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TECHNIQUE FOR ORDER PREFERENCE METHOD BY SIMILARITY TO IDEAL SOLUTION (TOPSIS) FOR DECISION SUPPORT SYSTEM IN DETERMINING THE PRIORITY FOR RECEIVING VILLAGE FUND ASSISTANCE

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ABSTRACT

In the modern era filled with global competition, now competition in realizing good and equitable infrastructure development has become the main focus in almost all specialty areas in Sub-districts throughout Indonesia. In STM Hulu Tiga Juhar Subdistrict, Deli Serdang Regency, they are now actively developing infrastructure, but are still constrained by several problems. One of the problems in determining the priority of receiving Village Fund assistance is still not accurate and still uses the manual method so it can lead to errors in determining the priority of receiving Village Fund assistance. To avoid things that are not desirable in determining priorities for receiving Village Fund assistance, it turns out that there are several techniques that can be used in determining priorities for receiving Village Fund assistance with a Decision Support System (SPK). By using the Decision Support System application in determining the Priority for Receiving Village Fund Assistance using the TOPSIS method at the STM Hulu Tiga Juhar sub-district office, the problems faced by the STM Hulu Tiga Juhar sub-district office can be resolved so that in determining the Priority for receiving Village Fund Aid is faster, more accurate. and accurate to avoid errors.

1. Introduction

In the modern era filled with global competition, now competition in realizing good and equitable infrastructure development has become the main focus in almost all special areas in Sub-districts throughout Indonesia [1]. In STM Hulu Tiga Juhar Sub-district, Deli Serdang Regency, they are now actively developing infrastructure, but are still constrained by several problems. One of the problems in determining the priority of receiving Village Fund assistance is still not accurate and still using the manual method so it can lead to errors in determining the priority of receiving Village Fund assistance in STM Hulu District.

Village Funds are funds sourced from the State Revenue and Expenditure Budget designated for Villages which are transferred through the district Regional Revenue and Expenditure Budget and used to finance government administration, development implementation, community development and community empowerment [2]. STM Hulu Tiga Juhar Subdistrict Deli Serdang Regency where the allocation of funds is still limited, the development is large and the growth rate of each village is not the same. To avoid things that are not desirable in determining priorities for receiving Village Fund assistance, it turns out that there are several techniques that can be used in determining priorities for receiving Village Fund assistance with a Decision Support System (SPK).

Decision Support System (DSS) can be defined as a mode of decision analysis and *database access.* This is shown to support decision making (*decision makers)* in making decisions effectively in both complex and disorganized conditions [3]. In the Decision Support System, there are several methods for ranking in determining priorities for receiving Village Fund assistance, including the *Technique For Others Reference by Similarity to Ideal Solution* (TOPSIS) method [4]. Topsis is to determine the weight value for

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each criterion, then proceed with a ranking process that will select existing alternatives [5], so that it can help the parties in the STM Hulu Tiga Juhar District.

2. Method

Decision Support System is a specific information system aimed at assisting management in making decisions related to semi-structured issues. This system has the facility to generate various alternatives that are interactively used by users [6].

A Decision *Support System* (DSS) is an interactive information system that provides information, modeling and manipulating data. The system is used to assist decision making in semi-structured and unstructured situations, where no one knows for sure how decisions should be made (Alter)[7].

The purpose of Decision Support Systems (DSS) was stated by Peter GW Keen and Scott Morton in the book Models and Information Systems

a. Help managers make decisions to solve semi-structured problems.
b. Support the manager's judgment instead of trying to replace it.
c. Increasing the effectiveness of manager decision making rather than efficiency [8]

The phases in the decision-making process include the following:

a. Intelligence is the process of tracing and detecting the scope of the problem by identifying the problem.
b. Design is the process of finding, developing and analyzing alternative courses of action.
c. *Choice* is the process of selecting among various alternative actions that may be carried out.

The Topsis method is one of the methods favored by researchers in designing a Decision Support System, in addition to a simple concept but complexity in problem solving, both of which are marked by the concept of completing this method, namely by choosing the best alternative and not only having the shortest distance from the positive ideal solution but also has the longest distance from the negative ideal solution [9].

The algorithm for solving this method is:

Step 1: Define in advance the criteria that are used as a benchmark for solving the problem.
Step 2: Normalize each alternative value (normalized matrix) and weighted normalized matrix.
Step 3: Calculating the value of the Positive or Negative Ideal Solution.
Calculate the distance weighted value of each alternative to the positive and negative ideal solutions.
Step 4: Calculate the Preference Value of each alternative.
Step 5: Ranking [10].

