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REGULAR RESEARCH ARTICLE

Determinant of Land Use Change in South Kalimantan: An Evidence from Banjarbaru City and Banjar Regency

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ABSTRACT

Environmental degradation, biodiversity loss, climate change, and other environmental catastrophe are negative impacts caused by irresponsible land use change. It is vital to investigate the driver of the land use change to avoid undesirable environmental catastrophes. On the other hand, determinants of the occurrence of the land use change are very complex to be identified. In the last few years, floods hit many parts of the world, one of them was a massive flood in South Kalimantan in the last few years. There is a presumption that this disaster is caused by land use changes inside the watershed. This paper aims to identify the determinants of the land use change in Banjarbaru City and Banjar Regency inside Martapura and Maluka Watershed. This study found out that having a secure land tenure per se does not incentivize landowners to prevent land use change. However, having a secure land tenure is a crucial factor in affecting land use change if the land they own is in large size. Having secure land tenure with large land size affects the occurrence of land use changes significantly by conducting agricultural and plantation extensification. This situation depicts that agricultural and plantation extensification exists in the rural area of South Kalimantan, which is triggered by economic profit orientation. Thus, the accumulation of secure land tenure and large land size need to be considered as land use change determinants for current and future's land use policy in the context of Indonesia.

KEYWORDS

Land use change; Rural livelihood; Land tenure; Land size; Agricultural extensification

1. INTRODUCTION

This research attempts to identify the human-environment determinants as the cause of land use change at the local level of South Kalimantan. Acquiring a holistic understanding of the local phenomenon of land use change is essential to understand the phenomenon of human-environment interactions and its link to environmental degradation, biodiversity loss, and even natural disasters (Wilcove et al., 2013). This research tries to conduct field-based research to obtain local evidence of land use change in the last 20 years in South Kalimantan. Based on this research's idea, we trace the most prominent driver of the global environmental problems caused by humans, especially in the Anthropocene, the age of humans (Crutzen & Stoermer, 2000 in Ruddiman, 2013). The significant occurrence of land use changes has created severe world's environmental catastrophe (Cho & McCarl, 2021; Siagian et al., 2019; Lambin & Meyfroidt, 2011; Chakir & Parent 2009). A flood is a form of environmental catastrophe caused by human interventions on land (Rogger et al., 2017). Aside from living with abundant natural resources, Indonesia has become one of a country in Southeast Asia with massive land use changes cases. It has become the most worrying issue for the current and the future of our mother earth (Wilcove, et.al., 2013). Land use change determinants in Indonesia have been established as one of the most complicated

information to obtain due to its complexities (Resosudarmo et al., 2012). Based on past researches, human-environment determinants of land use change can be categorized into various aspects. There are policies, economic consideration factors such as land size, land productivity, and human capital, the character of places and others that are complex to be identified (Chakir & Parent, 2009; Vien, 2011; Briassoulis, 2003; Lindarto et al., 2018).

South Kalimantan is known for its rich tropical rainforest as it is part of the global hotspot of biodiversity located in Borneo (Wulffraat, et.al., 2017). However, severe floods have contributed to massive destruction in the last few years (Pratama, et.al., 2021). The occurrence of the severe flood could be suspected as the result of land use disruption in the particular watershed (Rogger, et.al., 2017), such as Martapura and Maluka Watershed in the South Kalimantan. The disruption could also be suspected of a massive land use conversion due to economic activities, imbalance environmental sustainability and economic activities, weak forest management, and bad agricultural practices (Rogger, et.al., 2017). Observing the causes of the land use change in South Kalimantan could help future policymakers understand the complex connection between land use change and environmental destructions and create strategic action to diminish environmental destructions.

To understand the reality and find the determinants of the change, we conducted a field survey to a hundred respondents in the Martapura and Maluka Watershed region covering Banjarbaru City and Banjar Regency. We conducted structured interviews and purposely asked a hundred respondents inside Martapura and Maluka Watershed about their land use decision and their livelihood in the last twenty years to obtain broad information about the background of land use decisions. To pursue our aim, we focused on answering our research question, which is what are the determinants that affect the land-use changes inside Martapura and Maluka Watershed in South Kalimantan? The result of this study is beneficial for the policymaker, local government, public and private sector in planning more sustainable land use and diminishing massive environmental destructions.

