, 2004) from cultivated commodities (Yudichandra, 2019). Land rent is the remaining economic surplus as part of the total product value or total income after paying for all costs or total costs (Barlowe, 1986). In terms of soil fertility/quality and water availability (ricardian rent), annual crops (apples, guava, and oranges) tend to be the same as seasonal crops planted only twice per year, namely potatoes carrots. Even though the seasonal crop cropping pattern is only double due to water availability constraints, farmers are still very enthusiastic about producing carrot vegetables that consumers like. It is shown by a willingness to learn to use their capital to go to the Karo area of North Sumatra to cultivate red carrots, similar to imported carrots. Previously, Karo farmers could cultivate them. It shows farmers' firm intention to learn and, of course, from market needs that consumers like. The high land rent value of citrus plants is due to consumers' high demand for seasonal vegetables, a source of food needed by the community to fulfill nutrition and fiber.

The lowest land rent value is the lettuce-andewi-lettuce plant. Farmers are reluctant to do farming, so they choose to maintain and are needed by the community. Apple plants are in the second-lowest rank, and this is possible for several reasons. The average age of apple plants is> 25 years, with decreasing productivity and higher maintenance costs. Based on land suitability in the Bumiaji area, apple plants are classified as very suitable (Aditiyas *et al*., 2015). Various challenges for farmers in cultivating apple plants in controlling pests and diseases have higher production costs. Pests and diseases of apple plants can reduce yields by 43% for five-year-old plants (23-57% on average) (Malling, 2015).

Compared to citrus plants' maintenance, cultivating apples' operational costs are more expensive (Yudichandra, 2019). Proven as an example of the Bangli District of Bali and Karo District of North Sumatra, which have relatively the same regional characteristics as Batu and previously have apple plants, now there are no more apples and replaced by other plants such as oranges. Because apple plants are subtropical plants that require ripping, bending branches before flowering, and fruiting, farmers' operational costs for controlling pests and diseases remain high because pests and diseases that continue to occur are not treated for fruit. According to research (Rondhi *et al*., 2018), there will be competition for land use between agricultural commodities. Besides that, economically profitable commodities will be farmers' choice even though they are not following land characteristics (Kutywayoa *et al*., 2014). Even though the intensive cultivation pattern still makes the use of pesticides as the primary weapon, which results in resistance to pests and diseases so that the costs needed to control them are getting higher over time because the frequency of pesticide applications will be more frequent (McKenzie, 2001 and Damos *et al*., 2015).

Analysis of factors affecting land rent

(a) Analysis of the factors that influence apple land rent

Multiple correlation analysis with reference to the Pearson Correlation value shows no strong correlation between the independent variables x1 to x8. Multiple regression analysis, as dependent variable/response (Y) and independent variable x1- x8 shows the results based on the significance test regarding the value of P (probability), it appears that the variables that have a very significant effect on the value of land rent at the level of confidence 1% are x1, x2, x3, and x5. The variables x4, x6, x7, and x8 have no significant effect, or the effect of both is small for land rents (Table 4). The classical model test shows no data collinearity problem as indicated by the Variance Inflation Factor (VIF) value smaller than 10. The regression line's evaluation (goodness of fit) shows the coefficient of determination (R-Sq) of 88.5% and the coefficient value. adjusted determination (R-Sq (adj)) 87.2%. This value indicates that the variability that can be explained by the explanatory variables (X) in the model on the Y value (land rent) is 88.5%. In comparison, the remaining 11.5% is explained by other variables not observed in this analysis model.

Based on the F test, it is known that the overall model is fitted with the data where the F count is 71.057 with a significance value of 0.000 <α 0.05 or statistically significant. The multiple regression model reporting for apple land rents is as follows:

Land rent = 5,712 + 0,012 x1 + 0,025 x2 – 0,471 x3 – 0,043 x4 + 0,555 x5 + 0,088 x6 + 0,114 x7 + 0,010 x8

(b) Analysis of the factors that affect the land rent of annual crops (Guava and Citrus)

Multiple correlation analysis by referring to the Pearson correlation coefficient shows no strong relationship between the independent variables (X). Multiple regression analysis of land rent as dependent variable/response (Y) and independent variable x1 - x8. The independent variable test individually shows that three variables significantly affect the land rent value of guava and orange plants at $\alpha = 0.01$, namely x1, x2, x3, and x5. In contrast, the variables that significantly affect $\alpha = 0.05$ are x4; other variables. not real different (Table 4).