The formulas used in this method are as follows:

a. Normalize each alternative value (normalized matrix) and weighted normalized matrix

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \qquad i = 1,2, \ldots m \text{ and } j = 1,2,\ldots n \qquad (1)$$

b. Calculating the value of the weighted performance matrix

$$y_{ij} = w_i r_{ij}$$

$$A^+ = (y_1^+ y_2^+ \ldots y_n^+) \qquad (2)$$

$$A^- = (y_1^- y_2^- \ldots y_n^-) \qquad (3)$$

c. Calculate the distance weighted value of each alternative to the positive and negative ideal solutions for the positive ideal solution

Value of Positive :

$$D_i^+ = \sum_{j=1}^{n} (y_i^+ - y_{ij})^2 \qquad (4)$$

Negative Ideal Solution :

$$D_i^- = \sum_{j=1}^{n} (y_i^- - y_{ij})^2 \qquad (5)$$

d. Calculating the Preference Value of each alternative

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$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (6)$$

e. Ranking

3. Result and Discussion

3.1 Determining criteria and weights

The decision support system is expected to provide alternative results so that it can assist the agency in determining priorities for receiving Village Fund assistance. The method used in this decision-making is the *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS).

The method was chosen because the TOPSIS method is a form of decision support method based on the concept that the best alternative not only has the shortest distance from the positive ideal solution but also has the longest distance from the negative ideal solution.

The steps for determining the types of criteria in determining priorities for receiving Village Fund assistance are as follows:

Table 3.1 Criteria

Code	Criteria	Information	Weight
C1	Total Population (Soul)	Benefits	0.25
C2	Poverty Rate (Soul)	Benefits	0.35
C3	Area (Ha)	Benefits	0.10
C4	Geographic difficulty index	Benefits	0.30

3.2 Determining Criteria Value

The design of the system used in the research uses the TOPSIS method, adapted to the characteristics of the research object so that the analysis process can be carried out more easily with more accurate results.

All criteria in the application are given a value of 1-4, where a value of 1 is the lowest value and a value of 4 is the highest value.

The assessment table used for each criterion in determining the priority of receiving Village Fund assistance is as follows:

Table 3. 2 Value of Population Number Criteria

Total population	Information	Weight
< 476	Not solid	1
477 - 952	Currently	2
953 – 1,428	Congested	3
> 1,429	Very solid	4

Table 3. 3 Poverty Rate Criteria Values

Poverty rate	Information	Weight
< 15	Not many	1
16 – 30	Currently	2
31 – 45	Lots	3
> 46	A huge amount	4

Table 3. 4 Areas of Criteria Values

An area	Information	Weight
<907	Not Spacious	1

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908 - 1.814	Currently	2
1,815 - 2,721	Large	3
> 2,722	Very wide	4

Table 3. 5 Geographic difficulty index

Geographic difficulty index	Information	Weight
< 25	Low	1
2 6 – 50	Currently	2
51-75	Tall	3
> 7 6	Very High	4

3.3 Creating a Decision Matrix

The decision matrix refers to m alternatives that will be evaluated based on n criteria. The following sources will be appointed in this thesis are as follows:

Table 3. 6 Alternate Fit against each criteria

No	Alternative	Criteria			
		JP	**AK**	**LW**	**IKG**
001	Three Juhar	1,608 souls	40 souls	286 Ha	14.38
002	Young Liang	114 souls	10 Souls	1,432 Ha	26.78
003	Tanjung Muda	309 Souls	12 Souls	955 Ha	16.30
004	Sumbul House	1,905 Souls	56 souls	1,526 Ha	17.56
005	Pematang burrow	204 Souls	11 Souls	3,628 Ha	29.80
006	Sipinggan	668 Souls	22 souls	1,527 Ha	13.20
007	Downstream	544 Souls	19 souls	288 Ha	15.89

Note : **JP** : Total Population, **AK** : Poverty Rate, **LW** : Area, **IKG** : Geographic difficulty index

The results of the decision matrix formed from the initial data table for each alternative can be presented to facilitate calculations in determining priorities for receiving Village Fund assistance.

