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FACTORS OF AGRICULTURAL LAND-USE CHANGE IN TENGGARONG SEBERANG SUB-DISTRICT

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Abstract: *As a rice-producing center in Kutai Kartanegara Regency, agricultural areas in the Tenggarong Seberang Sub-District have consistently experienced land degradation due to non-agricultural activities. Degradation of agricultural land will persistently affect the reduction of food availability in the community, the emergence of social conflicts, the changes in lifestyle and livelihoods and the decline in the level of the community's economy. This research was intended to determine the extent of agricultural land-use change in Tenggarong Seberang Sub-District into a non-agricultural land. The method used in this research was spatio-temporary analysis with GIS by using Landsat 7 ETM+ and Landsat 8 OLI/TIRS data and multiple linear regressions. The results of this research indicated that agricultural land-use change from 2000 covering an area of 1,562,174 Ha had declined to 755,214 in 2020. And Factors of Agricultural Land-use Change is industry*

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1. INTRODUCTION (Calibri, 12pt)

Kutai Kartanegara Regency is considered as one of the regencies designated as Sustainable Food Agricultural Land (hereinafter referred to as LP2B), as stated in Regional Regulation of Kutai Kartanegara Regency Number 9 of 2013 concerning Spatial Planning of Kutai Kartanegara Regency of 2013-2033, that 13 sub-districts have been referred to as areas of potential for Sustainable Food Agricultural Reserves Land covering an area of 48,110 Ha. In spite of that, based on the Master Plan for Food Crops and Horticulture Areas in East Kalimantan, various major issues tend to be encountered in the agricultural sector, specifically agricultural land-use change. In Kutai Kartanegara Regency, agricultural land is typically devoted to plantations, housing and settlements as well as mining areas. One of them is the Tenggarong Seberang Sub-District. In the Tenggarong Seberang Sub-District, agricultural land-use change to mining land is as a consequence of the high purchase price of agricultural land offered by the company, so that farmers voluntarily sell their agricultural land (Suharto et al, 2015). In addition, according to Budiman (2019), farmers are forced to sell their agricultural land on account of the impact generated by adverse mining activities, such as waste and dust pollution. If land-use changes occur continuously, it may contribute to several other impacts such as reduced food availability and food security of the community (Prasada, 2018), the emergence of social conflicts, the changes in lifestyle and in livelihoods, and the decline of economy level of the community (Rezki, 2020). This research was intended to determine the factors of Agricultural Land-use Change in Tenggarong Seberang Sub-District. The results of this research were expected to provide insights and considerations in planning agricultural areas in the Tenggarong Seberang Sub-District.

2. DATA AND METHODS

2.1Data Collection Method

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Secondary and primary data were utilized as data sources in this research. Primary data were derived from Landsat 7 ETM+ and Landsat 8 OLI/TIRS images in 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018 and 2020. Meanwhile, the secondary data used in this research were obtained from GRDP of Kutai Kartanegara Regency, the population of Tenggarong Seberang Sub-District, the value of agricultural productivity in Tenggarong Seberang Sub-District and the number of large industries in Tenggarong Seberang Sub-District.

1. Gross Regional Domestic Bruto of Kutai Kartanegara Regency

GDRP of Kutai Kartanegara Regency was downloaded from Central Bureau Statistic of Kutai Kartanegara Regency website. GDRP of Kutai Kartanegara Regency can be seen in Table 1.

Table 1 Gross Regional Domestic Bruto of Kutai Kartanegara Regency in 2000 to 2020 every 2 years

(Source : Central Bureau Statistic of Kutai Kartanegara Regency, 2021)

No.	Year	GRDP (Million Rupias)	Precentage of GRDP Change (%)
1.	2000	23 404 509	-
2.	2002	26 837 949	14,67
3.	2004	42 409 271	58,02
4.	2006	66.363.636,72	56,48
5.	2008	103.959.393,46	56,65
6.	2010	100.465.049,92	3,36
7.	2012	167.314.214,02	66,54
8.	2014	156.723.063,82	6,33
9.	2016	127.869.342,84	18,41
10.	2018	161.920.385,78	26,63
11.	2020	149.057.816,45	7,94

Based on table 4.1, it can be seen that the GRDP value of Kutai Kartanegara Regency every five years has a less stable condition, where the highest increase occurred in 2010 to 2012. While the highest GRDP decrease occurred in 2014 to 2016.

