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Does Landscape Composition Affect Landscape Metrics? Case Study: Ngadas, Enclave Village of Bromo Tengger Semeru National Park, Malang, Indonesia

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ABSTRACT--*Ngadas is one of agricultural landscape in Indonesia. As an agricultural landscape, Ngadas have spatial dynamics. Spatial dynamics can often be seen and sought through several things such as changes in physical characteristics and composition. However, in this study researchers will focus on landscape composition. After knowing the landscape composition along with the landscape metrics value (number of patch, patch density, landscape shape index), the important research question is whether the landscape composition has a relationship with the landscape metrics? It is important to know that the recommendations produced for land improvement and so on can adjust the actual conditions that occur. So, the purpose of this study is to determine the relationship between landscape composition and landscape metrics. Spatial analysis and patch analysis are used to analyze data. After that, data proceed with correlation analysis using SPSS. The results of correlation analysis show that there is no correlation between landscape composition and landscape metrics.*

Keyword*--agricultural landscape, landscape composition, landscape ecology, landscape metrics*

I. INTRODUCTION

Ngadas is one of the mountainous regions in Malang, Indonesia. As a mountainous area, Ngadas has a dominant landscape condition in the form of an agricultural landscape. Agricultural landscapes are landscapes that have the characteristics of an agricultural ecosystem [1]. Agricultural landscapes are formed through the interaction of agricultural management and ecological structures that are considered important as areas of rural livelihood, culture and identity [1-3]. The intended agricultural activities include the utilization of biological resources by humans that are used to produce food and living necessities [7]. So, an agricultural landscape is a landscape that is formed due to human activities in utilizing biological resources by humans that are used to produce food and living needs in rural areas.

As an agricultural landscape, Ngadas have spatial dynamics. The importance of knowing spatial changes in the need to: (1) monitor, measure and project existing changes; (2) comparing patterns between different landscapes or spaces; and (3) helps to understand the processes that underlie the occurrence of space and landscape [6]. Spatial dynamics can often be seen and sought through several things such as:

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a. Changes in physical characteristics and composition (distribution) of agricultural land resources, as well as landscape structures

b. Changes in the number and proportion of patch types and spatial settings

However, in this study researchers will focus on landscape composition. Landscape composition is formed through comparison of natural landscape elements and artificial elements that make up the landscape. Landscape elements are divided into two namely natural and artificial. Natural landscape elements in the form of soil, rock formations, vegetation, and animals. Artificial landscape elements in the form of pavement, utility, and building structures [6].

In addition, it is necessary to know the variability of landscape metrics through Number of Patch (NP), Patch Density (PD), Landscape Shape Index (LSI) values. Number of Patch (NP) indicates the number of landscape units that arrange a landscape mosaic.Patch Density (PD) indicates the density of a patch that forms a landscape. Landscape Shape Index (LSI) is one of the metrics that can be measured through the line ratio the circumference of the area where the total margins are compared against landscaping with the same size square shape without outline inside. When the LSI value approaches number 1 then the urban area will tend to be square or circle (compact) while the LSI value will increase without boundary if the shape of the patch is increasingly complex or outlines getting longer [6]. After knowing the landscape composition along with the LSI value, the important research question is whether the landscape composition has a relationship with the landscape shape index? It is important to know that the recommendations produced for land improvement and so on can adjust the actual conditions that occur. So, the purpose of this study is to determine the relationship between landscape composition and landscape metrics.

II. RESEARCH METHOD

This research was conducted in Ngadas Village, Malang Regency. The first step taken is interpretation of land use distribution [4] at each developmental period. The analysis uses spatial comparison analysis to get a picture of the landscape composition [6]. Next, patch analysis is performed to determine changes in landscape metrics [9]. The analysis is combined with synchronous and diachronic to see the changes that occur from the interpretation of land use.