2. MATERIALS AND METHODS

Land is one of the essential natural resources on earth that exist in a fixed location, with no duplication. Its attachment to a fixed location makes land different from other resources (Tietenberg et al., 2014). Thus, land is so precious, whether in its physical or even social aspects. Moreover, land provides services to all creatures on earth that make land economically and ecologically valuable. According to Indonesian Government Regulation No. 16 the Year 2004, land use is described as natural and human interventions on the earth's surface (PP No. 16, 2004). The definition indicates that land use is undoubtedly attached to human activities on earth. The attachment could be a form of extracting various benefits from land, making land a vital resource. Economically, land allocation depends on its highest value (Tietenberg et al., 2014). Thus, wherever land exists, human tends to convert it to the most economically profitable use. On the other hand, maximizing land use in the context of economic activities is often seen as a detrimental factor of land sustainability. The excessive human economic intervention on land, known as the Anthropocene (Ruddiman, 2013), drastically diminishes the capacity of the land to provide ecological benefits to all creatures and generates severe ecosystem destructions.

Floods in South Kalimantan in the last few years indicate the presence of human's excessive interventions on landscape which can be seen by its land use change in the last twenty years. Referring to Prasetyo & Yosephin (2021), land clearing and conversion

to other uses such as mining and oil palm plantations have accumulated high rainfall in January 2021 and created a severe flood in the last fifty years (Prasetro & Yosephin, 2021). This unusual event has been highlighted by environmentalists concerned with ecosystems condition in South Kalimantan (Prasetyo & Yosephin, 2021). Small scale and even large scale actors had converted three million hectares of forest for commercial uses such as oil palm plantations and mining (Prasetyo & Yosephin, 2021). Aside from the fact that there are massive land use changes in South Kalimantan, there are abundant hidden determinants that affect the enormous land use change. Determinants of land use change have been studied a lot by academics. However, there is no fixed determinant since it depends on the spatial context and combinations between human and physical environments (Briassoulis, 2020). Topography, local weather, rainfall, and other physical factors are commonly known as physical factors of land use change. However, there are also dynamic factors such as human on land use decisions (Briassoulis, 2003). Human capital such as education (Briassoulis, 2003; Surya et al., 2020), land tenure, including land size, and land productivity are examples of human factors of land use decision (Bergeron & Pender, 1999; Briassoulis, 2003). Thus, land use change is extremely complex to be identified (Resosudarmo et al., 2012).

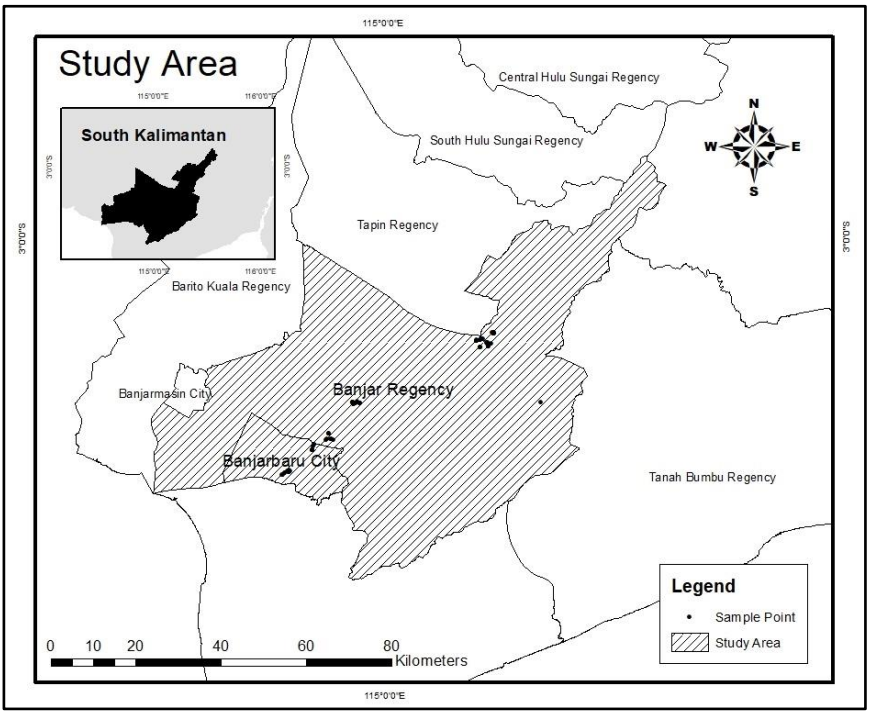

Figure 1. Study area and sample point.