Table 4 : Estimation results of the factors that affect the land rent of apple

Variable	Interpretation	coefisien	SE coefisien	T	P	VIF
Constant		5.712	0.622	9.191	0	
X1	production (kg Ha^{-1} $year^{-1}$)	0.012	0.001	10.601	0**	5.138
X2	price (Rp kg^{-1})	0.025	0.002	11.376	0**	2.559
X3	Production Cost (Rp)	-0.471	0.085	-5.563	0**	5.372
X4	Distance (Km)	-0.043	0.046	-0.924	0.358	1.393
X5	Large (m^2)	-0.555	0.102	-5.417	0**	7.644
X6	Age (year)	0.088	0.250	0.351	0.726	1.811
X7	Education	0.114	0.058	1.962	0.054	1.725
X8	Farming experiece (year)	0.010	0.024	0.408	0.684	2.522

The classic model test shows no data collinearity problem as indicated by the Variance Inflation Factor (VIF) value smaller than 10. Evaluation of the regression line (goodness of fit) shows the value. The coefficient of determination (R-Sq) is 83%, and the coefficient of determination adjusted (R-Sq (adj)) is 80.7%. This value indicates that the variability that can be explained by the explanatory variables (X) in the model to the Y value (land rent) is 83%. In comparison, the remaining 17% is explained by other variables not observed in this analysis model.

Based on the F test, it is known that the overall model is fitted with the data where the F value is 37.139 with a significance value of 0.000 <α 0.05 or statistically significant. The multiple regression model reporting for apple land rents is as follows:

Land rent = -7634,718 + 4,072 x1 + 4,347 x2 – 0,001 x3 - 3456,168 x4 – 7,334 x5 + 280,595 x6 + 816,420 x7 – 80,716 x8

(c) Analysis of factors affecting seasonal cropland rent

Multiple correlation analysis by referring to the Pearson correlation coefficient shows no strong relationship between the independent variables (X). Multiple regression analysis of land rent as dependent variable/response (Y) and independent variables x1, x2, x3, x4, x5, x6, x7, and x8 are shown in Table 6. The individual independent variable test shows that there are three very significant variables. Affect the land rent value of seasonal plants at α = 0.01, x1, x2, x3, x5, x6, and x8, while other variables are not significantly different.

Table 5 : Estimation results of factors affecting land rent of guava and citrus plants

Variable	Interpretation	coefisien	SE coefisien	T	P	VIF
Constant		-7634.718	15844.941	-0.482	0.632	
X1	production (kg Ha^{-1} $year^{-1}$)	4.072	0.300	13.584	0**	1.572
X2	price (Rp kg^{-1})	4.347	0.811	5.360	0**	1.198
X3	Production Cost (Rp)	-0.001	0.000	-3.925	0**	1.634
X4	Distance (Km)	-3456.168	1418.294	-2.437	0.018*	1.303
X5	Large (m^2)	-7.334	1.315	-5.576	0**	1.355
X6	Age (year)	280.595	272.621	1.029	0.307	4.359
X7	Education	816.420	1488.349	0.549	0.585	1.610
X8	Farming experiece (year)	-80.716	193.838	-0.416	0.679	3.849

The classical model test shows that there is no data collinearity problem as indicated by a tolerance value that is smaller than 1. Evaluation of the regression line (goodness of fit) shows the coefficient of determination (R-Sq) of 75.7% and the value of the adjusted coefficient of determination (R - Sq (adj)) 73.4%. This value indicates that the variability that can be explained by the explanatory variables (X) in the model on the Y value (land rent) is 75.7%. In comparison, the remaining 24.3% is explained by other variables not observed in this analysis model.

