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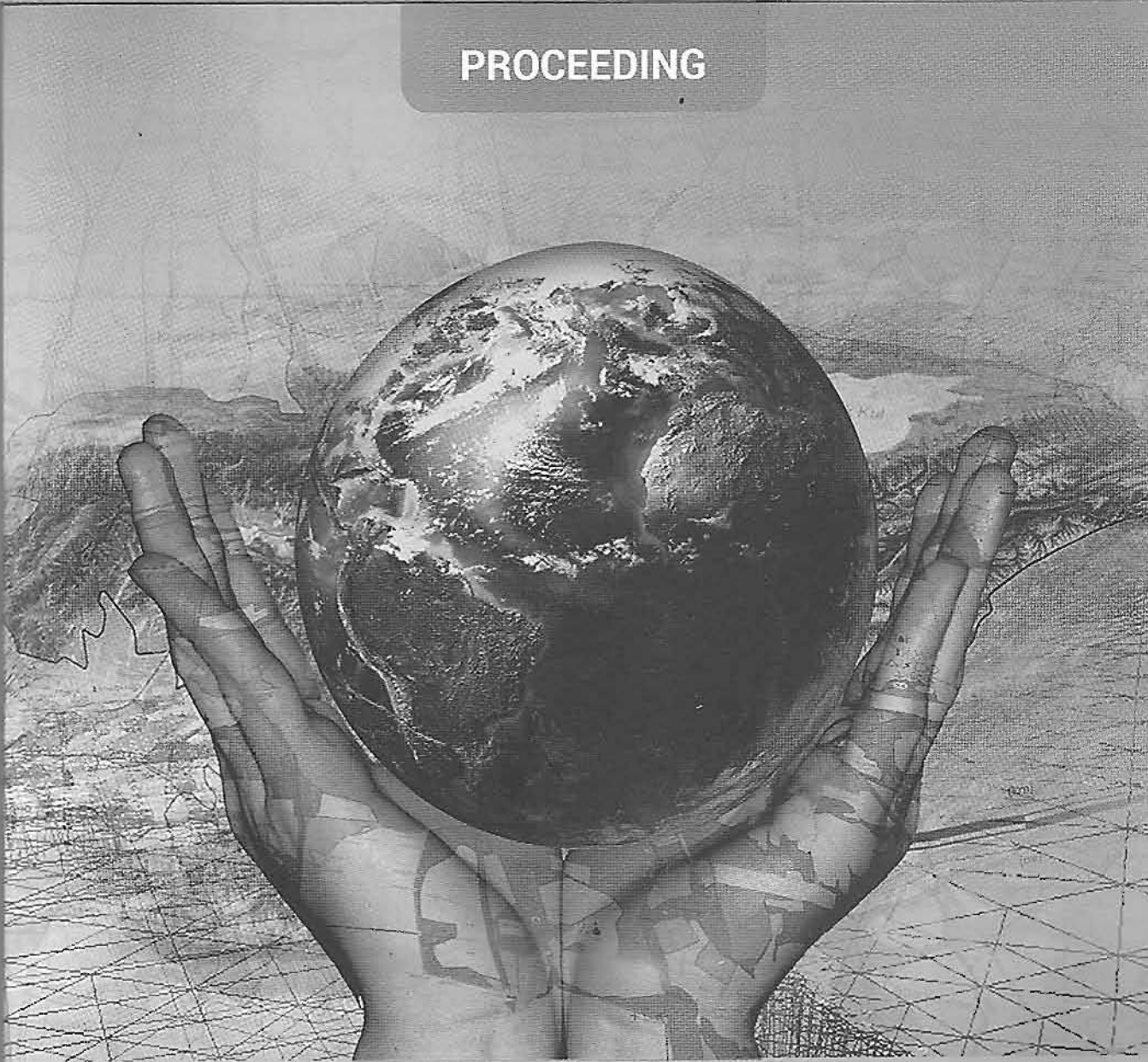

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Spatial Multi Criteria Analysis for Determining Paddy Field Availability in Cianjur Regency, West Java, Indonesia.

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ABSTRACT

Recently, food security become an issue in Indonesia, especially on paddy fields. Some paddy fields are being proposed to be protected by laws, expanded, or allocated for particular farmers. However, selecting and proposing paddy fields based on spatial multicriteria analyses have been an intricate tasks, therefore require a particular method, which is not available at present time in Indonesia. Recent methodological analysis on agricultural land availability has been considering physical or socio-economic aspects, however this would not ensure proper accounting of actual agricultural land utilization. The research was aimed to compare Boolean Combination and Weighted Linear Combination analysis methods to determine paddy field availability; to define spatial relationship between physical, economic, and legal aspects as well as sustainability related to determining agricultural land availability; and to calculate paddy field availability. In this research, additional aspects such as land allocation policies and erosion levels, were employed and served as supplementary variables in agricultural land availability analysis, therefore minimize possibility on conflicting land utilization and ensure agricultural sustainability. Spatial analysis using Geographical Information System coupled with Multi-criteria Evaluation was employed to investigate available lands based on previous criteria. Specifically, a Weighted Linear Combination (WLC) was assessed to provide dynamic variations of weight and adaptive to differ effect of each variable. Weighting by means of Analytic Hierarchy Process (AHP) showed that the physical factors (i.e. land suitability) achieved the highest rank (about 16.7%), while the lowest was land utilization (6.3%). Analysis of WLC suggested that there are about 136,549 Ha available for paddy field while calculation using Boolean Combination obtained 30,590 ha available for paddy field. In the context of decision-making the Boolean method tends to take risks in making decisions while the WLC method shares the risk in decision-making starts the lowest to the highest at risk.

