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Prototype Decision Support System to Detect Disaster Prone Areas with Saw Method (Tanggamus District Case Study)

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Abstract: Most of Tanggamus regency is a disaster-prone area, such as floods, landslides, earthquakes, and so on. To determine the area that is really potentially catastrophic is something complicated and the determination process there are many errors, because the determination process is based on subjectivity. In this case it is most likely that the area that is really potential for disaster does not enter into the territory prioritized by the government to be given socialization of insights about disasters or reduce the risk of disasters. This paper discusses the Simple Additive Weighting (SAW) method that can be used in determining disaster-prone areas in Tanggamus Regency. The area to be designated as a disaster-prone area has criteria that have been set. Criteria needed include: Flood disaster data, landslide disaster data, earthquake disaster data, tsunami disaster data, and fire disaster data. The result of this system is a list of disaster-prone areas that comply with the criteria specified as areas of special attention from local governments.

Keywords: Criteria, Simple Additive Weighting Method, Region Disaster Prone Local Government of Tanggamus.

1. INTRODUCTION

1.1 Background Issues

The role of the Regional Disaster Management Agency of Tanggamus Regency cannot be separated from the field of prevention and preparedness in disaster management in the process of achieving these objectives, the determination of disaster-prone areas must be in a professional and accurate way in order to produce data that can support quality and success.

A work programs. In the process of travel, accurate and quality data becomes an investment for a work program to be able to grow and develop in accordance with the vision and mission

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of a BPBD tanggamus district. Therefore, objectivity is necessary to be able to support every decision in order to get good and accurate data for a long period of time but this is very contradictory to those implemented in the field. Frequent assessment based on subjectivity is one example of decision-making failure in the process of determining disaster-prone areas. If left unchecked for a long time it can affect the performance of an organization resulting in the failure of an organization in achieving its goals.

Basically, the purpose of determining disaster prone areas in tanggamus districts using simple additive weighting (SAW) method is to properly obtain accurate and quality data on disaster prone areas, so that the program is able to work optimally and can survive in the organization for a long time. Although the goal sounds very sidechain, however, the process turns out to be very complex, takes quite a long time and costs are not small and very open opportunities to make mistakes in determining the right disaster-prone areas. Especially when the area that is referred to has characteristics that are not much different from other areas.

Therefore, the determination of disaster-prone areas is complicated and causes many wrong decisions, because the process of determination based on subjectivity. This means that areas that are actually potentially catastrophic are not included in the list of areas prioritized as disaster-prone areas.

With this system, Disaster Prone Areas are expected to produce a decision that is completely in accordance with the level of disaster vulnerability in a region so that local governments or related parties can give special attention to the area.

1.2 Problem Formulation

Based on the background above, obtained 3 (three) problem formulations to conduct research on decision support systems for the determination of disaster-prone areas in Tanggamus District using simple additive weighting (SAW) method as follows:

1. How can saw method provide solutions in the problem of determining disaster prone areas in Tanggamus Regency?
2. How to implement the Decision Support System
3. How is the implementation of the decision support system?

1.3 Limitations of The Problem

To focus the research, the limitations of the formulation of the above problems are as follows:

1. The decision support system is a decision support system that only helps provide alternative determination of disaster-prone areas at the district level.
2. The decision-making criteria used only use data from 2019.

1.4 Research Objectives

The purpose of this research is as follows:

1. Implementing SAW method in building a system to support the decision of disaster-prone area determination in Tanggamus Regency.
2. Build a Prototype Decision Support System for the determination of disaster prone areas in Tanggamus District using simple additive weighting (SAW) method.

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1.5 Benefit

The benefits obtained in the making of this decision support system include:

1. It can help determine areas that are actually potentially catastrophic.
2. Can reduce errors in determining disaster prone areas in Tanggamus District.
3. Can facilitate decision making in determining disaster prone areas in Tanggamus Regency.

