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ANALYTICAL HIERARCHY PROCESS (AHP) TO DETERMINE ZONING REGION VOCATIONAL EDUCATION

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Abstract

The purpose of research is determining rate, weight and score for eight parameters (drainage, rain fall, effective depth of soil, flood, soil texture, erosion, rock and slope) using analytical hierarchy process (AHP) as spatial analysis input data to produce vocational school zone. The assessment and weighting system for each parameter uses the AHP method. Weighting is done to determine the magnitude of the effect of each parameter used as input in determining the zoning of vocational education areas, each parameter is paired with one another and compared in importance. Based on the results of the AHP, there are 8 parameters that can be used as a reference for determining the vocational education areas zonation, namely drainage, rainfall, effective soil depth, flooding, soil texture, erosion sensitivity, rocks and slope. Weight of drainage is greater, and slope is smaller than other components. Drainage of harm associated with stagnant water, or the possibility of damage to underground constructions for poor ground water system. Slope weight is 5 % as spatial analysis input data. The impact of study gives benefits to stakeholder for determining vocational school location being easier, faster and more accurate.

Keywords: Analytical hierarchy process, Vocational school location, Weight, Zoning.

1. Introduction

Development zoning vocational education is one factor that ensures good quality in education [1], zoning development of education has proven to be an important indicator in student achievement. Many ways you can do in taking decisions to zoning district vocational education. The difficult thing in making a decision is the selection of the appropriate method in the decision making [2], Method/means determine zoning vocational education is needed to make the right decisions and efficient.

One method of determining the approach adopted in the vocational area zoning decision making hierarchy is the Analytical Hierarchy Process (AHP). AHP is used to resolve zoning vocational education area based on carrying capacity. AHP is an appropriate method associated with complex decisions that are interdependent in a decision model [3-5], Effective use of AHP in the decision to accommodate the measures that are qualitative and quantitative influence decisions through a hierarchical approach [6], AHP detailing the decision problem into a hierarchy of elements interconnected decision [6, 7], Decision structure AHP is a hierarchy that determines the size and determination of importance criteria and sub-criteria through paired comparisons [7], AHP is obtained on ranking among priorities in accordance with its ability to meet the level of interest the criteria developed [8], The resolution of issues with AHP there are some principles that should be understood, such as decomposition, comparative judgment and synthesis of priority [4,7].

Analytical hierarchy process is implemented for critical study and comparison of manufacturing simulation software, rowing talent identification based on main and weighted criteria, analysis of the risk assessment delay case study of public road construction project and supplier selection in the Indonesia pipe steel industry [8-11]. The result of analytical hierarchy process implementation is proved to be a good aid for structuring a decision problem, making a good decision and focusing on any problem areas within the decision-making process [8].

Vocational education became a trend before and after the COVID-19 pandemic. Several universities opened vocational study programs in several study programs according to market demand. Education, teaching, research and community service as well as supporting activities have been carried out by the academic community. Several research activities were carried out during the COVID-19 pandemic with the aim of increasing the strengths and opportunities of vocational education and eliminating its weaknesses and obstacles. The research activities carried out are about vocational education curriculum [12], the urgency of online learning media during the COVID-19 pandemic [13], distance learning in vocational high schools during the COVID-19 pandemic [14], an instructional design for online learning in vocational education according to a self-regulated learning framework for problem solving during the COVID-19 crisis [15], practicum content analysis in vocational education for over grow pandemic learning problems [16] and green skills understanding of agricultural vocational school teachers.

Environmental aspects are used as input to determine zoning vocational education is drainage conditions, rainfall, soil effective depth, flooding, soil texture, sensitivity to erosion, rocks, and slope. Evaluation of the environmental aspect is directed to determine the potential of the land for the development of vocational education area zoning. The scoring system and weighting of each parameter using the AHP. Weighting is done to determine the amount of influence of each parameter is used as input in determining zoning vocational education. Each parameter paired with each other and compared to the level of importance [2, 4, 7-11].

The purpose of research is determining rate, weight and score for eight parameters (drainage, rain fall, effective depth of soil, flood, soil texture, erosion, rock and slope) using AHP as spatial analysis input data to produce vocational school zone. This study on AHP to determine zoning region vocational education is very important because it makes it easier, faster and more accurate for spatial analysis input data to produce vocational school zone. Vocational school is important, relating to the more additional practicum than theoretical [12-17].

This article is the result of a survey research using MCDM method. Decision making method using the analysis procedures in AHP which can provide a reference for site selection zoning appropriate vocational education. Procedure in the AHP is as follows.