As our study area, we chose two administrative areas inside Martapura and Maluka Watershed, which covered Banjarbaru City and Banjar Regency (Figure 1). Martapura Watershed is part of the bigger Barito Watershed. Our consideration by choosing Martapura and Maluka Watershed is due to the evidence of the flood that occurred at the beginning of 2021 (Pratama et al., 2021), indicating ecological destruction due to land use changes inside these two watersheds. The most destructive result of the flood occurred in Banjarbaru City and Banjar Regency (Pratama et al., 2021) along the Martapura Watershed and Maluka Watershed. Moreover, based on the

data of The Ministry of Environment and Forestry, there were land cover changes between 2011 and 2020 in our study area (Figure 2). Land cover has been described as a remote interpretation of the earth's physical surface using satellite images (Fisher & Unwin, 2005). On the other hand, land use represents information on how people utilize land (Fisher & Unwin, 2005). Even though the land cover definition is different from land use, land cover data resembles general information of land use. Thus, we utilized land cover data as an initial stage to recognize the occurrence of land use change in the study area. The table below shows detailed numbers of the changes by using land cover data of 2011 and 2020 in the study area (Table 1). Based on the land cover data from the Ministry of Environment and Forestry, there were some significant changes of land covers into mixed dryland farming and plantation compared to other land covers in 2020. The most significant changes were from shrubs, primary and secondary dryland forest to mixed dryland farming. Other notable changes were seen from dryland farming and bare soil to plantations. These land cover data indicate that the land use change does exist. Thus, we need to find the determinant behind land use change from the field level.

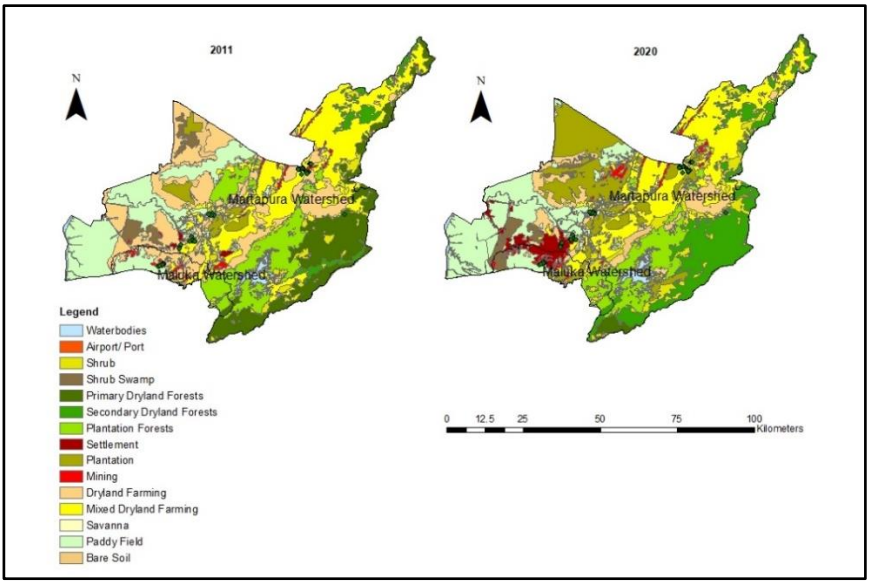

Figure 2. Land cover comparison in the study area in 2011 and 2020 (Source: The Ministry of Environment and Forestry, 2020)

We designed a combined structured and semi-structured field survey to a hundred respondents who live in the Martapura and Maluka Watershed. We had close-ended questions for statistical needs. Furthermore, we also have a semi-structured survey indicating predetermined questions but in the shape of an open-ended questionnaire to better understand the land use change phenomenon (Given, 2008). We asked them directly whether they had changed their land use in the last twenty years. Their yes or no answers allow us to utilize them as a dependent factor for our statistical analysis. Due to the pandemic and our limited movement and interaction during the interview, we only surveyed respondents who are accessible by road. Thus, people who lived remotely and potentially attached to the more complex reality remain untouched in this survey. Even though we have some open-ended questions, respondents' answers are limited. This situation affects our statistical approach. We grouped some potential

determinants answers to fits the binary expression of yes or no responses of the action of land use change. Thus, we use logistic regression. Logistic regression, also known as logit, is a statistical operation process to observe the maximum likelihood value of a dependent and some possible independent factors of a phenomenon (Trueck & Rachev, 2009).