Based on the F test, it is known that the overall model is fitted with the data in which the F value counts 32,683 with a significance value of 0.000 <α = 0.05 or statistically significant. The multiple regression model for apple land rents is as follows:

Land rent = 494,204 + 6,698 x1 + 2,399 x2 + 0,000 x3 - 396,957 x4 -6,535 x5 + 395,238 x6 + 490,003 x7 – 668,610 x8

Agricultural production costs are an essential factor in farming. As previously mentioned, the dominant factor and has the most influence on production is labor (Ntakyo *et al.*, 2013 and Kireeti *et al.*, 2014). Meanwhile, labor is increasingly difficult to find. Even farmers have to give more privileges to them, so they are easier to work with than urbanization (Satterthwaite *et al.*, 2010 and Jiang and Zhang, 2016). Various information regarding good crop production management has been carried out in various studies. Still, in its application, farmers are expected to find a suitable pattern for their agricultural land. For example, soil conservation uses ground cover crops (Hussain *et al.*, 2018) to minimize topsoil loss through erosion (Mozumdar, 2012). These practices are already being used and can benefit ecosystem management on land while maintaining crop production profitability. Other practices used to achieve production, and stewardship goals include monitoring nutrient levels to help limit nutrient costs per area (Schimmelpfennig, 2018), weed monitoring (Tilman *et al.*, 2002), and specialist application of pesticides (Castle and Naranjo, 2009).

Table 6 : Estimation Results of Factors Affecting Seasonal Crop Land Rents

Variable	Interpretation	coefisien	SE coefisien	T	P	Tolerance
Constant		494.204	2476.465	0.200	0.842	
X1	production (kg Ha^{-1} $year^{-1}$)	6.698	0.762	8.792	0.000**	0.093
X2	price (Rp kg^{-1})	2.399	0.381	6.299	0.000**	0.354
X3	Production Cost (Rp)	0.000	0.000	-3.331	0.001**	0.102
X4	Distance (Km)	-396.957	302.183	-1.314	0.193	0.181
X5	large (m^2)	-6.535	0.885	-7.386	0.000**	0.143
X6	Age (year)	395.238	91.141	4.337	0.000**	0.131
X7	Education	490.003	1662.251	0.295	0.769	0.274
X8	Farming experience (year)	-668.610	153.132	-4.366	0.000**	0.177

Plant productivity is an essential factor in calculating the land rent value of all commodities. Productivity must be seen from various aspects, both cultivation management and environmental factors. Environmental factors (Anggara *et al.*, 2017) include farming experience, education, and agricultural insurance (Topcu *et al.*, 2010). For example, the most influential apple crop production factors are organic fertilizers, labor, and farmer experience (Ntakyo *et al.*, 2013), pesticides (Kireeti *et al.*, 2014). Because intensive apple crop care encourages US farmers to use pesticides 12-20 times per season (Sisson, 2009 and Herz *et al.*, 2019). However, more intensive agriculture will have an impact on the environment (Simon *et al.*, 2017 and Orpet *et al.*, 2020), resulting in changes in the composition of agricultural land, and decreased biological activity and soil fertility (Sharma *et al.*, 2019 and Tang *et al.*, 2014).

It shows the role of land as an irreplaceable primary input and most efficient wealth-producing asset for farmers (Muyanga *et al.*, 2013), such as Ethiopian farmers who do not leave their land even it has been degraded (Moreda, 2018). In fact (Hilger *et al.,* 2013*)* stated that a decrease in productivity could be anticipated by increasing farmers' knowledge.

For this reason, the role of agricultural extension agents is needed in conveying the results of research or cultivation knowledge that are suitable for farmers. One of the main problems in traditional trading is related to the instability of agricultural commodity prices (Nuryadin *et al.*, 2016), especially for horticultural commodities (Irawan, 2007) These price fluctuations are often more detrimental to farmers than traders. In contrast, the main factor determining consumer demand is price compared with other related goods. Because traders can control farmers' purchase price so that even though the price at the consumer level is relatively constant, the trader can reduce farmers' purchase price to maximize their profits. Likewise, if there is an increase in prices at the consumer level, traders can imperfectly pass on the price increase to farmers. In other words, the price increase received by farmers is lower than the increase in the price paid by consumers. This price transmission pattern is not profitable for farmers because the price increases at the consumer level cannot thoroughly be enjoyed by farmers ((Irawan, 2007). Andani *et al.*, (2017) say there has been market distortion due to market failures which have caused economic output not to be achieved optimally. Besides, differences in infrastructure, income, and population density affect product prices.