***Keywords:** Land suitability, Spatial Analysis, Multi Criteria Evaluation, Weighted Linear Combination*

Introduction

Recently, food security become an issue in Indonesia, especially on paddy fields. Some paddy fields are being proposed to be protected by laws, expanded, or allocated for particular farmers. However, selecting and proposing paddy fields based on spatial, multicriteria analyses have been an intricate tasks, therefore require a particular method, which is not available at present time in Indonesia. Recent methodological analysis on agricultural land availability has been considering physical or socio-economic aspects, however this would not ensure proper accounting of actual agricultural land utilization. The research was aimed to compare Boolean Combination and Weighted Linear Combination analysis methods to determine paddy field availability; to define spatial relationship between physical, economic, and legal aspects as well as sustainability related to determining agricultural land availability; and to calculate paddy field availability. In this research, additional aspects such as land allocation policies and erosion levels, were employed and served as supplementary variables in agricultural land availability analysis, therefore minimize possibility on conflicting land utilization and ensure agricultural sustainability. Spatial analysis using Geographical Information System coupled with Multi-criteria Evaluation was employed to investigate available lands based on previous criteria. Specifically, a Weighted Linear Combination (WLC) was assessed to provide dynamic variations of weight and adaptive to different effect of each variable

Methodology

Location and time

Location of the research was Cianjur District. Analysis was conducted at Studio of Regional System Analysis, Crespent, IPB at 2010; Field observation was conducted in february to May 2010.

Method

Paddy field availability define as proper criterias in physical, socioeconomic, and legal factors that minimized conflict and ensure agricultural sustainability.

Multicriteria Evaluation (MCE) analysis was choiced to determined paddy field availability. Generally, a Multicriteria analysis is defined as "a decision-aid and mathematical tool allowing the comparison of different alternatives or scenarios, often conflicting according to many criteria in order to guide the decision maker (Roy in Chakkar and Mousseau, 2007)

Spatial multicriteria is an apllication of multicriteria that has explicit spatial dimensions. Two kind methods of MCE was used, the first method is *boolean combination* and the remaining is *Weighted Linear Combination (WLC)*.

MCE framework consist of goals and criterias detemination.The criteria are divided to factors and constraints. Factors are alternatives or criterias that support to reach the goal, where in contrast the constraints are alternatives or criterias that contrain the goal.

Based on this MCE framework, the goal was defined as Paddy field availability Map. Three factors were choiced, (1) Phyisical Factors, ie. land suitability, accesibility to water sources, erosion level; (2) Socio-economic factors, i.e. land utilization, accessibility to market place; accessilibility to road; (3) Legal Factors, i.e. regional land allocation policy (RTRW), forest land allocation policy, and estate land allocation policy.

Evaluation Criteria

In Boolean Combination method, all criteria (factors and contraints) were standardized to boolean value (0/non-suitable and 1/suitable), and method of agregation in GIS method was boolean intersection (multiplication criteria), where in contrast WLC method, factors and contraints were determined to degree of suitability for all areas (0-5) (Eastman, 2006). The higher value indicate the higher suitability. Following mathematical equation described the Agregation of WLC methods.

Figure 1. WLC Map

Where: WLC = *weighted linear combination*, X=degree of suitability factor/Sub-factor, W=weighted factor/Sub-factor, C= Constraint, *i=number of factors, j=location*

Weighted Factor determined by analytical hierarchy process (AHP) method (Saaty, 1994).

Result

Figure 1 showed spatial allocation resulting from Boolean Combination and WLC methods. Boolean combination method suggested tight area that available for paddy field while WLC method obtained

more areas. Green areas indicate paddy field availability mostly found at northern Cianjur Regency which has the form of flat land and adjacent to center activity (fig. 1.a). In the WLC method, the paddy field availability of class is divided into 5 classes as indicated by different colors in the Map (fig. 1.b). Color maps were increasingly red color indicates the value of the lower grade of availability. The red color on the map found in areas that have hilly and mountainous landform with steep slopes.

Table 1. Weighting Factors by AHP

Factors	W-Value
Land Suitability	0.167
Regional Land Allocation Policy	0.124
Distance to water source	0.124
Distaance to road	0.115
Erosion	0.115
Distance to market	0.101
Forest and Estate Allocation Policy	0.099
Customary Land	0.092
Land Utilization	0.063
Total	1.000

Weighting by means of Analytic Hierarchy Process (AHP) showed that physical factors (i.e. land suitability) achieved highest rank (about 16.7%), while the lowest was land utilization (6.3%).

Analysis of WLC suggested that there are about 136,549 Ha available for paddy field while calculation using Boolean Combination obtained 30,590 ha available for paddy field.

Conclusion

In the context of decision-making. boolean methods tend to take risks in making decisions while the WLC methods share the risk in decision-making starts the lowest to the most at risk.

References

Chakkar, S dan V. Mousseau, 2007. Spatial Multi Criteria Decision Making. LAMSADE. University of Paris Dauphine, France

Saaty. T.L. 1994. Fundamentals of analytic hierarchy process. RWS Publication. Pittsburgh, USA.

Eastmen, J.R. 2006. Idrisi Andes Guide to GIS and Image Processing. Clark Lab-Clark University.

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