More clearly, patch analysis is done by preparing data. Spatial data is downloaded through Google Earth. The next step is to classify land use using ArcMap 10.3 software with the coordinate system used in geometric correction is UTM with 1984 WGS datum zone 49S. After the data was ready, it is entered into the Fragstat 4.2 software to find out the variability, namely Number of Patch (NP), Patch Density (PD), Landscape Shape Index (LSI) [9]. Interpretation of results is done by comparing theories and results from previous studies or other secondary sources. After that the ratio of natural landscape elements: artificial landscape elements entered into SPSS along with NP, PD, LSI values at each time to do correlation test.

However, some representative samples were taken. Following is the location of each sample field studied (Figure 1).

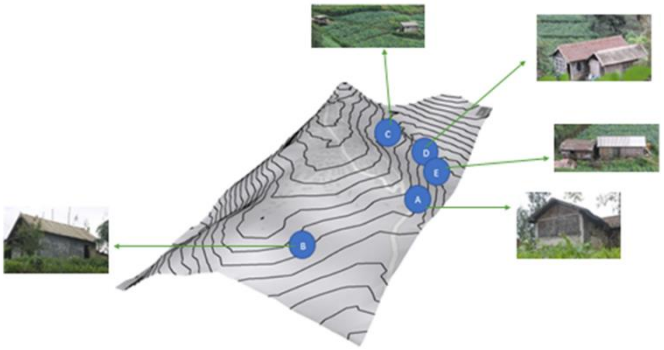

Figure 1: Sample

III. RESULT AND DISCUSSION

3.1 Agricultural Landscape History in Ngadas

The dynamics of the agricultural landscape in Ngadas Village can be traced based on the historical development of the agricultural landscape (Can be seen at Fig 2). 1910-1968 Ngadas Village was not part of Tengger Semeru National Park (TNBTS). The community still uses a rotating (nomadic) farming system with the main crop being corn. In 1968-1982 the New Order government replaced all corn plants into commercial plants, namely cloves, coffee, potatoes, onions, cabbage and potatoes. Furthermore, since 1982 Ngadas has been designated as the Enclave TNBTS Village and has the permanent right of the utilization zone which is now planted with potatoes. Changes in farming methods have an impact on the agricultural landscape in Ngadas Village [13, 1].

Figure 2: History of Ngadas Agricultural Landscape

3.2 Landscape Composition

The composition of the landscape can change with the change of resources that are replaced with other resources or lost without replacement [3]. Analysis of changes in landscape composition can be obtained through synchronous analysis and comparison between each period. Comparison is done by comparing the percentage of natural landscape elements with the percentage of artificial landscapes. Then, researchers compare the magnitude of each element in the same period. Land area measurement is assisted with AutoCad software. The subjects being compared were each sample analysis, 5 samples. In more detail, you can see in the Table 1. The components of natural and artificial landscapes do not have much difference for each sample. However, for each period the elements of the artificial landscape tend to increase in size although not significantly.

Table 1: Landscape composition of Ngadas Agricultural Landscape

Sample	1910-1968		1968-1982		1982 - sekarang	
	Natural (%)	Artificial (%)	Natural (%)	Artificial (%)	Natural (%)	Artificial (%)
A	100	0	99,9	0.1	98.8	1.2
B	100	0	99,9	0.1	99.5	0.5
C	100	0	99,9	0.1	97.8	2.2
D	100	0	99,9	0.1	99.1	0.9
E	100	0	99,9	0.1	99.2	0.8

3.3 Landscape Metrics

From the data above, it can be seen if the number of parts of the landscape mosaic or Number of Patch (NP) had the most number in the period 1968-1982. However, the value of density and landscape formation reached its peak precisely in the period 1910-1968.

The results of measurements above, indicate the most fragmentation in the period 1968-1982. Fragmentation in the agricultural landscape is actually very useful to cause diversity of natural enemies of plants so it is very beneficial for agriculture itself. Large number of patches in the years 1968-1982 due to polyculture agriculture. Polyculture farming has power over pests. In contrast to monoculture agriculture, vulnerability to pests is very large [14]. Thus, the advantage of the agricultural landscape in 1968-1982 was the cultivation of polyculture with a slope sharing system.