We conducted a literature review to consider possible hidden determinant of land use change in our study area. Most literature is concerned with the evidence of the causes of the land use change in various study areas. First, we consider some aspects that potentially affect landowners' decisions on their land. In terms of education level, human capital could be a factor that optimized a relatively small-scale productive land, such as plantations and agriculture (Briassoulis, 2003). Optimizing a relatively small-scale land could be mentioned as an intensification. Intensification occurs when the optimization of limited land has happened by various efficient land management and treatment (FAO, 2004) and is well known after the theme of green revolution appeared (Martin-Guay et al., 2018). An example of intensification is by innovating irrigation systems to optimize the productivity of their land (Briassoulis, 2003). This skill is commonly acquired if people gain a proper education or life experience (Ninh, 2021).

In contrast, people with lower education levels tend to change land use by inefficiently extending their productive land to obtain more products (Lambin et al., 2003; Tran et al., 2018). Thus, low education level can be assumed as a factor that led people to change the land use easily without any consideration of the land use change impact on the environment (Lambin et al., 2003; Tran et al., 2018). In our paper, we consider including the education level of the people in our research location and group them into two classifications, higher and less educated. The classifications refer to the concept of 12 years of compulsory education. Thus, people who earned less than 12 years of education are considered less educated, and the rest are considered higher educated.

Aside from human capital, there is governance aspect of land about how land is accessed and controlled in society (Bennett, et al., 2019). Better land governance concern on how tenurial system exist on land. According to Bennet et al, land tenure represents the condition of how land is occupied, managed, by whom, and under specific period of time (Bennett, et al., 2019). Secure land tenure has a significant role in people's decisions on their land use (Tanner et al., 2020; Arnot et al., 2011; Futtema & Brondizio, 2003). Secure land tenure covers various definition, legal concept, uncertainty of land rights, risk of losing rights, and so on (Arnot et al., 2011). FAO described land tenure as a legal or customarily determination for the relation between land and individuals or groups of people (FAO, 2002). The tenurial land concept in Indonesia's legal policy framework is generally covered by Basic Agrarian Law (BAL). BAL mentioned that the state owns land, and all the utilizations are used for peoples' prosperity (Act No. 5 of 1960). Following that definition, the state has the right to deliver various legal forms of ownership to individuals or groups of people (Act No. 5 of 1960).

Table 1. Land cover transition in the study area 2011 and 2020

Land Cover 2011 (Ha)	Land Cover 2020 (Ha)														
Land Cover	**Water Bodies**	**Airport/ Port**	**Shrub**	**Shrub Swamp**	**Primary Dryland Forest**	**Secondary Dryland Forest**	**Plantation Forests**	**Settlement**	**Plantation**	**Mining**	**Dryland Farming**	**Mixed Dryland Farming**	**Paddy Field**	**Bare Soil**	**Total**
Water Bodies	7,524.40			123.76			38,447.11	14,533.94	4,296.37		3,521.33	35,851.48	23,015.10	230.64	**127,544.10**
Airport/ Port		106.57													**106.57**
Shrub	48,509.67		40,525.74			339,989.55	76,894.21	33.24	129.25	1,506.83	5,111.06	**320,712.89**	626.70	71.58	**834,110.72**
Shrub Swamp				4,566.08				14,455.63	90,346.76		352.09		9,511.29	40.44	**119,272.28**
Primary Dryland Forest			13,574.52		5,286.95	112,676.91	76,894.21		543.02			**400,798.79**		381.33	**610,155.74**
Secondary Dryland Forest			10,171.01			110,448.43						**400,215.28**		58.70	**520,893.42**
Plantation Forests	5,389.96		5,806.01			150.44	41,408.98	20.22	51,190.39	2,468.96	808.33	119,342.99	259.10	8,071.35	**234,916.73**
Settlement	1,422.91			199.65				73,707.80	2,560.51	15.82	254.20	69,295.60	65.95		**147,522.44**
Plantation									**166,010.35**	236.02			376.80	10.68	**166,633.85**
Mining	20.01		3,301.71	4,264.71				73,342.59	2,100.77	11,112.63	3,421.00	241,362.36	136.45	305.47	**339,367.69**
Dryland Farming	2,916.83		5,415.83	4,804.11			76,894.21	133,430.39	**194,667.91**	4,954.18	34,244.46	144,751.54	74,964.83	3,780.73	**680,825.03**
Mixed Dryland Farming	8,947.24		12,659.21			49,378.22	77,639.46	74,708.59	62,204.32	5,677.12	393.98	284,034.48	18,028.68	675.63	**594,346.92**
Savanna								14,455.63							**14,455.63**
Paddy Field	6,552.59			8,733.81				45,861.60	91,186.46	10.50	509.58	175,754.28	168,146.26	451.88	**497,206.97**
Bare Soil			11,473.26		4,880.18		38,447.11		283,477.68	711.58	2,707.39	184,723.89	445.58	199.22	**527,065.89**
Total	**81,283.60**	**106.57**	**102,927.30**	**22,692.12**	**10,167.13**	**612,643.54**	**426,625.29**	**444,549.63**	**948,713.78**	**26,693.64**	**51,323.42**	**2,376,843.57**	**295,576.74**	**14,277.64**	**5,414,423.98**

