Land cover changed and economic achievement of farmers in the Rawas subwatershed area

by Chuzaimah Et All

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Chuzaimah[1,2*], F Sjarkowi[1], E Wildayana[1] and Yunita[1]

[1]Faculty of Agriculture, Universitas Sriwijaya, South Sumatera, Indonesia
[2]Faculty of Agriculture, IBA University, South Sumatera, Indonesia

*chuzaimah.4ri3@gmail.com

Abstract. Watershed management is intended to provide maximum economic benefits for local communities without neglecting environmental sustainability. The problem in this paper are how changes in land cover and how economic achievements in the form of income of conversion and non-conversion farmers in Rantau Kadam Village, Karang Dapo District. The data collected consists of primary data and secondary data. Land cover was analyzed using ArcMap Ver.10.2 with Landsat 8 for path/row 124/62 and 126/62 for image analysis. Meanwhile, the amount of income is determined using the formulas of income (NR), revenue (TR) and cost of production (TC). The land cover change was carried out by comparing the land cover map in 2009 with the land cover map in 2013 and 2018. The results showed that there had been changes in land use in Rantau Kadam Village, especially fields, open land and plantations. The use of open land has continued to increase from 1.83% (in 2009) to 8.77% (in 2013), and in 2018 it was 37.26%, while fields and plantations showed a decreasing trend. In conversion, it was found that the income of non-rubber converting farmers had a lower income value than oil palm conversion farmers. The average income of farmers per hectare per year for rubber commodity farmers is IDR 5,515,029.42/ha/year, while oil palm conversion farmers are IDR 17,109,341.38/ha/year. The policy implication that can be taken is that there must be institutional strengthening so that the selling price that applies between farmers can be the same.

1. Introduction

The decline in permanent vegetation cover and the expansion of critical land that reduces the ability of watersheds to store water is one of the critical characteristics of a watershed [1]. Based on the map of the potential for restoration of the Musi watershed, it was found that more than 1.2 million ha or 17% of the Musi watershed area were identified as areas experiencing deviation/degradation from the allocated functions [2]. Watershed management planning needs to integrate biophysical, socio-economic and institutional factors to achieve the sustainability [3]. In addition, watershed management also aims to prevent damage (maintain carrying capacity) and repair the damage (recovery of carrying capacity). Watershed management using a multi-disciplinary approach is a must [4,5]. This is true if the role of biodiversity in maintaining ecosystems is continuously considered [6-10].

Changes in land use will affect changes in socio-economic conditions and vice versa. Changes in the economic structure of the population will involve changes in land use. This is in line with previous research [11,12], land use changes have a significant impact on economic growth. Land resources play a crucial role in all economic development sectors because land serves to accommodate all economic development activities. Land conversion is generally caused by population growth, economic activity,

and development that increase land demands and needs to develop agricultural and non-agricultural activities [13-16]. Land conversion is a mechanism that brings together supply and demand for land with different production characteristics, where there is a change in use from one activity to another [17-19]. The conversion of agricultural land directly or indirectly will affect the physical, social and economic conditions for the population and the environment [20].

According to Kusnadi et al. [21], from the results of research conducted in North Musi Rawas District that the initial negative impacts caused by land conversion from an ecological point of view are the destruction of sub-small rivers, loss of habitat for various types of fauna such as birds, pigs forest (*Sus scrofa*), tiger (*Panthera tigris*), bear (*Ursus sp*), pedestal chicken (*Gallus various*) and several types of primates. If viewed from socio-anthropological factors in line with the development and growth of population, different living arrangements change rapidly following the effect of increasing community needs, where the existence of land will be increasingly threatened. Based on these issues and information, the formulation of the problem raised in this paper is how to changes land cover and farmers' economic achievements in the form of income, both farmers who have converted and those who have not converted.

2. Materials and methods

This research was conducted in North Musi Rawas District with the target area of research in the Rawas subwathersed (Figure 1-2), namely Rantau Kadam Village, Karang Dapo District. Rantau Kadam Village is located in the eastern part of Musi Rawas Utara District or is located at 2◦42'09.1" South Latitude and 102◦58'08.7" East Longitude. Rantau Kadam Village is divided into 11 hamlets, with administrative boundaries consisting of the northern part bordering the Beringin Sakti Village, the southern region bordering the Karang Dapo Village, the western part the Karang Dapo Village and the eastern part bordering the Kertasari Village. Geologically, apart from being known as suitable soil for plantations, the Rantau Kadam Village area also contains various mining materials. This village is fed by a large river called the Rawas River, causing Rantau Kadam Village to be included in the Rawas subwathersed, part of the Musi watershed.