2. Population of Tenggarong Seberang Sub District

Population of Tenggarong Seberang Sub District was downloaded from Central Bureau Statistic of Kutai Kartanegara Regency website and from that data can be seen that from 2000 to 2020, Tenggarong Seberang Sub-district has experienced a population increase of 26,212 or more than 50% of the population in 2000. Population of Tenggarong Seberang Sub District can be seen in Table 2.

Table 2 Population of Tenggarong Seberang Sub District in 2000 until 2020 every 2 Years (Source : Central Bureau Statistic of Kutai Kartanegara Regency)

No.	Year	Population (People)	Precentage of Population Change (%)
1.	2000	40.050	-
2.	2002	44.381	10,81
3.	2004	48.754	9.85
4.	2006	49.393	1,31
5.	2008	52.583	6.46
6.	2010	61.441	16,85
7.	2012	65.014	5,81
8.	2014	69.447	6,82
9.	2016	73.372	5,65
10.	2018	77.155	5,56
11.	2020	67.877	12,3

3. The Number of Large Industries of Tenggarong Seberang Sub-District

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The number of large industries in Kutai Kartanegara Sub-District was from Department of Industry and Trade in Kutai Kartanegara Regency. The number of large industries in Tenggarong sub-district increased from 2006 to 2014. While from 2014 to 2020 there was no increase in the number of large industries in Tenggarong Seberang Sub-district. The large industry in Tenggarong Seberang Sub-district itself consists of ship and boat industry as well as plastic industry. The data of large industries in Tenggarong Seberang sub district can be seen in Table 3.

Table 3 Number of Large Industries of Tenggarong Seberang Sub-District in 2000 until 2020 every 2 Years (Source : Department of Industry and Trade in Kutai Kartanegara Regency, 2021)

No.	Year	Number of Industry (unit)	Precentage Large Industry Change
1.	2000	0	-
2.	2002	0	0
3.	2004	0	0
4.	2006	1	0
5.	2008	2	100
6.	2010	3	50
7.	2012	4	33,33
8.	2014	5	25
7.	2016	5	0
8.	2018	5	0
5.	2020	5	0

4. The value of agricultural productivity in Tenggarong Seberang Sub-District

Agricultural productivity levels per two years tend to change. This condition can be seen in the productivity value in 2008 to 2010 the largest decrease of 21.79 ku/Ha. While the highest increase occurred in 2010 to 2012 which was 22.44 ku / Ha. That data can be seen in Table 4.

Table 4 The value of agricultural productivity in Tenggarong Seberang Sub-District in 2000 untul 2020 every 2 Years (Source : Agriculture and Lifestock Office, 2021)

No.	Year	Productivity (ku/Ha)	Precentage of Productivity Change (%)
1.	2000	46,56	-
2.	2002	46,41	0,32
3.	2004	47,82	3,04
4.	2006	56,10	17,31
5.	2008	50,73	9,57
6.	2010	28.94	42,95
7.	2012	51,38	77,54
8.	2014	54,47	6,01
9.	2016	57,59	5,73
10	2018	46,96	18,93
11.	2020	48,54	3,36

2.2Analysis Method of Agricultural Land-use Change

The extent of agricultural land-use change to non-agricultural land was determined by applying the spatio-temporal modeling method. The spatio-temporal model is a model that can represent the observed natural phenomena in spatial and temporal terms. The stage of spatio temporal analysis are

1. Radiometric Correction

Radiometric correction is a stage of image processing performed before performing a certain analysis. Radiometric correction relates to correction of sensor-related effects to increase the contrast of each image pixel (Supriatna and Sukartono, 2002). In this research radiometric correction using software called Quantum GIS

2. Geometric Correction
   Geometric correction is a basic correction of the imagery that aims to provide a characteric image of the map. These characteristics can be shapes, scales or projections performed by restoring the pixel position of the image at the position of the earth's surface (Yanuar et al, 2018).
3. Area Restriction
   After geometric correction, then the area restriction is done. The purpose of the area restriction is to facilitate the analysis process, where the analysis process will be conducted in accordance with the research area. Area restrictions are done by overlaying between the imagery and the map of the pattern of agricultural area space in Tenggarong Seberang Subdistrict
4. On Screen Digitation
   Digitization can be interpreted as the process of converting or converting data that was originally analog data into digital format (Sitepu et al, 2017). At this stage, digitization of agricultural areas in Tenggarong Seberang sub-district using time series imagery.
5. Calculation of Land Use Chage
   Calculation of land function changes is done after digitization stage is done. At this stage it is done using calculate geometry tools in ArcGIS applications. The calculation of land function change area aims to know the change in land area in agricultural area in Tenggaring Seberang Subdistrict.