2.Method

This article is the result of a survey research using MCDM method. Decision making method using the analysis procedures in AHP which can provide a reference for site selection zoning appropriate vocational education. Procedure in the AHP is as follows:

a. Build hierarchy. Built hierarchy made in several levels associated. Design hierarchy for zoning region vocational education is presented in Fig. 1.

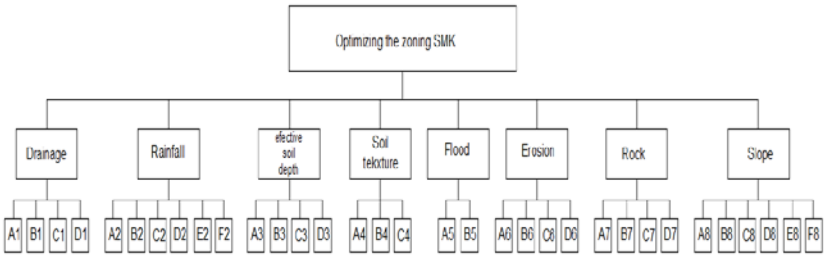

Fig. 1. Design hierarchy for zoning region vocational education.

b. Comparing the elements of a decision based on the couple and to reduce the concept of decision-making.

c. The parameters determined by normalization of the eigen vector associated with the maximum eigen matrix ratio. Comparison matrix couples is presented in Table 1.

Table 1. Comparison matrix couples.

Value	Definition
1	Equally important
3	Quite important
5	High importance
7	Very high importance
9	Extremely high interests
2,4,6,8	Values between each criterion

d. The weight of each parameter was calculated using the ratio of the pair with the assumption that if the value of CR <0.10 then show the level of consistency and a good sensitivity, meaning that the weight gained is quite rational. But if the weight> 0.10 then there has been a judgment is inconsistent or bad sensitivity value, meaning that the calculation must be repeated MCDM before continuing on spatial analysis.

e. Spatial analysis is the aggregation weights relative that has been produced in the previous stage to produce composite weight as the final score of spatial decision making.

3. Results and Discussion

The scoring system and weighting of each parameter that is used as input to determine zoning vocational education using AHP. Weighting is done to determine the amount of influence of each parameter is used as input to zoning district vocational education. 8 parameters evaluated or assessed the influence zoning vocational education areas are: drainage, rainfall, soil effective depth, flooding, soil texture, sensitivity to erosion, rocks and slope. Each parameter paired with each other and compared to the level of importance.

3.1. Pair comparison matrix

Table 2 is a table comparing the results of each parameter is filled by the experts in determining zoning vocational education. Each parameter is compared to the level of importance to each of the other parameters [2, 4, 7-11]. The results of Table 2 and then transformed into the form of a matrix. Comparison matrix couples is presented in Table 2.

Table 2. Comparison matrix couples.

Parameter	DR	RF	ESD	FL	ST	ER	RK	SL
DR	1	2	2	4	2	2	2	2
RF	½	1	2	2	2	3	2	2
ESD	½	½	1	2	2	2	2	4
FL	¼	½	½	1	2	2	2	5
ST	½	½	½	½	1	2	2	4
ER	½	1/3	½	½	½	1	2	5
RK	½	½	½	½	½	½	1	2
SL	½	½	¼	1/5	¼	1/5	½	1

Note: DR is the drainage; RF is the Rainfall, ESD is the Effective depth of soil, FL is the flood; ST is the Soil texture; ER is the Sensitivity to erosion; RK is the rock; and SL is the Slope

Based on comparative matrix pairs, Table 2 indicated that the flood is quite very important to consider than the drainage, then flooding given factor assessment 4. As for rainfall, effective soil depth, soil texture, sensitivity to erosion, rocks and slope a little more important than drainage, it is provided by the expert assessment 1 for 2. Sensitivity erosion are important enough to be considered when compared to the rainfall then given ratings 3. While the effective depth of soil, flooding, soil texture, rock and slope a little more important to consider when compared to the bulk rain. The slope is quite crucial when compared to an effective depth of the soil, so it is given the value 4. As for flooding, soil texture, sensitivity to erosion and rock a little more important when compared to an effective depth of soil. Steep slopes interests to be considered when compared to flood, then rated 5. While the texture of the soil, erosion and rock sensibilities a little more important when compared with the flood, it is given a value of 2. The slope is very important enough to be considered in spatial analysis when compared to sensitivity to erosion then rated 5. While the rock a little more important when compared with the sensitivity to erosion, it is given a value of 2. the slope of the rock a little more important, given the value of 2. to calculate the weight of each parameter includes two steps, namely:

a. Sum of values for each column in the matrix comparison parameter. Each parameter 1 and the other is compared in pairs. The value of the parameter comparison pairs then summed by column every parameter. The total sum of the columns of each parameter will be used as the divisor factor in the calculation of the normalized partner. [2, 4, 7-11]. Table 3 present the division between the parameter pairs which then summed each column. From the calculation results show that the value for the slope is slightly smaller than the effective depth of soil, flooding, soil texture and sensitivity to erosion. Comparison matrix summation couples is presented in Table 3.