[Source: The Ministry of Environment and Forestry, 2020]

On the other hand, secure land tenure is not just about legal aspect. In Arnot et al. (2011), they mentioned that secure tenurial systems varies across regions (Arnot et al., 2011). Some link land tenure security with legal aspect of land titling, and some link land tenure security with the uncertainty of land rights (Arnot et al., 2011). A secure land tenure is an aspect that trigger more incentives for the land holders to better managed their land (Arnot et al., 2011). Rather than just a legal concept, land tenure security also mentions about risk of losing rights to use the land. By just borrowing the land or having a profit sharing, even though under legal circumstance, the risk of losing the benefits of the land or even rights to use the land is high. This condition potentially less incentives the borrower of the land to better managed the land. There are big uncertainties, whether the holders will extent the rent, or even suddenly stop the rent which affect their access to use the land. Thus, by just borrowing the land or profit sharing with land holders could be classified as insecurity of land tenure or weak land tenure security. While the concept of land tenurial is complex in Indonesia, in this paper, we elaborate some tenurial concepts of tenurial rights in our study sites into secure land tenure and weak land tenure security (Table 1).

Table 2. Tenurial classification in this research

No.	Tenurial	Classifications
1.	Secure land tenure if people mentioned one of these tenure	Arable land, paying tax
		Freehold title
		Girik letter
		No certificate but paying tax
2.	Weak land tenure security if people mentioned one of these tenure	Arable land and does not pay tax
		Borrowed / profit sharing with owner of land/rent.

Secure land tenure potentially leads to intensification behaviour. It is a prominent expectation for many actors to minimize land use changes and environmental degradation caused by the extensification of agricultural and forestry sectors. FAO mentioned that intensification helps the agricultural activities more efficient by increasing the production by the unit of land (FAO, 2004). In contrast, extensification is a process of expanding the agricultural land to obtain more agricultural products (Dias, et.al., 2016). According to Bergeron and Pender (1999), farm size or land size for agricultural purposes is significant for farmers' land use decisions (Bergron & Pender, 1999). Owners of big-sized land tend to pretend the old behavior of agricultural activities related to extensification, while the small farmers do not (Bergron & Pender, 1999). Small-scale farmers tend to optimize irrigation technology to yield more productions by their limited land (Bergron & Pender, 1999). Thus, by practice, land size matters as a factor that determines the land use decision. Based on this reason, we utilize the land size aspect as an independent factor that influences the land use change. According to FAO (2015), the size of agricultural land could be used to differentiate small scale and large-scale farmers (FAO, 2015). FAO mentioned that farmers with land size below 2 Ha are small-scale farmers (FAO, 2015). In this paper, farmers with land less than 2 ha are small-scale farmers, and farmers with land equal and more than 2 Ha are large-scale farmers.