2.3Analysis Method of Agricultural Land-use Change Factors

In determining the factors of agricultural land-use change to non-agriculture land, the multiple linear regression analysis method was used in this research. The regression analysis used the extent of land-use change as the dependent variable (Y), and four independent variables consisting of the number of industries(X1), agricultural productivity (X2), the value of GRDP (X3), and the population (X4). Thus, the form of the regression equation can be expressed as follows:

$Y= a + \beta 1X1+ \beta 2X2+ \beta 3X3+ \beta 4X4 + e$

Where :

Y = The Extent of Land-use Change

a = Constant

β1, β2,…= Regression Coefficient

X1= The number of industries

X2= Agricultural Productivity

X3= The Value of GRDP

X4= Changes in Population

e = Error

The stages of the classical assumption test of multiple linear regression are:

1. Multicollinearity Test
   The multicollinearity test was used to determine the presence or absence of multicollinearity between the dependent variables. The values of tolerance and Variance Inflation Factor (VIF) were used as indicators of multicollinearity. Based on Gio and Rosmaini (2016), a value of VIF that exceeds 10 is regarded as indicating multicollinearity.
2. Heteroscedasticity Test
   Heteroscedasticity test was used to identify whether there was an inequality of variation over a range of measured values. The regression model may be defined well if there is no heteroscedasticity or homoscedasticity detected.
3. Autocorrelation Test
   Autocorrelation test was used to determine whether there was a correlation between variables in the prediction model in a changing time period. This test is highly required if the data is collected at different points in time (data time series). The regression model may be declared well if no autocorrelation is detected. There is no autocorrelation detected if the Durbin-Watson value ranges in between 0 to 4. If the Durbin-Watson value is less than 1 or more than 3, then autocorrelation is detected (Gio and Rosmaini, 2016)

After the classical assumption test was completed, a significance test was applied to multiple linear regression consisting of:

1. F Test

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F test was conducted to determine whether the independent variables simultaneously had an effect on the dependent variable. The F test was performed by identifying the F value and the significance value in the ANOVA test table.

2. Coefficient of Determination(R2)

Coefficient of Determination (R2) was used to assess the ability of a model to explain the variation of the dependent variable. The coefficient of determination ranges in between 0.0 and 1.0, if the coefficient of determination is close to 1, then the regression predictions perfectly fit the data. The R2 test value can be seen in the Adjusted R Square in the Model Summary table.

3. Partial Test (t Test)

Partial test or t test was used to determine the level of significance or the extent to which the independent variables can affect the dependent variable individually.

3. RESULT AND DISCUSSION

3.1Tenggarong Seberang Sub District Overview

Tenggarong Seberang subdistrict is one of the sub-districts in Kutai Kartanegara Regency. Tenggarong Seberang subdistrict consists of 18 villages and villages. Administratively, Tenggarong Seberang subdistrict is directly adjacent to Tenggarong and Sebulu subdistricts to the west, Loa Kulu Subdistrict to the south, Marang Kayu Subdistrict to the north and bordering Samarinda City and Muara Badak Subdistrict to the east. The administrative map of Tenggarong Seberang Subdistrict can be seen in figure 4.1.