Table 3. Comparison matrix summation couples.

Parameter	DR	RF	ESD	FL	ST	ER	RK	SL
DR	1	2	2	4	2	2	2	2
RF	0:50	1	2	2	2	3	2	2
ESD	0:50	0:50	1	2	2	2	2	4
FL	0:25	0:50	0:50	1	2	2	2	5
ST	0:50	0:50	0:50	0:50	1	2	2	4
ER	0:50	0:33	0:50	0:50	0:50	1	2	5
RK	0:50	0:50	0:50	0:50	0:50	0:50	1	2
SL	0:50	0:50	0:25	0:20	0:25	0:20	0:50	1
DR	4:25	5.83	7:25	10.70	10:25	12.70	13:50	25.00

Note: DR is the drainage; RF is the Rainfall, ESD is the Effective depth of soil, FL is the flood; ST is the Soil texture; ER is the Sensitivity to erosion; RK is the rock; and SL is the Slope

b. The value of each cell division with a total value in the column in question and the average value of the normalized weights.

The result of the division of each matrix is named as a paired comparison matrix normalized. [2, 4, 7-11]. Table 4 illustrates the weight value of each parameter pair comparison. The weight of the drainage of the other parameters varies depending on the result of the division of the value that has been given by the experts. Likewise with the other parameter weighting, the weight values between one another with different parameters. Comparison matrix normalized couples and the average normalized classified is presented in Table 4.

Based on calculations presented in Table 4 the average value of the normalized comparison matrix, drainage greater weight than others. The average normalized line drainage parameters were 0.23 or 23% more influential than the other parameters. Rainfall 0:18 or 18% effect on land capability analysis. 0:15 Effective soil depth or influence only by 15%. Flood 0:13 or effects by 13%. 0:11 soil texture, or by 11% influence on the evaluation of the ability of the land. Erosion sensitivity 0.10 or a 10% influence on the evaluation of the ability of the land. 0:07 rock or only 7% influence and the slope is 0:05 or only by 5% only influence the slope of the land capability evaluation.

Table 4. Comparison matrix normalized couples and the average normalized classified.

Parameter	DR	RF	ESD	FL	ST	ER	RK	SL	Weight
DR	0:24	0:34	0:28	0:37	0:20	0:16	0:15	0:08	0:23
RF	0:12	0:17	0:28	0:19	0:20	0:24	0:15	0:08	0:18
ESD	0:12	0:09	0:14	0:19	0:20	0:16	0:15	0:16	0:15
FL	0:06	0:09	0:07	0:09	0:20	0:16	0:15	0:20	0:13
ST	0:12	0:09	0:07	0:05	0:10	0:16	0:15	0:16	0:11
ER	0:12	0:06	0:07	0:05	0:05	0:08	0:15	0:20	0:10
RK	0:12	0:09	0:07	0:05	0:05	0:04	0:07	0:08	0:07
SL	0:12	0:09	0:03	0:02	0:02	0:02	0:04	0:04	0:05
amount	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00	1:00

Note: DR is the drainage; RF is the Rainfall, ESD is the Effective depth of soil, FL is the flood; ST is the Soil texture; ER is the Sensitivity to erosion; RK is the rock; and SL is the Slope

3.2. Estimates of the ratio of consistency

Estimates of the ratio of consistency is divided by 3 phases, there are (a) vectors total weight, (b) vector consistency and, (c) consistency index (CI) and ratio consistency (RC). Vectors total weight is calculated for gaining total weight of each parameter. Vector consistency is calculated for gaining consistency of each parameter. Consistency index (CI) is calculated for knowing value of how far from consistency. Ratio consistency (RC) is calculated for gaining all weight values for all parameters smaller than the default (CR < 0,100) then all parameters can already be used to our study.

a. Determination of the vector sum of weights by multiplying the weight of the first parameter to the first column of the matrix comparison of early and so on up to eight parameters. [2, 4, 7-11]. Vectors total weight is presented in Table 5.