Table 3. 7 Alternative Fit against each criteria

Alternative	Criteria			
	C1	**C2**	**C3**	**C4**
A1	4	3	1	1
A2	1	1	2	2
A3	1	1	2	1
A4	4	4	2	1
A5	1	1	4	2
A6	2	2	2	1
A7	2	2	1	1

In the table above, explaining the alternative changes to symbols A1 to A7 where the symbols explain the names of the Villages and symbols C1 to C4 are symbols for criteria.

3.4 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Process

a. Normalize each alternative value (normalized matrix) and weighted normalized matrix
With i= 1 ,2 ...m; and j=1,2...n, where:
Rij = normalized matrix[i][j]
Xij = Decision Matrix[i][j]
1) Finding the Total Population Value (C1)

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$|X1| = \sqrt{(4^2 + 1^2+1^2+4^2+1^2+2^2+2^2)} = 6.557439$

$R_{11} = \frac{4}{6.557439} = 0.609994$

$R_{21} = \frac{1}{6.557439} = 0.152499$

……

$R_{71} = \frac{2}{6.557439} = 0.304997$

2) Finding the Poverty Rate Value (C2)

$|X2| = \sqrt{(3^2 + 1^2+1^2+4^2+1^2+2^2+2^2)} = 6$

$R_{12} = \frac{3}{6} = 0.5$

$R_{22} = \frac{1}{6} = 0.166667$

……

$R_{72} = \frac{2}{6} = 0.333333$

3) Finding Area Value (C3)

$|X3| = \sqrt{(1^2+2^2 + 2^2 + 2^2+4^2+2^2 + 1^2)} = 5.830952$

$R_{13} = \frac{1}{5.830952} = 0.171499$

$R_{23} = \frac{2}{5.830952} = 0.342997$

……

$R_{73} = \frac{1}{5.830952} = 0.171499$

4) Finding the Geographical Difficulty Index (C4)

$|X4| = \sqrt{(1^2+2^2 + 1^2 + 1^2+2^2+1^2 + 1^2)} = 3.605551$

$R_{14} = \frac{1}{3.605551} = 0.27735$

$R_{24} = \frac{2}{3.605551} = 0.5547$

……

$R_{74} = \frac{1}{3.605551} = 0.2774$

	0.609994	0.5	0.171499	0.27735
	0.152499	0.166667	0.34299	0.5547
	0.152499	0.166667	0.342997	0.27735
R	0.609994	0.666667	0.342997	0.27735
	0.152499	0.166667	0.685994	0.5547
	0.304997	0.333333	0.342997	0.27735
	0.304997	0.333333	0.17149	0.27735

b. Weighted Normalized Matrix

Yij = Wj * Rij; where i = 1 ,2 ,...,m; and j = 1,2,...,n

In this case the preference weight value has been determined by the Kec. Upstream STM with weight value

(w) = (0.25; 0.35; 0.10 ; 0.30)

	0.25* 0.609994	0.35* 0.5	0.10* 0.171499	0.30 *0.27735
	0.25* 0.152499	0.35* 0.166667	0.10* 0.342997	0.30* 0.5547
	0.25* 0.152499	0.35* 0.166667	0.10* 0.342997	0.30* 0.27735
R	0.25* 0.609994	0.35* 0.666667	0.10* 0.342997	0.30* 0.27735
	0.25* 0.152499	0.35* 0.166667	0.10* 0.685994	0.30* 0.5547
	0.25* 0.304997	0.35* 0.333333	0.10* 0.342997	0.30*0.27735
	0.25* 0.304997	0.35* 0.333333	0.10* 0.171499	0.30*0.27735

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	0.152499	0.175	0.01715	0.083205
	0.038125	0.058333	0.0343	0.16641
	0.038125	0.058333	0.0343	0.083205
yij	0.152499	0.233333	0.0343	0.083205
	0.038125	0.058333	0.068599	0.16641
	0.076249	0.116667	0.0343	0.083205
	0.076249	0.116667	0.01715	0.083205

c. Calculating the Value of Positive Ideal Solution Or Negative Ideal Solution

1) Positive Ideal Solution

$$A^+ = \left(y_1^+ \; y_2^+ \ldots y_n^+\right)$$

Find the value of y max :

$$y_1^+ = \text{Max}\left(\begin{matrix}0.152499; 0.038125; 0.038125; 0.152499; 0.038125; \\ 0.076249; 0.076249\end{matrix}\right)$$

$$= 0.152499$$

$$y_2^+ = \text{Max}\left(\begin{matrix}0.175; 0.058333; 0.058333; 0.233333; 0.058333; \\ 0.116667; 0.1166\end{matrix}\right)$$