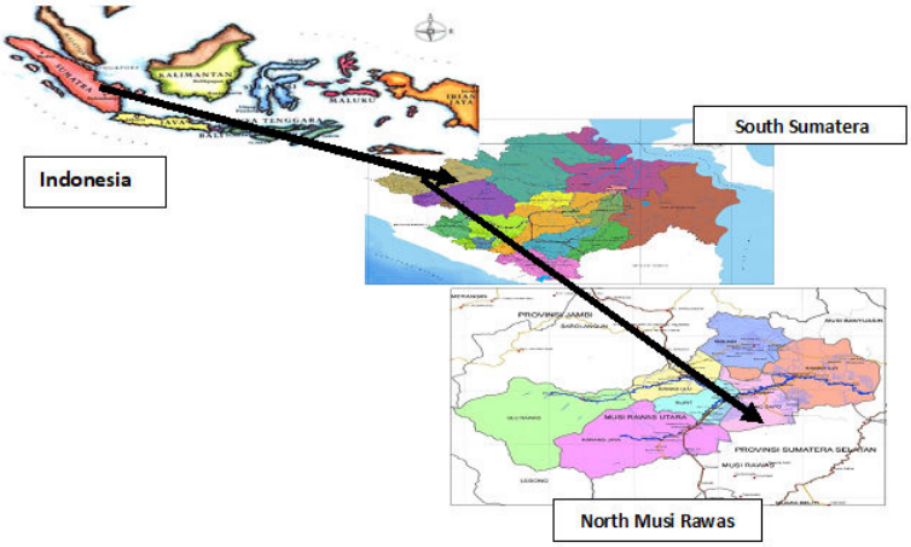

Figure 1. Study location.

Data collection was carried out starting in November 2019. Primary data collection is done by setting representative observation targets, namely (1) village sample, determined by purposive method and (2) community sample in this case farmers, determined by simple random sampling technique, with a sample of 30 farmers who were converting land and 30 farmers who did not convert.

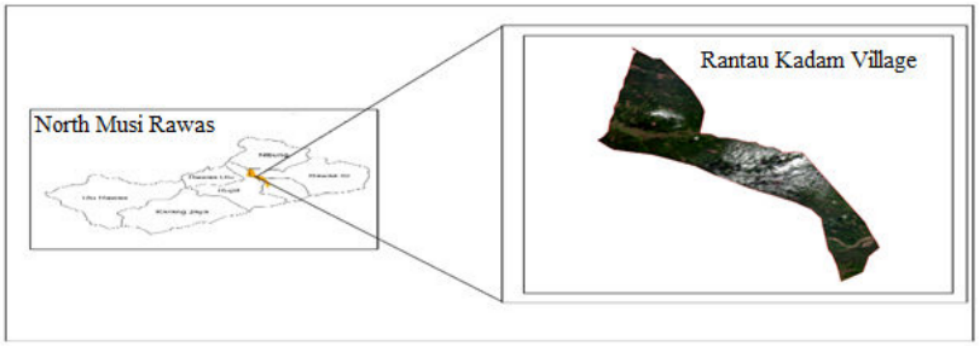

Figure 2. Map of research location.

Land cover data were processed using ArcMap 10.2 software with the primary data in Landsat 8 images on path/row 124/62 and 126/62. Land cover data were obtained from image interpretation using the supervised analysis technique in Geographic Information System (GIS).
Socio-Economic Achievement [25].

Income : NR = TR – TC.....1
Revenue : TR = Q x Pq.....2
Production cost : TC = TVC + TFC 3

Description:

NR = Net revenue (IDR)
TR = Total revenue (IDR)
TFC = Total fixed cost (IDR)
TVC = Total variable cost (IDR)
TC = Total cost (IDR)
Q = Total rice production (IDR)
Pq = Selling price (IDR/kg)

3. Results and discussion

3.1. Dynamics of land cover change

Land cover is a biophysical attribute on the earth's surface in an area [23]. According to Dewi [24], the term land cover refers more to the type of vegetation that exists on a particular land, while land use refers to human activities on that land. Furthermore, the land use system combines both, including the cycle of vegetation change and management activities for both planting and harvesting.

Table 1. Land cover dynamics from 2009 – 2018 in Rantau Village Kadam, Karang Dapo, North Musi Rawas District, South Sumatera Province.