Table 5. Vectors total weight.

Parameter	The vector sum of weights	Result
DR	(0:23×1) + (0:18×2) + on (0.15×2) + (0:13×4) + (0:11×2) + (0.10×2) + (0:07×2) + (0:05×2)	2:03
CH	(0:23×0.50) + (0:18×1) + (0:15×2) + (0:13×2) + (0:11×2) + (0.10×3) + (0:07×2) + (0:05×2)	1:58
ET	(0:23×0.50) + (0:18×0.50) + (0:15×1) + (0:13×2) + (0:11×2) + (0.10×2) + (0:07×2) + (0:05×4)	1:34
BJ	(0:23×0.25) + (0:18×0.50) + on (0.15×0.50) + (0:13×1) + (0:11×2) + (0.10×2) + (0:07×2) + (0:05×5)	1:13
TT	(0:23×0.50) + (0:18×0.50) + on (0.15×0.50) + (0:13×0.50) + (0:11×1) + (0.10×2) + (0:07×2) + (0:05×4)	0.97
ER	(0:23×0.50) + (0:18×0.33) + on (0.15×0.50) + (0:13×0.50) + (0:11×0.50) + (0.10×1) + (0:07×2) + (0:05×5)	0.83
BT	(0:23×0.50) + (0:18×0.50) + on (0.15×0.50) + (0:13×0.50) + (0:11×0.50) + (0.10×0.50) + (0:07×1) + (0:05×2)	0.61
KL	(0:23×0.50) + (0:18×0.50) + on (0.15×0.25) + (0:13×0.20) + (0:11×0.25) + (0.10×0.20) + (0:07×0.50) + (0:05×1)	0:39

Note: DR is the drainage; RF is the Rainfall, ESD is the Effective depth of soil, FL is the flood; ST is the Soil texture; ER is the Sensitivity to erosion; RK is the rock; and SL is the Slope

b. Vector determine consistency by dividing the weighted sum of the weight vector parameters and calculates the average value of consistency (λ). [2, 4-11]. Vector consistency is presented in Table 6.

Table 6. Vector consistency.

Parameter	Consistency ratio	Result
DR	2:03: 0:23	8.96
CH	1:58: 0:18	8.96
ET	1:34: 0:15	9:02
BJ	1:13: 0:13	8.98
TT	0.97: 0.11	8.77
ER	0.83: 0:10	8.71
BT	0.61: 0:07	8.63
KL	0:39: 0:05	8:39
Total		**70.42**
Average		**8.80**

Note: DR is the drainage; RF is the Rainfall, ESD is the Effective depth of soil, FL is the flood; ST is the Soil texture; ER is the Sensitivity to erosion; RK is the rock; and SL is the Slope

c. Calculating CI (consistency index) and CR (ratio consistency):

CI values stated value of how far from consistent. RI value depends on how many parameters (n) that is being compared. In this study, the parameters used are the 8 parameters of the specified RI $ 1.41 (based on a random inconsistency index *n* = 1, 2, 3 ... 12) and is used to calculate the consistency ratio. Consistency of the ratio calculation in this research note that the comparison process is quite consistent partner with value ratio (CR) of 0081 is smaller than the standard is 0,100. Eight weight values for all parameters smaller than the default (CR <0.100), then to eight parameters can already be used to determine the zoning of land vocational education. [2, 4, 7-11].

4. Conclusion

Based on the results of the AHP, there are eight parameters that can be used as a reference in determining zoning vocational education area are: drainage, rainfall, effective soil depth, soil texture, flooding, erosion sensitivity, rock and slope.

Drainage of harm associated with stagnant water, or the possibility of damage to underground constructions for poor ground water system. Rainfall is the second parameter that affects the vocational education area zoning. Rainfall intensity on a piece of land is very important. Function of rainfall is as a source of clean water supply for various needs.

Effective depth of soil is a thick layer of soil from the ground surface to the parent material. Effective depth of the soil is influenced by soil type and the state of erosion. Flood indicates the lands or territories for some time under water caused by rain or stream from elsewhere. The soil texture associated with the presence of clay minerals contained in the soil.

Erosion sensitivity analysis is intended to determine the condition of the land associated with the ability of the land to the possibility of erosion. Early introduction to soil erosion which may potentially be useful in anticipatory actions or avoid the use of the land and eroded. Expanse of rock at a depth of 2 meters or less, the influence on the development of constructions that require excavation soil that is not too deep.

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