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Comparative Analysis Of Saw And Topsis In Selecting Recipients Of Basic Food Assistance

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Abstract. *The Basic Food Program is one of the Indonesian government's alternative programs for distributing aid to underprivileged or poor communities. A selection process needs to be carried out to determine recipients of basic food assistance. Decision Support Systems are effective systems used to produce calculations with output in the form of rankings. The methods that are quite widely used are the Simple Additive Weighting (SAW) method and the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS). This research aims to apply the SAW and TOPSIS methods in selecting aid recipients so that appropriate results are obtained which can be proposed as solutions to decision-making problems. There are 6 criteria used in this case, including: residence, occupation of the head of the family, type of floor, type of wall, place to urinate, lighting source. The data used as a test is data from the Banyuurip village community in 2023. The calculation process is carried out by finding the weight value of each alternative for each criterion. The selected aid recipients are those who have the greatest value as the best alternative. From the calculation results of the SAW (Simple Additive Weighting) and TOPSIS methods, the calculation results of the two methods were obtained. The alternative with the largest value or rank 1 produced by SAW and TOPSIS was both selected as alternative A10. Of the 12 data tested, SAW and TOPSIS have 50% similar alternative ranking results, including: rank 1 = A10, rank 5 = A9, rank 7 = A7, rank 8 = A6, rank 11 = A2, and rank 12 = A12. The SAW method gets better results compared to the TOPSIS method, because it gets precise, stable results and shorter processing time.*

Keywords. *Decision Support System, Simple Additive Weighting (SAW), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), basic food.*

INTRODUCTION

In order to eradicate poverty, one of the government's main priorities is to improve the welfare of the poor and those at risk of becoming poor. This is mandated in Ministerial Regulation Number 05 of 2021 concerning the Implementation of the Basic Food Program issued by the Indonesian Ministry of Social Affairs (Kementerian Sosial Republik Indonesia, 2021). In this scenario, the staple food program seeks to ease the financial burden by meeting some of participants' food needs, contributing to poverty, and facilitating the use of alternative payment methods. Therefore, the basic food program is just one of many government efforts aimed at helping the poor and disadvantaged.

One of the villages in Tuban Regency, Senori District, East Java, Banyuurip Village is one of the communities participating in the basic food program. Based on information obtained through interviews at the Banyuurip Village Hall, only those who are financially incapable are entitled to receive the basic food program. Because the village has set a recipient quota, a screening method must be used to determine whether recipients of basic food assistance are eligible to receive the assistance.

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In defining poverty, the Minister of Social Affairs uses 14 criteria set out under number 146/HUK/2013, as a basis for evaluation in determining the choice of aid recipients. In order to determine whether or not it is appropriate for KPM to be included in DTKS, the Ministry of Social Affairs stipulated a new regulation at (Menteri Sosial Republik Indonesia, 2022) with number 262/HUK/2022. This regulation consists of five aspects and nine poverty criteria. The new regulation automatically replaces the previously existing 14 poverty criteria with five aspects and nine poverty criteria. Home status, employment, concerns about meeting food needs, food expenditure that exceeds total expenditure, clothing costs, type of floor, type of wall, toilet, and source of electric lighting are the nine criteria set by the Minister of Social Affairs which are used as references (Nur Faizah Al Bahriyatul Baqir, 2022). The Ministry of Social Affairs has assessed five aspects of poverty: housing, work, food, clothing and shelter. based on information from Banyuurip on three criteria, namely concerns about food adequacy, food expenditure exceeding total expenditure, and expenditure on unused clothing. Therefore, this study uses six criteria: place of residence, occupation of the head of the family, type of wall, type of floor, place to urinate, and source of lighting.

Based on information gathered from each RT in the hamlet, the population of Banyuurip Village is estimated to reach 2,000 people. Banyuurip Village will receive 15 basic food aid assistance in 2023. This data shows that to determine whether an individual or area is worthy of receiving basic food assistance, a large number of residents must be screened and evaluated. The number of people who receive basic necessities is not sufficient because evaluation procedures are still carried out manually without utilizing a digital system. In this problem, it can be revealed that Banyuurip Village needs a decision support system that can effectively assist, accelerate and facilitate the selection of recipients of basic food assistance based on the criteria set by the Decision Support System (DSS).