2. LIBRARY REVIEW

2.1 Decision Support System

Decision Support System (DSS) is an interactive information system that serves to assist management in making decisions by using data modeling or data analysis equipment as the basis for alternative development that can be used by users. (Setiyaningsih, 2015)
Decision Support System in particular can be defined as an information technology-based system that is able to provide and support problem solving capabilities as well as communication capabilities for semi-structured problems in an organization in tanggamus district. (Setiyaningsih, 2015)
The conclusion is that The Decision Support System (DSS) is an interactive information system that serves to assist management in making problem-solving decisions as well as the ability to communicate semi-structured problems in an organization in tanggamus district.

2.2 Fuzzy Multiple Attribute Decision Making (FMADM)

Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to find the optimal alternative of a certain number of alternatives with certain criteria using an objective approach, the weight value is calculated automatically thus ignoring the subjectivity of decision making.

2.3 Definition of Disaster

Disaster is an event or series of events that threaten and disrupt people's lives and livelihoods caused, either by natural and/or non-natural factors or human factors resulting in human fatalities, environmental damage, property losses, and psychological impacts. Disaster, National Disaster Management Agency. (Bruno, 2019). Disaster is a natural and non-natural event that has a huge impact on the human population.

2.4 Tanggamus Regency

Tanggamus district is located in disaster prone areas, especially floods, landslides, earthquakes, tsunamis, fires, pickaxes, and coastal abrasions. The threat of flooding arises as an accumulative effect of suboptimal watershed management. The threat of landslides arises due to the tendency of areas dominated by hilly areas with diverse dominant rock characteristics coupled with high rainfall. The threat of earthquake disaster comes from the earthquake path that extends for 6500 km in the subduction zone to the west of Sumatra Island, sunda fault, and Krakatau volcano cluster. The tsunami threat appears as a further effect of tectonic and volcanic earthquakes occurring in the sea. The fire threat has the potential to occur in areas with a fairly high population density. The threat of pickaxe nipples

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has the potential to occur in relatively flat areas. And the threat of coastal abrasion arises as a result of the management of less integrative coastal areas. (Bencana & Page, 2018)

3. RESEARCH METHODS

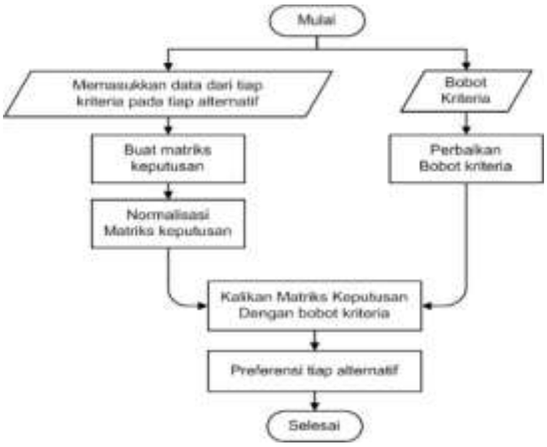
3.1 Research Methods

Observation Method Is An Activity to Pay attention accurately, record emerging phenomena, and consider the relationship between aspects in the phenomenon, as the method of observation is usually interpreted as observation and record the phenomenon of phenomena that are investigated systematically(Arsyad et al., 2021)

3.2 SAW method

Saw method is often known as weighted summation method. The basic concept of the SAW method is to look for weighted summations of performance ratings on each alternative on all attributes. The SAW method requires the normalization of the decision matrix (X) to a scale that can be compared to all existing alternative (Bruno, 2019)(Bruno, 2019)(Frieyadie, 2016)(Frieyadie, 2016)ratings.