3.2Analysis Results of Agricultural Land-use Change

Agricultural land-use change to non-agricultural land in Tenggarong Seberang Sub-District was determined through spatio-temporary analysis with GIS by means of data from Landsat 7 ETM+ and Landsat 8 OLI/TIRS images in 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018 and 2020. The analysis results of agricultural land-use change to non-agriculture land from 2000 to 2020, which was identified every 2 years can be seen in table 1 below:

Table 5 The Extent of Agricultural and Non-Agricultural Lands of Tenggarong Seberang Sub-District in 2000 to 2020 per 2 years (Source: Analysis, 2021)

No.	Year	Extent (Ha)		Percentage of Agricultural Land Extent Change (%)
		Agriculture	Non-Agriculture	
1.	2000	1.562,174	262,645	-
2.	2002	1.555,714	269,554	0,41
3.	2004	1.372,745	451,579	11,76
4.	2006	1.221,107	603,596	11,05
5.	2008	1.162,832	658,599	4,77
6.	2010	1.047,276	775,438	9,94
7.	2012	906,299	917,281	13,46
8.	2014	865,434	957,937	5,76
9.	2016	782,216	1039,937	9,61
10.	2018	762,186	1049,110	2,56
11.	2020	755,214	1067,481	0,92

Table 1 indicates that there was a decline in the conversion of agricultural areas to non-agricultural areas within 20 years, which was identified every 2 years. The largest decline in agricultural area occurred in 2010 to 2012, which was amounted to 140.768 Ha. Moreover, there was a decline of 806.96 Ha in agricultural areas from 2000 to 2020. The canges can be seen in Figure 1.

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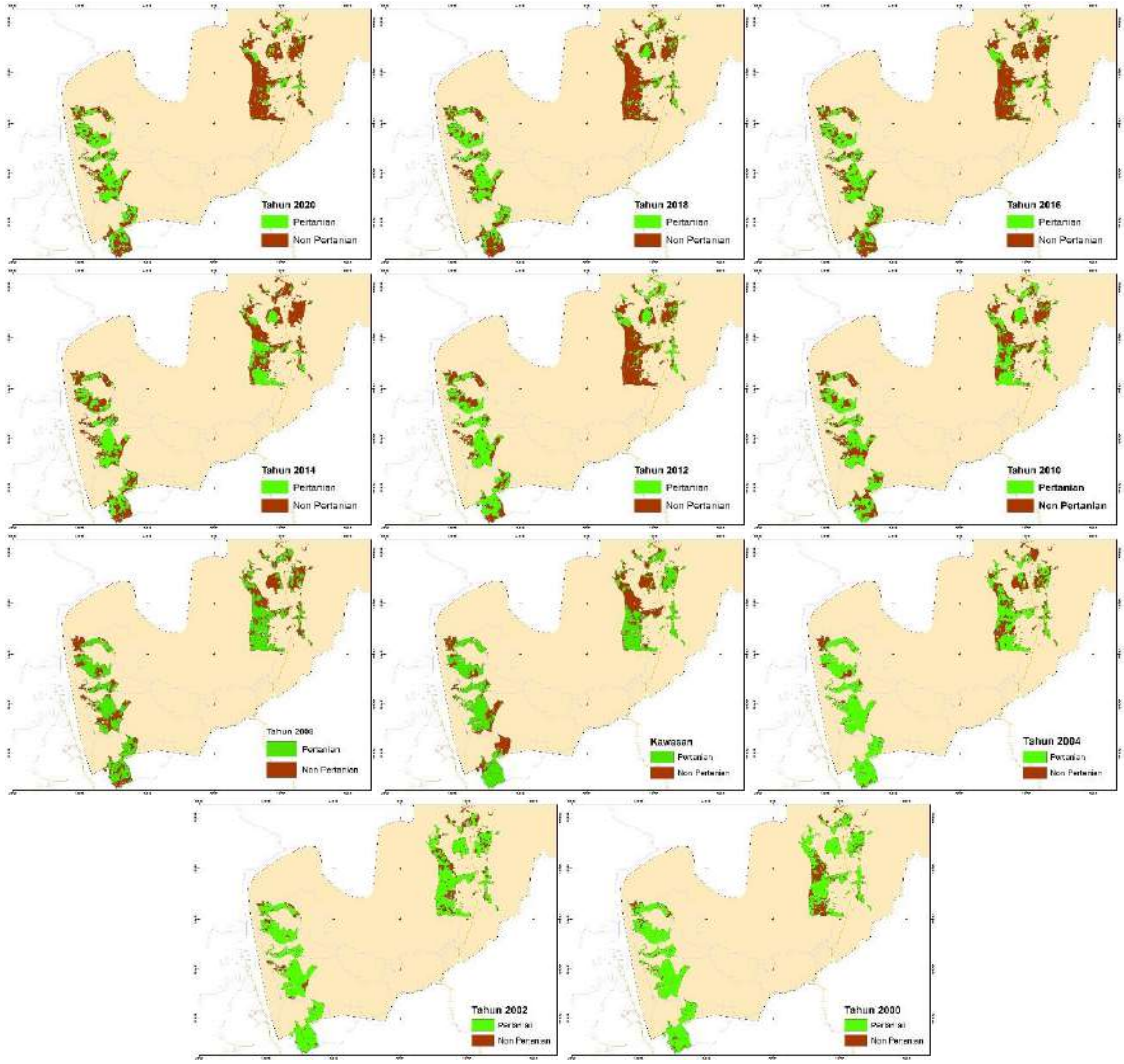
Figure 1. Agricultural Land Use Change from 2000 to 2020 every 2 years