To obtain more opportunities to find the determinant of land use change, we pick another factor. Besides the tenurial status and land size, there is a land productivity factor that potentially affects the landowners' decision of their land use. The less productive land peoples have, the more it persuades the owner of the land to change the land use. Thus, it leads to the occurrence of land use change (Bergeron & Pender,

1999). In contrast, when land is productive, it is less necessary for landowners to convert and expand their land to other uses (Kubitza, et.al., 2018). Based on Kubitza's evidence, we are using productive land as our last factor that potentially affects people's land choices. Considering our limited data, we optimize all the available data we have from the field. Since we do not have the number of land productivity, we use a productive land factor instead. Productive land in this research represents the land that holds secure land tenure, and the owners cultivate either paddy, rubber, or oil palm on those land. In contrast, the rest of the data that join non-productive land are the land with weak land tenure security, abandoned land or built for buildings or houses.

We use the binary logit model to analyze the likelihood of four independent factors affecting landowners' decisions to change their land use. First, we run a logit model for two independent factors, education level and secure land tenure. There are a hundred observations in total. For the second step, we also run the logit model for two derivative factors of secure land tenure: land size and productive land owned legally. We have seventy-five observations for this step since only 75% of the landowners have secure land tenure. By utilizing this binary logistic regression model, we acknowledge our statistical limitation since this approach discriminates the reality of variation of the actual data that exists on the household level.

3. RESULTS AND DISCUSSION

We asked a hundred respondents about various information of their livelihood, demographic, land-related information and whether they changed their land use in the last twenty years to obtain holistic information about households' level relation to land use decisions. In term of livelihood aspect, 55% of the respondents mentioned that their primary income come from resource-based activities. We classified their main income as resource-based activities because they benefited from land resources such as cultivating paddy, rubber, or oil palm. Other than those three, some of the respondents' income are generated from traditional gold panning and freshwater fish farming. The remaining 45% of the respondents' main income comes from the service sector, such as civil servants, teachers, drivers, and construction labourers. Although the rest 45% of respondents did not mention that their main income come from resources-based activities, they diversified their income by farming activities such as having rubber plantations and cultivating paddy. In conclusion, most of the respondents have associated with the land resource.

Based on the fact we have, asking their history about their land use decision is essential since they have complex relationships with the land. In relation to this main research purpose, we asked our respondents about their land use decision in the last twenty years. Only 19% or nineteen households mentioned that they changed their land use in the last twenty years. Most households converted their land from shrub and abandoned land to other economically benefitting, such as rubber and paddy field. They converted their land for additional land for cultivating rubber, paddy or even oil palm plantations. To acquire scientific evidence of the land conversion determinants, we conducted a logistic regression. Our dependent (Y-axis) variable is the yes or no answers to the change of the respondents' land in the last twenty years. Moreover, our independent variables are education level, land tenure, land size, and productive land.

3.1. Land use change, education, and land tenure

Based on the logistic regression we have run for the dependent variable, which is land use change and two independent variables, education and secure land tenure, we obtain this equation:

$$Log\left(\frac{p}{1}-p\right) = -1.960794 - 0.1664642279 * Education + 0.6943484 * Land\_tenure \quad (1)$$

Where p equals to the probability of the land use change occurrence (UCLA: Statistical Consulting Group, n.d.).

Table 3. Logistic regression of land use change with education and land tenure as independent variables

Land_change	Coef.	Std. Error	z	P>|z|	95% Conf. Interval	
Education	-0.1664642	0.6242279	-0.27	0.790	-1.389928	1.057
Land_tenure	0.6943484	0.6776162	1.02	0.306	-0.6337549	2.022452
Cons.	-1.960794	0.6257908	-3.13	0.002	-3.187322	-0.7342668

As we have mentioned in the previous section, we use education level to represent human capital. Most of the respondents are in their productive age. However, only 23% of the respondents gained twelve years of compulsory education or finished high school. We used the education level to determine whether respondents' education level affects their decision on their land use. The result shows no significant correlation between education level and the land use decision since the z value for education is only 0.27 under 95% confidence interval. It means that whether the respondents gain better education or not, it did not significantly affect their behaviour on the land use. However, even though there is no significant correlation between education and land use change behaviour, the z value shows a negative sign. Negative sign means the level of education is inversely proportional to land use change. Some studies mentioned that education tends to reduce the land use change by better land management and leading to intensification behaviour (Ninh, 2021). The insignificant z value of education does not mean there is no correlation with land use change. The insignificant z value would probably be caused by the limited data we have gathered and used in the logistic regression. Thus, this research would potentially be advanced in the future with more complex variables to obtain more truth about the relationship between landowners' education and land use decisions.