3.3 Flowchart Research



Figures : 1. Research Flow

3.4 Set criteria for disaster-prone areas.

The Regional Disaster Management Agency of Tanggamus District sets the following criteria:

No	Notation	criterion
1	C1	Very High Rainfall ≥ 3 times / year
2	C2	Soil Conditions That Often Occur Erosion Due to Rain ≥ 3 times / year
3	C3	Geographic Location
4	C4	Tidal Conditions of Sea Waves

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5	C5	Summer Time in the Hills

3.5 Decision Support System Concept

According to Fishbourne and McCrimmon in explaining that the Simple Additive Weight (SAW) is often also known as weighted summation method. The basic concept of the Simple Additive Weight(SAW) method is to look for weighted summation of performance ratings on each alternative on all attributes. According to Asnawati and Kanedi, assessment criteria can be determined by themselves according to the needs required by a particular company or organization.(Setiyaningsih, 2015)(Setiyaningsih, 2015) In the journal Heri Sulistiyo (2011), the definition of the ideal Decision Support System (DSS) is:(Setiyaningsih, 2015)(Setiyaningsih, 2015)(Winiarti & Yuraida, 2012)(Winiarti & Yuraida, 2012)

1. DSS is a computer-based and user-based system.
2. DSS is intended to assist decision makers in solving problems at various levels of management and not to change human position as decision makers.
3. DSS is able to provide alternative solutions to semi/unstructured problems for individuals or groups and in a wide variety of decision-making processes and styles.
4. DSS uses data, databases and analysis of decision models.
5. DSS is adaptive, effective, interactive, easy to use and flexible.
6. DSS provides access to a wide variety of data source formats and types.

3.6 Formula Simple Additive Weighting

3.6.1 Formula Simple Additive Weighting

The formula for normalization is as follows [6] :(Frieyadie, 2016)(Frieyadie, 2016)

r_{ij} = X_{ij} If j is an attribute of ~~profit (Benefit)~~

Max$_i$ X_{ij}

r_{ij} = Min$_i$ X_{ij} If j is a cost attribute

X_{ij}

information:

R_{ij} = Performance Rating Value

X_{ij} = attribute values that each criterion has

Ma$_i$xx_{ij} = the largest value of each criterion

M$_i$nx_{ij} = smallest value of each criterion

Benefit= if the greatest value is best

Cost =If the smallest value is best shaped

where rij is the normalized performance rating of the Ai alternative to the Cj attribute; i=1,2...,m and j=1.2...,n. Preference value for each alternative (V_i)

3.6.2 Simple Additive Weighting Preference Values

Preference value for each alternative (Vi) is given as follows:

n

Vi = $\sum w_j R_j$

J=i

information:

V_i = ranking for each alternative

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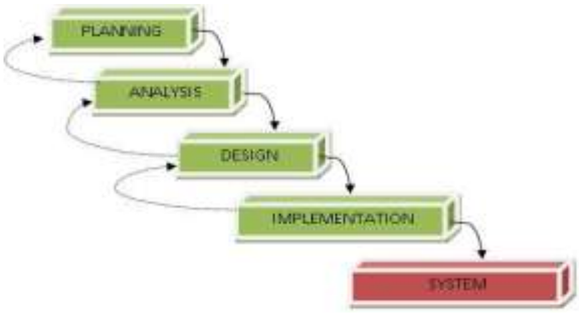
w_j = the weight value of each criterion
r_{ij} = normalized performance rating value

A larger Vi value indicates that ai alternatives are more elected.

4. DISCUSSION

4.1 Design



1. Waterfall

To design a decision support system model with this Simple Additive Weighting method, there are several steps that can be done, among others:

1. Set criteria for disaster-prone areas.
2. Determining the Percentage of weights of each criterion
3. Describes the alternate values of each criterion.
4. Calculate normalization.
5. Calculate the process of warkingan.
6. Sort the highest to lowest scores.

4.2 IMPLEMENTASI

3.4.1 Set criteria for disaster-prone areas.

The Regional Disaster Management Agency of Tanggamus District sets the following criteria

No	Notation	criterion
1	C1	Very High Rainfall ≥ 3 times / year
2	C2	Soil Conditions That Often Occur Erosion Due to Rain ≥ 3 times / year
3	C3	Geographic Location
4	C4	Tidal Conditions of Sea Waves
5	C5	Summer Time in the Hills

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3.4.2 Specifies the percentage of weight of each criterion.