Analytical Hierarchy Process (AHP), Weight Product (WP), Visekriterijumsko Kompromisno Rangiranje (VIKOR), Simple Additive Weighting (SAW)(Siregar et al., 2021), Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS), Organization Rangement Et Synthese De Donnes Relationnelles (ORESTES)), Multi Attribute Utility Theory (MAUT), Fuzzy Logic, and ELECTRE are several techniques that can be utilized in Decision Support Systems (DSS), according to Limbong et al (Putra & Apriyanto, 2022)

Processes that use automated decision making are known as “Simple Additive Weighting” (SAW). According to Chung (2018) in (Majid, Pramita Widyassari, Teknologi, Cepu, & Widyassari, 2022), the SAW method is often used to facilitate the decision-making process because the assessment is more accurate based on the specified preference weight criteria

values and normalization matrix calculations based on attribute values. Research (Dedek Cahyati Panjaitan, Hengki Juliansa, Robi Yanto, 2021) shows that the SAW method produces a total change of 8.4 percentage points in sensitivity testing, while the Weighted Product (WP) approach produces a change of 0.027 percentage points. In the comparative analysis of SAW, TOPSIS and Weighted Product (WP) using Hamming Distance, it was concluded that the methods that were closest to the decision results were the SAW and TOPSIS methods, so these methods were suitable to be used to support obtaining objective decision results (Yusnaeni & Ningsih, 2019).

Based on the problems and literature that has been obtained, in this research it is necessary to apply a suitable and accurate method to assist decision making in selecting recipients of basic food assistance. The expected contribution of this research is to compare the SAW and TOPSIS methods in selecting recipients of basic food aid. It is hoped that by implementing this method, the decision to select basic food aid recipients will be obtained with appropriate results and can help recommend to the village how to resolve the problem of selecting basic food aid recipients in the future.

METHOD

At this stage, the method used to overcome the problem will be explained, in this case the selection of incentive recipients. The method proposed by researchers is to compare two methods, namely saw and the comparison method, namely topsis. The purpose of the comparison is to find out which of these two methods is the most suitable and accurate for selecting recipients of basic food aid. To find out the accuracy, the first thing to do is process the data, then calculate using the algorithm as shown in Figure 1 below..

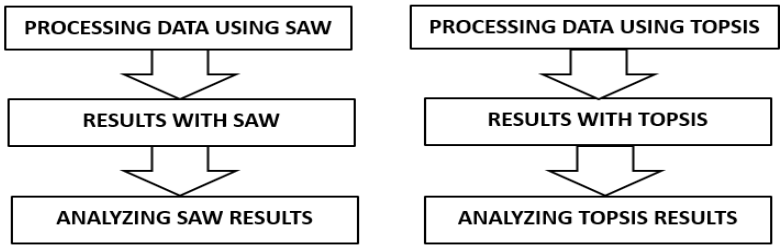

Figure 1. Research flow

A. SAW (*Simple Additive Weighting*)

The SAW method calculation requires the normalization stage of the decision matrix (X) to a scale which will later be compared with all existing alternative ratings (Ramsari & Hidayat, 2020). To get a total score or what is called preferences, the SAW method requires the decision

maker to determine the weight for each criterion (M & Dewi, 2018). If the weight for each criterion is known, then the total alternative score (which in this study is people 1 to people n) is obtained by adding up all the results of multiplying the rating and weight of each criterion(Cahya Purnomo, Yanti, & Widyassari, 2021). The rating for each criterion must be dimension-free, meaning that it has gone through a previous matrix normalization process. The process steps are explained in Figure 2.