In contrast, we have found non-land related factors that show a significant result. As we know, educational level tends to improve people's income (Wolla & Sullivan, 2017). In this paper, we have proven that education significantly has a positive correlation with respondents' income. From a hundred respondents, only 23% of respondents finished compulsory education. Education helps farming households to manage their land better than conducting unsustainable behaviour of land utilization, such as expanding additional land use for agricultural needs (Ninh, 2021). Thus, even though there is no significant correlation between education level and land use decision in this research, allocating education as the basis of all citizens basic needs is crucial for policymakers. Fulfilling education needs shows a positive vibe of rural households' economic development and leads to better land management behaviour by preventing extensive land use change.

Table 4. Logistic regression of education with income as the independent variable

Income	Coef.	Std. Error	z	P>|z|	95% Conf. Interval	
Education	1.0608727	0.5388735	1.97	0.049	0.0046994	2.117045
Cons.	-1.689481	0.3141942	-5.38	0.000	-2.30529	-1.073671

Aside from education, another prominent factor commonly discussed to prevent excessive land use change is establishing secure land tenure. From our survey, 75% of respondents are categorized as having secure land tenure. Since secure tenurial is complex in the context of Indonesia, we grouped some land statuses that potentially

identified administratively as having a legal tenurial right as one example of secure land tenure (Arnot et al., 2011). Kubitza (2018) mentioned that there are ways how legal tenurial affect farmers' behaviour on land intensification (Kubitza et al., 2018). Having legal tenurial rights can assure owners to give the fullest investment on the land and achieve better access to credit (Kubitza et al., 2018). Legal tenurial affects the owner decisions on their land, potentially giving higher opportunity to allocate the land most efficiently. In other words, having legal tenurial rights means strengthening land tenure security. Land tenure security incentivize farming households to intensify their land and increase land productivities (Kubitza et al., 2018). Thus, land extensification by changing additional land for agricultural activities can be avoided.

Following Kubitza (2018) statement, this paper also observed the fact on our research area. We expected that the reality on the field would depict a significant correlation between secure land tenure and land use change. In fact, after we run the statistical operation, there is no significant correlation between land tenure and land use change under 95% confidence interval. However, it shows a positive sign between land tenure and land use change. It means that even though not significant, owning secure land tenure tends to increase the opportunity of conducting land use change. This situation contrasts with the common theory where secure land tenure potentially prevents land use change. Moreover, Futtema & Brondizio (2003) supports our statement since their paper mentioned that well defined land tenure does not always lead to land intensification and conservation (Futtema & Brondizio, 2003). Due to this statistic result, we looked for a deeper understanding of whether there is any significant result by running logistic regression of derivative variables of secure land tenure, land size and land productivity.

3.2. Land use change, land size, and productive land

From all the data we gathered, we chose the land size and land productivity as the derivative variables of having secure land tenure. We assume land size and land productivity potentially affect the land use decision of landowners. Seventy-five respondents were classified for having secure land tenure in our research. The range of the land size owned by respondents varied between 10 and 50,000 square meters. The equation for this logistic regression is:

$$\mathbf{Log}\left(\frac{\mathbf{p}}{\mathbf{1}}-\mathbf{p}\right) = -\mathbf{1.410162} + \mathbf{0.0000615} * \boldsymbol{land\_size} - \mathbf{0.0870643} * \boldsymbol{productive\_land} \quad (2)$$

Where p is the opportunity for the occurrence of land use changes.

By utilizing a 95% confidence interval, the z value for land size is 2.61 which is considered significant when using 95% confidence. In short, the statistical result depicts that the bigger the land size of secure land tenure owned by respondents, the more it causes land use change. From a hundred respondents, there were 19 households mentioned that they change their land use in the last twenty years. However, we have limitations. First, the distribution of land size owned by holders that did land use change spread unevenly. Second, there were 3 error answers. The three-error answers mentioned they have land and did change the use of the land, but they did not mention about their land size. Thus, we only have 16 complete data (land size owned and did land use change). To obtain a deeper understanding of how significant land size affects land use change, we put the data bellow.