$$= 0.233333$$

$$y_3^+ = \text{Max}\left(\begin{matrix}0.01715; 0.0343; 0.0343; 0.0343; 0.068599; \\ 0.0343; 0.01715\end{matrix}\right)$$

$$= 0.068599$$

$$y_4^+ = \text{Max}\left(\begin{matrix}0.083205; 0.16641; 0.083205; 0.083205; 0.16641; \\ 0.083205; 0.083205\end{matrix}\right)$$

$$= 0.16641$$

Maka Nilai $A^+ = (0.15250;\ 0.233333; 0.068599;\ 0.16641)$

2) Negative Ideal Solution

$$A^- = \left(y_1^- \; y_2^- \ldots y_n^-\right)$$

Find the value of y min :

$$y_1^- = \text{Min}\left(\begin{matrix}0.152499; 0.038125; 0.038125; 0.152499; 0.038125; \\ 0.076249; 0.076249\end{matrix}\right)$$

$$= 0.038125$$

$$y_2^- = \text{Min}\left(\begin{matrix}0.175; 0.058333; 0.058333; 0.233333; 0.058333; \\ 0.116667; 0.1166\end{matrix}\right)$$

$$= 0.058333$$

$$y_3^- = \text{Min}\left(\begin{matrix}0.01715; 0.0343; 0.0343; 0.0343; 0.068599; \\ 0.0343; 0.01715\end{matrix}\right)$$

$$= 0.01715$$

$$y_4^- = \text{Min}\left(\begin{matrix}0.083205; 0.16641; 0.083205; 0.083205; 0.16641; \\ 0.083205; 0.083205\end{matrix}\right)$$

$$= 0.083205$$

Maka Nilai $A^- = (0.038125;\ 0.058333;\ 0.01715;\ 0.083205)$

d. Calculating the *Distance* Weighted Value of Each Alternative Against Positive and Negative Ideal Solutions

1) Positive Ideal Solutions

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_i^+ - y_{ij})^2}$$

$$D_1^+ = \sqrt{\begin{matrix}(0.152499 - 0.152499)^2 + (0.233333 - 0.175)^2 + (0.068599 - 0.01715)^2 + \\ (0.16641 - 0.083205)^2\end{matrix}}$$

$$= 0.113899$$

$$D_7^+ = \sqrt{\begin{matrix}(0.152499 - .0.076249 + (0.233333 - 0.116667)^2 + (0.068599 - 0.01715 + \\ (0.16641 - 0.083205)^2\end{matrix}}$$

$$= 0.17028$$

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2) Negative Ideal Solutions

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_j^-)^2}$$

$$D_1^- = \sqrt{(0.152499-0.038125)^2 + (0.175-0.058333)^2 + (0.01715 - 0.01715)^2 + (0.083205 - 0.083205)^2}$$

$$= 0.163378$$

$$D_7^- = \sqrt{(0.076249-0.038125)^2 + (0.116667-0.058333)^2 + (0.01715 - 0.01715)^2 + (0.083205 - 0.083205)^2}$$

$$= 0.069687$$

e. Calculating the Preference Value of Each Alternative

$$V_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

A larger Vi value indicates that the alternative Ai is preferred.

$$V_1 = \frac{0.163378}{0.113899+0.163378} = 0.589224$$

$$V_2 = \frac{0.084954}{0.211856+0.084954} = 0.28689$$

$$V_7 = \frac{0.069687}{0.17028+0.069687} = 0.290402$$

f. Ranking

Based on the results of the above calculations, the rankings can be obtained as follows:

Table 3.9 Ranking of TOPSIS method

No	Alternative	Final score	Information
1	Sumbul House	0.699798	Rank 1
2	Three Juhar	0.589209	Rank 2
3	Pematang burrow	0.318396	Rank 3
4	Sipinggan	0.301881	Rank 4
5	Downstream	0.290326	Rank 5
6	Young Liang	0.28689	Rank 6
7	Tanjung Muda	0.070071	Rank 7

4. Conclusion

From the results of calculations using the TOPSIS method the final score is 0.699798 (Sumbul Village) is the first priority, the final value is 0.589209 (Third Juhar Village) is the second priority, the final value is 0.318396 (Liang Pematang Village) is the third priority and so on. Where priority 1 is more to get village fund assistance than priority 2 and so on.

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