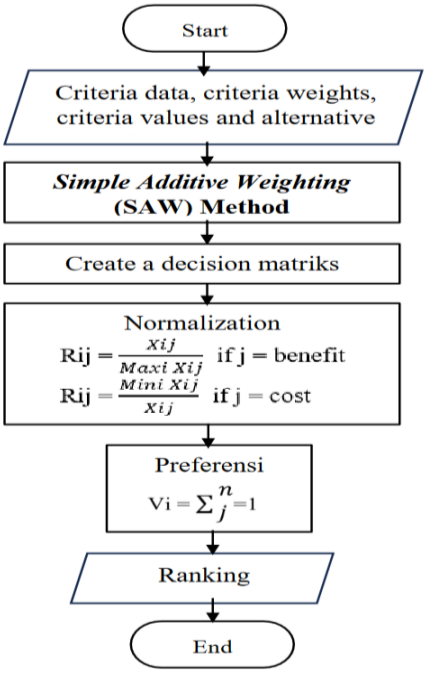

Figure 2. SAW Method Flow

B. TOPSIS (*Simple Additive Weighting*)

The TOPSIS method is one of the retrieval methods Multicriteria decision making was first introduced by Yoon and Hwang in 1981(Saputra, Fitriasih, & Setiyowati, 2019). TOPSIS is based on concept, a good selected alternative not only has shortest distance from a positive ideal solution, but also has the longest distance from a negative ideal solution(Liawan, 2019). The concept simple and easy to understand, computationally efficient, and has the ability to measure the relative performance of decision alternatives in mathematical form simple. Topsis requires a performance rating of each Ai alternative on each normalized Ci criterion. The following is flowchart of the TOPSIS Method process in figure 3.

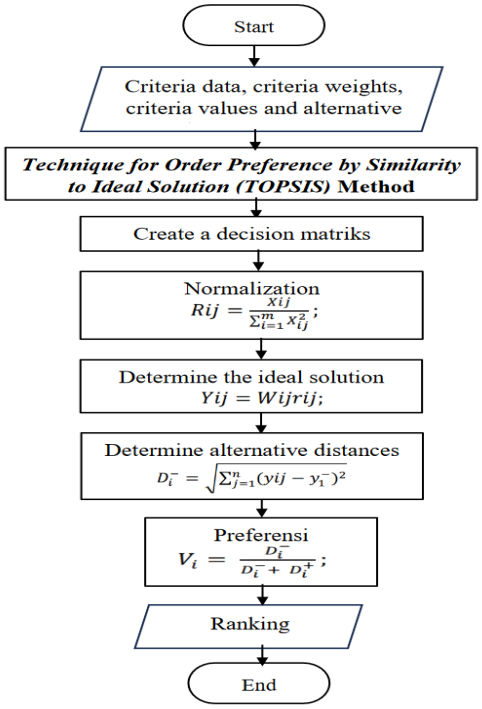

Figure 3. TOPSIS Method Flow

C. Data Preparation

There are 6 assessment criteria for basic food recipients, where there is a weight for each criterion, as in the table 1.

Tabel 1. Assessment Criteria Table

No	Criteria code	Criteria Name	Attribute	Weight
1	C1	Residence	cost	25
2	C2	Job of Head of Family	benefit	20
3	C3	Floor type	benefit	15
4	C4	Wall type	benefit	15
5	C5	Toilet facilities	benefit	15
6	C6	Lighting Source	cost	10

There were 12 population sample data used for testing in this study, namely A1 to A12. The following also displays the values of each alternative against each assessment criteria as in table 2.

Tabel 2. Alternative Value Table

Alternative	C1	C2	C3	C4	C5	C6
A1	1	2	1	1	1	4
A2	1	1	1	1	1	5
A3	1	5	3	2	1	4
A4	1	2	4	2	1	3
A5	1	5	3	2	1	3
A6	1	2	2	2	1	4
A7	1	2	3	2	1	3
A8	1	5	3	1	1	4
A9	1	5	3	1	1	4

A10	1	5	4	2	1	3
A11	1	2	1	1	1	5
A12	1	1	1	1	1	5

RESULTS AND DISCUSSION

A. SAW Method Calculation

After the data is obtained, then carry out calculations with the data using the SAW method. The first step is Matrix Normalization. When completing the SAW method, normalization is carried out on the matrix X, which becomes R. It can be seen in table 3.