Table 5. Land size and land use change

No	Land Size Owned by Respondents (m²)	Number of Land Use Changes
1	10 – 1.500	6
2	2.000 – 50.000	10
Total of changes		**16**

This statistic calculation proves that having secure land tenure does not automatically prevent the occurrence of land use change. Contrary, land size in this study area affects the occurrence of land use change. People who have larger land sizes tend to expand their farms to acquire more products. A respondent strengthens our result by saying:

"*Paddy fields do exist, but land for plantation originally from shrub*"[1].

Other respondents also said:

"*We have changed our land from forest to rubber plantation*"[2]

The statement from our informant can be interpreted as the way he made a decision on his land. From that statement, we can interpret that he has plenty of lands. Thus, he can cultivate paddy and also other plantations. The plantation has originated from a shrub or forest which indicates a land use change activity. When we observed other answers, there were some other similar answers. They mentioned that they have paddy fields and extend other cultivation on their additional owned land by changing forest and shrubs to rubber plantations. The backgrounds of this fact are mostly due to households' needs. Thus, they need to produce more than just rice. Aside from their households' fulfilment, having a large land size provides various economic opportunities for respondents on their land use decision. The accumulation of the land size information indicates that the bigger the land size landowners have tended to influence their land decisions.

In fact, intensification of land is expected to be applied by landowners to reduce the chance of land use change by conducting extensification of agricultural and plantation production. However, what is happening in our study area is the opposite. This situation indicates that economic profit remains the primary reason for land use decisions in our study area. The more land they have, the more economic profits are expected to be acquired. This is linear with Briassoulis (2003) statement, mentioning that the increasing demand and expected profits of agricultural and plantation productions trigger the land use change behaviour (Briassoulis, 2003). In relation to that, there is other potential reasons of why landowners with bigger land size cause land use change. Landowners with bigger parcels of land tend to expand and buy new land from smaller neighbouring landowners to gain more land as inputs for more agricultural and plantation products (Briassoulis, 2003).

Table 6. Logistic regression of land use change with land size and land productivity as independent variables

Land_change	Coef.	Std. Error	z	P>|z|	95% Conf. Interval	
Land_size	0.0000615	0.0000284	2.16	0.030	5.83e-06	0.0001173
Land_prod	-0.870643	0.6867375	-1.27	0.205	-2.216624	0.4753378
Cons.	-1.410162	0.4353282	-3.24	0.001	-2.263389	- 0.5569341

On the other hand, another variable, productive land, does not have a significant correlation with the occurrence of land use change. The logistic regression of this variable shows an insignificant z value (1.27), which is far from a significant z value under 95% confidence interval. However, the z value of productive land indicates a negative sign that is inversely proportional to land use change. The inversely proportional results of productive land and land use change indicate that better agricultural land and plantation management tend to generate efficient land use to

[1] Interview with Mukeri 57 yeras old (2021)
[2] Interview with Yusri 56 years old (2021)

produce goods. Thus, the expansion of agricultural and plantation land could be reduced. In contrast, weak land management due to land ownership inequality potentially leads to less efficient land management (McCarthy & Robinson, 2016).

4. CONCLUSION

Land use change has been recognized as a complex issue in global environmental discourses. However, it is vital to find out the determinants of land use change to understand this global issue holistically. We tested four independent variables to find out the main reason for land use change in South Kalimantan since there were destructive floods in the last view years indicating land use change. In the case of our study, education and productive land do not have any significant correlation with the land use changes. On the other hand, only land size variables owned by landowners with secure land tenure classification significantly affect the occurrence of land use change. This means secure land tenure per se does not affect the occurrence of land use change. However, landowners who have large size of secure land tenure is statistically proven as the determinant of land use change. Landowners with large land tend to expand their paddy fields and rubber plantation by maximizing all their land to gain maximum economic profit. Thus, land use change caused by land expansion commonly happens in larger land sizes. Moreover, larger land size potentially triggers landowners to gain more size by buying more land from its surrounding area, which small landowners own as the way of agricultural and plantation expansions. In conclusion, secure land tenure and land size need to be managed and considered as the land use change determinants. These two determinants are also vital for future consideration of land use policy to reduce the occurrence of unsustainable land use change.

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