3.3Analysis Results of Agricultural Land-use Change Factors

In this research, multiple linear regression analysis was intended to evaluate the most influential factors of the four variables, specifically the land-use change, the number of industries, the value of PRDB and the population. Prior to multiple linear regression, the classical assumption test was performed in this research. The classical assumption test was used to provide certainty that the regression equation obtained had accuracy in estimation, unbiased and consistent. The classical assumption test in this research is described as follows:

A. Multicollinearity Test

The multicollinearity test was used to determine the presence or absence of multicollinearity between the dependent variables. The values of tolerance and Variance Inflation Factor (VIF) were used as indicators of multicollinearity. It was found that the VIF value of industry, productivity, GRDP and population variables was below 10. Therefore, it may be defined that no multicollinearity was detected in the data. The Multicollinearity test can be seen in Table 6.

Table 6 Multicollinearity Test (Source: Analysis, 2021)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1 A	(Constant)	3.909	2.150		1.818	.129		
	Industri (X1)	.192	.037	1.481	5.122	.004	.241	4.149

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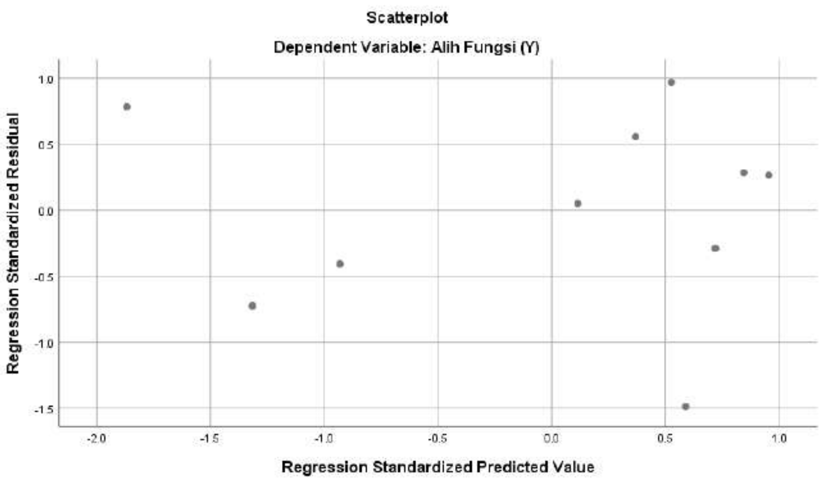
Produktivitas (X2)	-.148	.049	-.837	-3.031	.029	.264	3.791
PDRB (X3)	.173	.039	1.008	4.458	.007	.394	2.537
Penduduk (X4)	-.431	.188	-.440	-2.292	.070	.546	1.831

a. Dependent Variable: Alih Fungsi (Y)

B. Heteroscedasticity Test

Heteroscedasticity test was used to identify whether there was an inequality of variation over a range of measured values. The regression model may be defined well if there is no heteroscedasticity or homoscedasticity detected. The results indicated that the points on the scatter plot were spread out and did not form a certain pattern. Thus, it may be declared that heteroscedasticity in the data was not found. The heteroscedaticity test can be seen in Figure 2.