Land cover type	2009		2013		2019	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
Field	1209	24.89	960	20.19	347	7.30
Plantation	3512	72.29	3356	70.58	2634	55.38
Settlement	48	0.99	22	0.46	3	0.06
Open field	89	1.83	417	8.77	1772	37.26

Table 1 shows that from 2009 to 2018, the dominant land cover in Rantau Kadam Village was land cover for plantation use. According to Chuzaimah et al. [25], the land use in North Musi Rawas District in 2014 was mainly used as mixed plantations, covering an area of 3,516.47 km² or reaching 57.99% of the total district land area and spread across all subdistricts. The analysis results from table 1 show that the dynamics of land cover changes in fields, plantations and settlements experienced a decreasing trend from 3,512 hectares (72.29%) from 2009 to 3,356 hectares or 70.58% in 2013 and continued to decline until 2018 reached 55.38%.

In contrast to the use of open land, which has increased from 1.83% (2009) to 8.77% (in 2013), and in 2018, it has risen to 37.26%. This is because the farming communities that have rubber plantations are generally not productive anymore. Furthermore, the gardens were neglected, and even many rubber plants died, and their farms became open areas. This is one of the causes of the increasing number of open land.

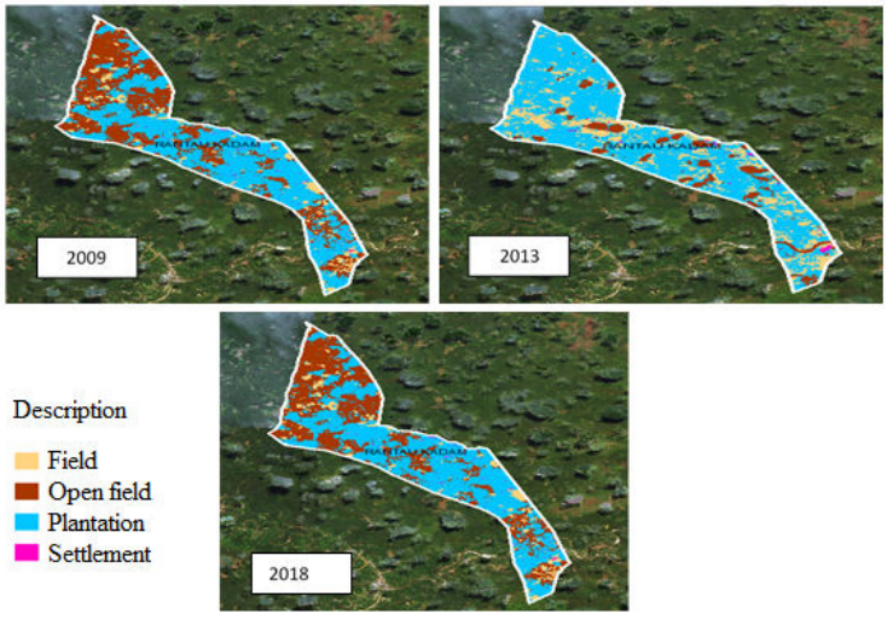

Figure 3. Land cover in Rantau Kadam Village, North Musi Rawas in 2009, 2013 and 2018.

Figure 3 shows that there has been a change in land cover in Rantau Kadam Village, especially open land and plantations. The originally blue area changes to a red heart, indicating that the plantation area

has undergone a change in land cover to open land. In addition to what has been described above, this phenomenon occurs due to the long distance of the land owned by the farmer's house, where the farther the distance from the land to the house, the farmer requires more sacrifices in managing the land, such as time and travel costs to more extensive land. Thus, farmers choose to sell or even abandon the existing land to not take care of it. This is also the cause of open land, which is increasing from year to year.

3.2. Non-converted and converted farmers' income

Land conversion is a process of changing land, but only the appearance (from one form to another) and the function remains the same. Land conversion will have implications for farmers' live will have an impact on the economic welfare of farmers. This, of course, is dominated by the majority of economic problems, namely that everyone wants to improve their standard of living.

Production costs are all economic expenditures used by farmers, both rubber farmers and oil palm farmers, consisting of fixed costs and variable costs to generate income and are measured in rupiah. Fixed costs are production costs whose size is not affected by the production volume, and the results do not run out in one growing season. Calculation of fixed costs is measured by calculating the depreciation costs of tools incurred in the farming process. Equipment depreciation costs are influenced by the type and number of agricultural equipment used and owned by farmers in farming. It should be noted that what is meant by non-converting farmers here are farmers who cultivate rubber commodities, and subsequently, convertible farmers are farmers who produce oil palm commodities.

Fixed costs for farmers who do not convert rubber commodities consist of hoes, machetes, sickles, tapping bowls, printers, sharpeners, buckets, knives and wire. The average fixed cost for non-converted farmers was found in the use of sharpeners, which was IDR 1,123/ha/year (0.66%) and the highest price was in the use of tapping bowls by 29.78% (IDR 170,000.58/ha/year. Meanwhile, the fixed costs for conversion farmers (palm) are hoes, machetes, sickles, egrek and ganco. The most fixed costs incurred by farmers in the exploitation of oil palm commodities on machete equipment are 51.17% (IDR 21,600) per ha per year.