Tabel 3. Normalisasi Matriks

Alternative	C1	C2	C3	C4	C5	C6
A1	1	0,4	0,25	0,5	1	0,75
A2	1	0,2	0,25	0,5	1	0,6
A3	1	1	0,75	1	1	0,75
A4	1	0,4	1	1	1	1
A5	1	1	0,75	1	1	1
A6	1	0,4	0,5	1	1	0,75
A7	1	0,4	0,75	1	1	1
A8	1	1	0,75	0,5	1	0,75
A9	1	1	0,75	0,5	1	0,75
A10	1	1	1	1	1	1
A11	1	0,4	0,25	0,5	1	0,6
A12	1	0,2	0,25	0,5	1	0,6

Normalization in table 3 is carried out by looking for the maximum value. The maximum value is used as a divider of all values on the same criteria. So the preference value for each alternative is in accordance with table 4.

Tabel 4. Preference Value of Each Alternative

Alternative	value	rank
A1	0,6675	9
A2	0,6125	11
A3	0,9375	3
A4	0,88	4
A5	0,9625	2
A6	0,78	8
A7	0,8425	7
A8	0,8625	5
A9	0,8625	5
A10	1	1
A11	0,6525	10
A12	0,6125	11

Based on the largest preference value, basic food recipients will be obtained based on ranking.

B. TOPSIS Method Calculation

The next process is to carry out calculations using the TOPSIS method. First, normalize the X matrix to become the R matrix shown in Table 5.

Tabel 5. Normalisasi Matriks

Alternative	C1	C2	C3	C4	C5	C6
A1	0,28868	0,16496	0,10847	0,18257	0,28868	0,28943
A2	0,28868	0,08248	0,10847	0,18257	0,28868	0,36179
A3	0,28868	0,41239	0,3254	0,36515	0,28868	0,28943
A4	0,28868	0,16496	0,43386	0,36515	0,28868	0,21707
A5	0,28868	0,41239	0,3254	0,36515	0,28868	0,21707
A6	0,28868	0,16496	0,21693	0,36515	0,28868	0,28943
A7	0,28868	0,16496	0,3254	0,36515	0,28868	0,21707
A8	0,28868	0,41239	0,3254	0,18257	0,28868	0,28943
A9	0,28868	0,41239	0,3254	0,18257	0,28868	0,28943
A10	0,28868	0,41239	0,43386	0,36515	0,28868	0,21707
A11	0,28868	0,16496	0,10847	0,18257	0,28868	0,36179
A12	0,28868	0,08248	0,10847	0,18257	0,28868	0,36179

The Normalization Value in table 5 is obtained by dividing each alternative criterion by the total criteria (An / Σ $Total\ kriteria$). Next is to find the Y matrix. It can be seen in table 6.

Tabel 6. Normalisasi R to Normalisasi Y

Alternative	C1	C2	C3	C4	C5	C6
A1	0,00072	0,00033	0,00016	0,00027	0,00043	0,00029
A2	0,00072	0,00016	0,00016	0,00027	0,00043	0,00036
A3	0,00072	0,00082	0,00049	0,00055	0,00043	0,00029
A4	0,00072	0,00033	0,00065	0,00055	0,00043	0,00022
A5	0,00072	0,00082	0,00049	0,00055	0,00043	0,00022
A6	0,00072	0,00033	0,00033	0,00055	0,00043	0,00029
A7	0,00072	0,00033	0,00049	0,00055	0,00043	0,00022
A8	0,00072	0,00082	0,00049	0,00027	0,00043	0,00029
A9	0,00072	0,00082	0,00049	0,00027	0,00043	0,00029
A10	0,00072	0,00082	0,00065	0,00055	0,00043	0,00022
A11	0,00072	0,00033	0,00016	0,00027	0,00043	0,00036
A12	0,00072	0,00016	0,00016	0,00027	0,00043	0,00036

The Normalized Y value is obtained by multiplying the R matrix value by its weight (W). Finally, the distance between the positive ideal solution (A+) and the negative ideal solution (A-) is obtained.

Tabel 7. Distance Of Positive Ideal And Negative Ideal Solutions

Alternative Distance towards Solutions Positive Ideal		Alternative Distance towards Solutions Negative Ideal	
Code	Value	Code	Value
$A1$ +	0,000722	$A1$ -	0,000722
$A2$ +	0,000825	$A2$ -	0,000165
$A3$ +	0,000651	$A3$ -	0,000163

*A*4 +	0,000548	*A*4 -	0,000274
*A*5 +	0,000433	*A*5 -	0,000433
*A*6 +	0,000362	*A*6 -	0,000217

In table 7, it is obtained from selecting the highest max value (A+) and (A-) which is the lowest value of all existing alternatives. The next step is to determine the alternative distance to the positive ideal solution (D+) and negative ideal solution (D-), as in table 8.