Figure 2. Heteroscedaticity Test (Source : Analysis, 2021)



C. Autocorrelation Test

Autocorrelation test was used to determine whether there was a correlation between variables in the prediction model in a changing time period. This test is highly required if the data is collected at different points in time (data time series). The regression model may be declared well if no autocorrelation is detected. There is no autocorrelation detected if the Durbin-Watson value ranges in between 0 to 4. If the Durbin-Watson value is less than 1 or more than 3, then autocorrelation is detected (Gio and Rosmaini, 2016). The results showed that the Durbin-Watson value in the analysis results was amounted to 2.172, where the results were below 4.0. So, it can be stated that there was no autocorrelation detected between variables.

Table 3. Autocorrelation Test (Source : Analysis, 2021)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.948[a]	.899	.819	1.82711	2.172

a. Predictors: (Constant), Penduduk (X4), Produktivitas (X2), PDRB (X3), Industri (X1)
b. Dependent Variable: Alih Fungsi (Y)

In regards to the classical assumption test that had been successfully carried out, it may be declared that the classical assumption test can be met. Furthermore, multiple linear regression analysis was also carried out, including the F test, the coefficient of determination test and the t test. The results of multiple linear regression analysis can be seen in the following table:

A. F Test

F test was conducted to determine whether the independent variables simultaneously had an effect on the dependent variable. The F test was performed by identifying the F value and the significance value which indicates the significance level of influence in the ANOVA test table. In the F test, the independent variables can be stated simultaneously have an effect on the dependent variable if the value of Sig. <

0.005. The results indicated that the value of Sig. in this research was amounted to 0.010 or more than 0.05. Therefore, it can be defined that the independent variables did not have a simultaneous effect on the dependent variable.

Tabel 4. F Test (Source : Analysis, 2021)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	149.113	4	37.278	11.167	.010[b]
	Residual	16.692	5	3.338		
	Total	165.805	9			

a. Dependent Variable: Alih Fungsi (Y)
b. Predictors: (Constant), Penduduk (X4), Produktivitas (X2), PDRB (X3), Industri (X1)

B. Coefficient of Determination (R2)

Coefficient of Determinationi (R2) was used to assess the ability of a model to explain the variation of the dependent variable. The coefficient of determination ranges in between 0.0 and 1.0, if the coefficient of determination is close to 1, then the regression predictions perfectly fit the data. It can be seen that the value of Adjusted R Square was amounted to 0.819. This indicates that the population, productivity, industry and GRDP variables had an influence proportion of 81.9% and the other 18.1% were influenced by variables not examined.

Table 4. Coefficient of Determination (R2) (Source : Analysis, 2021)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.948[a]	.899	.819	1.82711	2.172

a. Predictors: (Constant), Penduduk (X4), Produktivitas (X2), PDRB (X3), Industri (X1)
b. Dependent Variable: Alih Fungsi (Y)

C. Partial Test (t Test)

Partial test or t test was used to determine the level of significance or the extent to which the independent variables can affect the dependent variable individually. In the t-test, the independent variable may be defined to have a significant effect on the dependent variable if the t-count value (symbolized by Sig.) has a value less than the error value of 0.005. It can be seen that of the four independent variables, namely industry (X1), productivity (X2), GRDP (X3), and population (X4), there was only 1 variable that had a Sig value. below 0.005, specifically the industry variable. Thus, it can be declared that the variable that had a significant influence on the extent of agricultural land-use change was industry variable, which had significantly indicated any changes in the number of industries.

Table 5. Partial Test (t test) (Source : Analysis, 2021)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.909	2.150		1.818	.129		
	Industri (X1)	.192	.037	1.481	5.122	.004	.241	4.149
	Produktivitas (X2)	-.148	.049	-.837	-3.031	.029	.264	3.791
	PDRB (X3)	.173	.039	1.008	4.458	.007	.394	2.537
	Penduduk (X4)	-.431	.188	-.440	-2.292	.070	.546	1.831

a. Dependent Variable: Alih Fungsi (Y)

4. CONCLUSION

Regarding to the research that had been successfully carried out, the extent of agricultural lands was found to have declined persistently to non-agricultural lands by referring to extents per 2 years in the past

20 years. The change in extent from 2000 to 2020 was amounted to 806.96 Ha. Based on the variables examined, it was found that changes in the number of industries were able to indicate industry variable as the only variable that had a significant influence on agricultural land-use change into non-agricultural land.

5. ACKNOWLEDGMENTS

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