Table 2. Average total production cost of non-converted and converted farmers in Rantau Kadam Village

Cost	Non-converted rubber (IDR/ha/th)	Converted palm oil (IDR/ha/th)
Fixed cost (TFC)	170,000.58	42,210.63
Variabel cost (TVC)	361,530.00	1,023,420.00
Total cost (TC)	531,530.58	1,065,630.63

Variable costs for farmers who do not convert rubber commodities consist of purchasing fertilisers, pesticides and alum. The lowest average variable cost occurred in the cost of using alum, which was IDR 48,750 or 3.48% of the total average variable cost. This is because the production of rubber produced in this village is not much anymore, so that it affects the amount of alum used, where alum is used to thicken rubber latex. On the other hand, the highest cost of using fertilizer is 56.31% of the total average variable cost (IDR 203.580). In oil palm farming run by conversion farmers in Rantau Kadam Village, the variable costs incurred include fertilizer costs, pesticide costs and seeds. The average total variable costs incurred by conversion farmers are IDR 1,023,420. This large amount of expenditure is influenced by the high cost of seeds, IDR 561,000 or 54.82% of the average total variable cost. This is influenced by the spacing applied in the oil palm plantations of smallholder communities. The total cost of production is fixed costs (fixed costs) and variable costs (variable costs) for non-converted and converted farmers in Rantau Kadam Village. From Table 2, it can be seen that the total costs incurred by non-converted farmers are much smaller than those of converting farmers. This is greatly influenced by the number of fixed costs and variable costs incurred by farmers.

Table 3. Average income of non-converted and converted farmers in Rantau Kadam Village.

Description	Non-converted rubber	Converted palm oil
Production (ha/year) (Q)	1,209.31	16,561.74
Selling price (IDR/kg) (Pq)	5,000.00	1,100.00
Revenue (IDR/ha/year) (TR)	6,046,560.00	18,174,972.00

Revenue is the product of the production of non-converting farmers or conversion farmers, in this case, rubber and palm oil commodities, at the prices prevailing at the time of the study. The selling price of farm production results in the form of money that farmers get after selling their farm products. Table 3 shows that the selling price for rubber is only IDR 5000/kg. This is influenced by world rubber prices, which experienced price fluctuations from 2011 to 2019, so that they also affected the rubber prices of farmers in rural areas. And also supported by low rubber production due to the old age of rubber, so it is less productive. The final result of the income becomes a little for non-converting farmers. For conversion farmers, the production of palm oil produced is still relatively small. In Rantau Kadam Village, the spacing used has not been according to the proper recommendations, so it is still too tight between one plant to another. This, of course, affects the production of palm oil that will be produced. The denser the plants, the competition between oil palm plants in getting sunlight and nutrients will be even more significant to affect the growth and production of the oil palm itself. However, compared to nonconverted farmers' income, the income of converting farmers is still higher.

Table 4. Average income of non-converted and converted farmers in Rantau Kadam Village.

Description	Non-converted rubber	Converted palm oil
Reception (IDR/ha/year) (TR)	6,046,560.00	18,174,972.00
Total cost (IDR/ha/year) (TC)	531,530.58	1,065,630.63
Revenue (IDR/ha/year) (NR)	5,515,029.42	17,109,341.38

Revenue is net income (profit) which is the difference between revenue and total business costs, measured in rupiah (IDR). The size of the income value is influenced by the income obtained by farmers who are not converted or converted and depends on the high and low production costs they incur in the rubber or oil farming process. Based on Table 4, it can be seen that the average income of converting farmers is greater than the average income of non-converting farmers, with a difference of IDR 11,594,311.96/ha/year. Due to the higher income of converted farmers than non-converted farmers, conversion activities can increase farmers' income to meet their needs.

4. Conclusions

Changes in land cover that occurred in Rantau Kadam Village during the analysis period in 2009, 2013 and 2018 showed an increase and decrease in area. On the land cover of fields, plantations, and settlements, there is a reduction in the land cover area, but there is an increase in open land. Non-converting farmers generate much lower income levels than convert farmers to oil palm. This means that conversion does not always have a negative impact, but it can also positively impact. The influence on the level of income is the type of commodity that is planted. Whether it has a high selling value or not that must be considered.

The policy implication of this research is the need for institutional strengthening, where activities can be carried out jointly rather than individually, so that by institutionalizing each activity can be well coordinated. If it is related to the price, the selling price at the farmer level can be the same because it is

coordinated. Furthermore, efforts are made to revive community groups that already exist in the village but the stretching of these groups is no longer felt.

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