An alternative to increasing the income of apple farmers in the last few years before the pandemic is to turn the land into agro-tourism land because agricultural commodities with their diversity and uniqueness have become a strong attraction agro-tourism. In contrast to tropical plant agro-tourism, tropical apple agro-tourism is still classified as attractive to Indonesians because this plant is rarely found in other places. Agro-tourism is a recreational activity that has been successful in rural and cultural environments at attractive prices for various markets. In 2010, agro-tourism became popular, but it is still limited to industrial land with a relatively large area. With the increasing interest of tourists, agro-tourism is growing and emerging with community management (López and García, 2006). That will double impact on socio-economic relations and space in rural areas (Bršċić and Huguesa, 2006).

For this reason, to overcome this, a certified tour guide is required by the agriculture and tourism offices. Another impact of implementing agro-tourism on small farms is that the value of benefits is felt quite large, as evidenced by farmers' readiness in preparing plant seeds as replacements for old and less productive plants. In contrast, other farmers whose land has not been used as agro-tourism land are not ready for plant rejuvenation and tend to maintain existing plants.

Another influence of tourism activities other than agro-tourism is the need for tourists to get souvenirs. The high number of tourists in Batu City encourages diversification of apple products so that it is no longer just in the form of fresh fruit. Increasingly prefer processed apples as souvenirs to take out of town because they are practical, light, and relatively more durable than fresh apples. The profit obtained if fresh products are processed into processed products is 3 to 5 times higher than fresh products (Damayanti *et al.*, 2014). Types of preparations produced by the apple fruit processing industry are currently popular such as chips, jenang, and apple cider (Relawati *et al.*, 2015), brem, jam, apple dodol, apple cider vinegar, apple candy.

Processed apples utilize fresh apples of good quality, such as apple chips and fruit with poor quality. It is an opportunity for farmers to market all fruit types produced, whether small or large, even slightly damaged. Ripe apples can be used as a substrate for making nata de apple. When viewed from the supply chain network map in developing diversified products, there are five integrated entities: farmer suppliers, users/consumers, related industries, supporting industries, and supporting institutions. The role of farmers is the most vital because if there are no apples, there will be no unique souvenirs that tourists will bring or vice versa. No derivative products will be produced. Therefore it is necessary to have a follow-up effort to extend the product's life and increase profit (Damayanti *et al.*, 2014).

The difference in land rent between apple and orange and guava land is one of the driving factors for converting apple land in Batu City. Following the opinion of Zakaria and Rachman (2013), factors of soil fertility, distance from the market, production costs can have an impact on land rent. It is known that there are gaps that need to be overcome so that farmers do not mind defending their land. Next is the land rent obtained from plants, then the two gaps need government intervention. According to (Yakin, 2015), if the management of natural resources and the environment has problems and cooperation cannot be carried out. The role of the government as the more dominant party is needed. Encouraging the use of apple derivative products and providing subsidies can encourage the acceleration of behavior change in the expected results and provide replacement costs for decreased income or adjustment costs outside the main production costs (Daulay *et al*., 2016b).

CONCLUSION

The development of apple plants in Indonesia is still centered in the initial planting area in East Java, with an area percentage of 99.81%. Development constraints in other areas are due to high production costs and low prices. Compared to other commodities, apple plants' land rent value tends to be lower, except for land with the lettuce-andewi-lettuce cropping pattern, especially for citrus plants that are more than three times higher than apple land rent. It makes it challenging to achieve the sustainability of Indonesian apple production even though the apple plant is felt to have become part of the people of Batu City. The factors affecting each commodity's land rent value tend to be the same: production, production costs, and land area. Increasing land rent value can be done by attracting tourists through agrotourism and improving cultivation management to increase production and production costs, implement agricultural conservation, and reduce farmer's and collector traders' dependence.

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