The author sets the weights for each criterion as follows :

No.	Notation	Criterion	Weight
1	C1	Very High Rainfall ≥ 3 times / year	40%
2	C2	Soil Conditions That Often Occur Erosion Due to Rain ≥ 3 times / year	20%
3	C3	Geographic Location	15%
4	C4	Tidal Conditions of Sea Waves	10%
5	C5	Summer time in Hill	15%
Total			100%

3.4.3 Describe the alternate values of each criterion

Regretted in this example, the Regional Disaster Management Agency of Tanggamus District chose 5 sub-districts as samples with the following criteria. [8](<i>DISASTER RECAPITULATION 2019</i>, n.d.)(<i>DISASTER RECAPITULATION 2019</i>, n.d.)

No	Region Name	Alternative Notation
1	District of Semaka	V1
2	District of . Bulok	V2
3	District of . Ulu Belu	V3
4	District of . Kota Agung	V4
5	District of . Wonosobo	V5

alternative	criterion				
	C1	C2	C3	C4	C5
District of Semaka	90	85	70	70	80
District of Bulok	80	80	60	50	70
District of Ulu Belu	60	85	70	20	85
District of Kota Agung	70	75	80	85	65
District of Wonosobo	70	55	60	70	70

4.3 Discussion

4.3.1 Calculating Normalization(Formula And How to Calculate SPK SAW Method,n.d.)

$$R_{1.1} = \frac{90}{\mathrm{Max}(90;80;60;70;70)} = \frac{90}{90} = 1$$

$$R_{1.2} = \frac{80}{\mathrm{Max}(90;80;60;70;70)} = \frac{80}{90} = 0{,}89$$

$$R_{1.3} = \frac{60}{\mathrm{Max}(90;80;60;70;70)} = \frac{60}{90} = 0{,}67$$

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$$R_{1.4} = \frac{70}{\text{Max}(90;80;60;70;70)} = \frac{70}{90} = 0{,}78$$

$$R_{1.5} = \frac{70}{\text{Max}(90;80;60;70;70)} = \frac{70}{90} = 0{,}78$$

$$R_{2.1} = \frac{85}{\text{Max}(85;80;85;75;55)} = \frac{85}{85} = 1$$

$$R_{2.2} = \frac{80}{\text{Max}(85;80;85;75;55)} = \frac{80}{85} = 0{,}94$$

$$R_{2.3} = \frac{85}{\text{Max}(85;80;85;75;55)} = \frac{85}{85} = 1$$

$$R_{2.4} = \frac{75}{\text{Max}(85;80;85;75;55)} = \frac{75}{85} = 0{,}88$$

$$R_{2.5} = \frac{55}{\text{Max}(85;80;85;75;55)} = \frac{55}{85} = 0{,}65$$

$$R_{3.1} = \frac{70}{\text{Max}(70;60;70;80;60)} = \frac{70}{80} = 0{,}88$$

$$R_{3.2} = \frac{60}{\text{Max}(70;60;70;80;60)} = \frac{60}{80} = 0{,}75$$

$$R_{3.3} = \frac{70}{\text{Max}(70;60;70;80;60)} = \frac{70}{80} = 0{,}88$$

$$R_{3.4} = \frac{80}{\text{Max}(70;60;70;80;60)} = \frac{80}{80} = 1$$

$$R_{3.5} = \frac{60}{\text{Max}(70;60;70;80;60)} = \frac{60}{80} = 0{,}75$$

$$R_{4.1} = \frac{70}{\text{Max}(70;50;20;85;70)} = \frac{70}{85} = 0{,}82$$

$$R_{4.2} = \frac{50}{\text{Max}(70;50;20;85;70)} = \frac{50}{85} = 0{,}59$$

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$$R_{4.3} = \frac{20}{Max(70; 50; 20; 85; 70)} = \frac{20}{85} = 0{,}24$$