Interpretation of NP (Number of Patch) alone is not enough to analyze changes or dynamics of the landscape. PD (Patch Density) or known as patch density and LSI (Landscape Shape Index) also greatly affect a landscape. Although the Patch Value in 1968-1982 was high, it was not accompanied by PD and LSI values, this indicates that the patches formed were not spread out and were less complex.

The ecological endurance of a landscape will be higher if the units are spread out and increasingly complex [5]. So, for the level of complexity and distribution of patches that are very good is the period 1910-1968 evidenced by high patch values. One contributing factor is plant diversity because at that time the forest and bush had no clear boundaries. You can clearly seen in Table 2.

Table 2: Landscape metrics of Ngadas Agricultural Landscape

Period	Sample	NP	PD	LSI
1910-1968	A	4.0000	2.750	2.6374

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Period	Sample	NP	PD	LSI
	B	4.0000	0.9139	2.8407
	C	9.0000	3.9465	3.0000
	D	3.0000	0.9669	2.8616
	E	5.0000	1.8741	3.2649
mean		**5.0000**	**1.92535**	**2.909**
1968-1982	A	19.000	1.5705	4.0698
	B	2.0000	0.4510	1.7186
	C	6.0000	2.4640	2.9431
	D	2.0000	0.9591	1.5124
	E	2.0000	0.8826	1.4854
mean		**6. 2000**	**1.18918**	**2.34586**
1982-now	A	4.0000	2.896	2.8280
	B	6.0000	1.6219	1.5313
	C	5.0000	1.7878	3.8765
	D	5.0000	1.8741	3.2649
	E	5.0000	1.6797	3.0215
mean		**5.0000**	**2.34586**	**2.90444**

3.4 Relationship between landscape composition and landscape metrics

The relationship between landscape composition and landscape metrics is traced through correlation analysis. The results of correlation analysis show that there is no correlation between landscape composition and landscape metrics. Correlation analysis with a significance value of 0.05 turns out that no one has a value below 0.05 for NP, PD, and LSI against landscape composition. Thus, it was concluded that there was no correlation between landscape composition and landscape metrics.It can be seen in Figure 3.

Correlations

		Landscape Composition	NP	PD	LSI
Landscape Composition	Pearson Correlation	1	.069	-.128	-.360
	Sig. (2-tailed)		.808	.649	.188
	N	15	15	15	15
NP	Pearson Correlation	.069	1	.290	.601*
	Sig. (2-tailed)	.808		.294	.018
	N	15	15	15	15
PD	Pearson Correlation	-.128	.290	1	.374
	Sig. (2-tailed)	.649	.294		.169
	N	15	15	15	15
LSI	Pearson Correlation	-.360	.601*	.374	1
	Sig. (2-tailed)	.188	.018	.169	
	N	15	15	15	15

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 3: Correlation Analysis Result

This happens because the landscape metrics only looks at the arrangement of patches based on its groups without seeing what natural landscape elements are in it. Figure 4 shows that images entered in fragstat software do not see the landscape elements but see different types of land use. So, further interpretation is needed to see whether differences in composition affect the resilience of the ecosystem and its ecology.

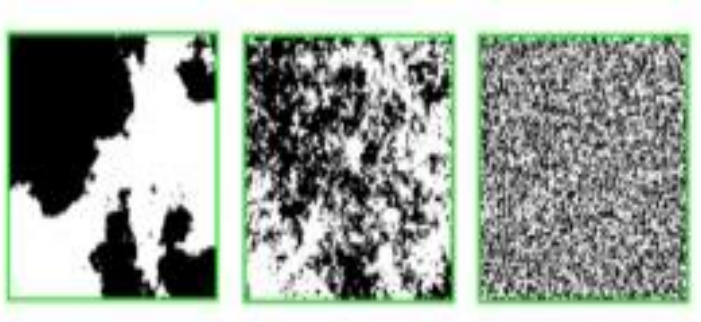

Figure 4: Patch Ilustration

IV. CONCLUSION

Landscape composition conditions do not have a correlation to metric landscapes. This is because the metric landscape only measures the differences in land use. Meanwhile, the interpretation must use other theories and methods.

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