Tabel 8. Max and Min Values of the Distance of Positive Ideal and Negative Ideal Solutions

Alternative Distance towards Solutions Positive Ideal		**Alternative Distance towards Solutions Negative Ideal**	
Code	**Value**	**Code**	**Value**
D1 +	0,000751	D1 -	0,00018
D2 +	0,000865	D2 -	0,000145
D3 +	0,000178	D3 -	0,000788
D4 +	0,000217	D4 -	0,000583
D5 +	0,000217	D5 -	0,000785
D6 +	0,000289	D6 -	0,000366
D7 +	0,000217	D7 -	0,000456
D8 +	0,000289	D8 -	0,000739
D9 +	0,000289	D9 -	0,000739
D10 +	0,000217	D10 -	0,000865
D11 +	0,000362	D11 -	0,000219
D12 +	0,000362	D12 -	0,000145

In table 8, it is obtained by moving and adjusting the MAX and MIN values. The final step in the TOPSIS calculation is to find the preference value for each alternative illustrated in table 9.

Tabel 9. Preference Value for Each Alternative

Alternative	**value**	**rank**
A1	0,240167	10
A2	0,192985	11
A3	1,0505	2
A4	0,77755	6
A5	1,046066	3
A6	0,487733	8
A7	0,607941	7
A8	0,985088	4
A9	0,985088	5
A10	1,15292	1
A11	0,292539	9
A12	0,192985	12

C. Comparison of SAW & TOPSIS

From the comparison of the calculations of the two MADM methods, namely SAW and TOPSIS, the highest n value is taken based on the value of each alternative which can be seen from Table 10.

Tabel 10. Comparison of the Weight Values of Each Alternative

SAW			TOPSIS		
Rank	**Value**	**Alternative**	**Rank**	**Value**	**Alternative**
1	1	A10	1	1,1529	A10
2	0,9625	A5	2	1,0505	A3
3	0,9375	A3	3	1,0461	A5
4	0,88	A4	4	0,9851	A8
5	0,8625	A9	5	0,9851	A9
6	0,8625	A8	6	0,7776	A4
7	0,8425	A7	7	0,6079	A7
8	0,78	A6	8	0,4877	A6
9	0,6675	A1	9	0,2925	A11
10	0,6525	A11	10	0,2402	A1
11	0,6125	A2	11	0,193	A2
12	0,6125	A12	12	0,193	A12
Max	1		Max	1,1529	
Min	0,6125		Min	0,193	
range	0,3875		range	0,9599	

From the calculation results of the SAW (Simple Additive Weighting) and TOPSIS methods, comparison results of the two methods were obtained. The alternative with the largest value or rank 1 produced by SAW and TOPSIS was both selected as alternative A10. Of the 12 data tested, SAW and TOPSIS have 50% similar alternative ranking results, including: rank 1 = A10, rank 5 = A9, rank 7 = A7, rank 8 = A6, rank 11 = A2, and rank 12 = A12 .

In the Ranking Results in the SAW table the range from the first rank to the last rank is not too far, whereas in TOPSIS the range is too far between the first rank and the last rank, namely 0.9599. So it can be concluded that the value from the SAW calculation is more stable compared to TOPSIS. Pairwise matrix comparisons in the SAW method are only carried out once in the comparison of criteria so that SAW is a shorter job compared to TOPSIS.

CONCLUSION

From the calculation results of the two methods, it can be concluded that: Some of the ranking orders between the two methods are the same and some are different; The SAW method gets better results compared to the TOPSIS method, because the calculation results are precise, stable, and the processing time is shorter. So the suitable method for determining recipients of basic food aid using 6 assessment criteria is SAW. It is hoped that the results of this research will be able to provide recommendations and make it easier to determine recipients of basic food assistance for policy makers in Banyuurip village.

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