$$R_{4.4} = \frac{85}{Max(70; 50; 20; 85; 70)} = \frac{85}{85} = 1$$

$$R_{4.5} = \frac{70}{Max(70; 50; 20; 85; 70)} = \frac{70}{85} = 0{,}82$$

$$R_{5.1} = \frac{80}{Max(80; 70; 85; 65; 70)} = \frac{80}{85} = 0{,}94$$

$$R_{5.2} = \frac{70}{Max(80; 70; 85; 65; 70)} = \frac{70}{85} = 0{,}82$$

$$R_{5.3} = \frac{70}{Max(80; 70; 85; 65; 70)} = \frac{85}{85} = 1$$

$$R_{5.4} = \frac{70}{Max(80; 70; 85; 65; 70)} = \frac{64}{85} = 0{,}76$$

$$R_{5.5} = \frac{70}{Max(80; 70; 85; 65; 70)} = \frac{70}{85} = 0{,}82$$

The normalization results are described in the following matrix :

$$\begin{pmatrix} 1{,}00 & 1{,}00 & 0{,}88 & 0{,}82 & 0{,}94 \\ 0{,}89 & 0{,}94 & 0{,}75 & 0{,}59 & 0{,}82 \\ 0{,}67 & 1{,}00 & 0{,}88 & 0{,}24 & 1{,}00 \\ 0{,}78 & 0{,}88 & 1{,}00 & 1{,}00 & 0{,}76 \\ 0{,}78 & 0{,}65 & 0{,}75 & 0{,}82 & 0{,}82 \end{pmatrix}$$

4.3.2 Calculating the Process of Warkingan

Based on the matrix calculation process, then by using the percentage calculation weight can be calculated as follows :

V1 = (0,40) (1) + (0,20) (1) + (0,15)
(0,88) + (0,10) (0,82) + (0,15) (0,94)
= 0,955

V2 = (0,40) (0,78) + (0,20) (0,88) + (0,15)
(1) + (0,10) (0,82) + (0,15) (0,82)

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= 0,852

V3 = (0,40) (0,89) + (0,20) (0,94) + (0,15) (0,75) + (0,10) (0,59) + (0,15) (0,82)
= 0,839

V4 =(0,40) (0,78) + (0,20) (0,65) + (0,15) (0,75) + (0,10) (0,82) + (0,15) (0,82)
= 0,795

V5 = (0,40) (0,67) + (0,20) (1) + (0,15) (0,88) + (0,10) (0,24) + (0,15) (1)
= 0,771

The list of highest scores from the sample is as follows :

No	**Region name**	**value**
1	District of Semaka	0,955
2	District of Bulok	0,852
3	District of Ulu Belu	0,839
4	District of Kota Agung	0,795
5	Wonosobo	0,771

Based on the order of the disaster and the number of disasters from 2019, several lists of disaster-prone areas can be produced from potentially large disaster areas to areas with potential districts of disasters, among others:

a. District of semaka
b. District of bulok
c. District of Ulu Belu
d. District of Kota agung
e. Wonosobo

5. CONCLUSIONS AND SUGGESTIONS

5.1 CONCLUSION

1) Saw method is often known as weighted summation method. The basic concept of the SAW method is to look for weighted summations of performance ratings on each alternative on all attributes. The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared to all existing alternative ratings.

2) From the discussion above, it can be concluded that the determination of disaster-prone areas by simple additive weighting (SAW) method can help in determining the area that really has the potential for disaster by calculating the number of disasters that occur in an area, especially in tanggamus district.

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3) From the calculation using simple additive weight method, with reference criteria of Disaster data in Tanggamus District in 2019, then selected areas that have the potential for disaster in order, namely:

a. District of Semaka
b. District of Bulok
c. District of Ulu Belu
d. District of Kota agung
e. Wonosobo

5.2 Suggestions

The application of Simple Additive Weighting (SAW) method in this DSS needs to be evaluated continuously in order to be more optimal and in subsequent research can be made mapping areas that have the potential for disasters on a large scale in Tanggamus District.

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