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A DECISION SUPPORT SYSTEM USING ROC-TOPSIS TO SPECIFY ELIGIBILITY IN THE FAMILY HOPE PROGRAM

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Abstract—*Selection committee at Jetis Village Sukoharjo Regency, Indonesia had difficulty to assign FHP assistance recipients priority. This is a problem must be resolved so that selection committee can be helped to determine which candidates are entitled to receive. This research is to develop a system using Rank Order Centroid (ROC) and Technique For Order Preference By Similarity to Ideal Solution (TOPSIS) methods and measure accuracy level of two methods used. Data used is 150 on potential 2024 FHP assistance recipients obtained from Jetis. From 150 real data in 2024, there were 71 people receiving FHP assistance, while a system developed in this research is produced 62 recipients. ROC method is used to specify each criterion importance level and TOPSIS method to process data which ultimately results in a potential ranking aid recipients. From comparison of original data and research results, there were 121 data had same system output as original data. From an accuracy rate of 81%, ROC and TOPSIS methods show the potential to increase accuracy and fairness in determining priority for candidates who are entitled to receive FHP assistance.*

Keywords*: decision making, family hope program, ROC, TOPSIS.*

Intisari—Panitia seleksi Kalurahan Jetis, Kabupaten Sukoharjo, Indonesia kesulitan dalam menentukan prioritas penerima bantuan Program Keluarga Harapan (PKH). Hal ini menjadi masalah yang harus diselesaikan agar panitia seleksi terbantu untuk menentukan calon penerima bantuan PKH yang memang berhak mendapatkan bantuan. Tujuan penelitian ini menghasilkan sistem menggunakan metode *Rank Order Centroid* (ROC) dan metode *Technique For Order Preference By Similarity to Ideal Solution* (TOPSIS) dan mengukur tingkat akurasi dari dua metode yang digunakan. Data yang digunakan adalah 150 data calon penerima bantuan PKH 2024 yang didapatkan dari Kelurahan Jetis. Dari 150 data tahun 2024, terdapat 71 orang menerima bantuan PKH sedangkan sistem yang dikembangkan dalam penelitian ini menghasilkan 62 orang yang layak menerima bantuan PKH. Metode ROC digunakan untuk menentukan tingkat kepentingan setiap kriteria yang dan metode TOPSIS untuk mengolah data yang akhirnya menghasilkan ranking calon penerima bantuan. Dari hasil perbandingan data asli dan hasil penelitian, terdapat 121 data memiliki output sistem yang sama dengan data asli. Dari tingkat akurasi sebesar 81%, metode ROC dan TOPSIS menunjukkan potensi untuk meningkatkan akurasi dan keadilan dalam menentukan prioritas kandidat yang berhak menerima bantuan PKH.

Kata Kunci*: pendukung keputusan, program keluarga harapan, ROC, TOPSIS.*

INTRODUCTION

Poverty is a social problem that is a major concern for governments in various countries, including Indonesia [1]. Poverty is a problem often faced by developing countries caused by the internal conditions of a country [2]. From the previous Indonesia government to the present, various efforts have been made to overcome the problem of poverty [3]. This condition is identical to a disease that is already severe but is still in the treatment stage and experiments are being carried out on its cure [4]. Poverty refers to a condition in which a person is unable to significantly improve his standard of living or is unable to achieve a better standard of living [5]. To overcome poverty problems complexity, comprehensive action is needed by government so that social welfare can be achieved [6].

The Indonesian government is always trying to solve this problem. Efforts made to solve and break the chain of poverty have been supported by many regulations, such as Law Number 11 of 2009 concerning Social Welfare and Permensos Number 1 of 2018 concerning a Family Hope Program [7]. As part of efforts to improve the community welfare, the government has presented a number of social protection programs aimed at overcoming the challenges that arise due to poverty [8]. Through this action, the government is committed to providing a positive impact in improving the economic conditions of the community. One of the policies that is the main focus and top government priority is FHP [9].

FHP is an effort to provide financial assistance to families or individuals who are classified as poor and vulnerable, as recorded in integrated social welfare data [10] [11]. The main role of FHP is its efforts to become the main foundation in overcoming poverty problems, while also acting as a coordinator for various national social protection and empowerment programs [12]. Focusing on improving welfare, FHP is designed as a strategic tool to provide support and protection to community groups who are in the most vulnerable economic range [13].

Based on observations results in Jetis Village, Sukoharjo Regency, Indonesia, a significant problem was found, namely aid funds distribution that were not on target. Village officials who are as selection committee for aid recipients have difficulty in determining the priority of prospective FHP aid recipients that village majority population still has a low to middle income. This is a problem that must be resolved immediately so that village officials do not have difficulty in determining prospective FHP aid recipients and can distribute the aid to residents fairly according to the established criteria.

A Decision Support System (DSS) is a computer based system that combines an expert intellectual abilities and the computer ability to process data into information to increase the decision making effectiveness [14]. DSS solves problems and communication skills in semi-structured and unstructured conditions by processing data with various models interactively so that it can provide information that can be used in making a decision [15]. TOPSIS is an algorithm used to create a ranking order based on calculation results, with a specified performance weight assessment [16]. TOPSIS concept is based on alternatives selection that have the shortest distance between the positive ideal solution and the longest distance to the negative ideal solution [17]. Rank Order Centroid (ROC) approach produces weight estimates that minimize the maximum error of each weight by identifying the centroids of all possible weights that preserve the objective importance rank order [18]. ROC is a simple method, can produce weight values according to the criteria used, the highest performance in terms of alternative identification and can overcome attribute weighting in decision making [19]. ROC advantage is able to display more important or prioritized criteria until the end of criteria and determining weight value is obtained from priority levels order of criteria starting from the first, second, third and so on [20].

Some previous studies relating to selection of FHP assistance beneficiaries with DSS have been made. They include research by Musaddad and Kriswibowo compared Big Data and machine learning using same data and measuring instruments. This research use 14 variables to identify poor family criteria. If at least 9 variables are met then family can be included in poor category. Research results obtained a comparison between big data and machine learning methods and it was concluded that one with high accuracy results was the machine learning method using the averaged neural network algorithm model, so that it could be used as an alternative for decision making in determining poor families who are entitled to assistance [21].

A journal detailing research results by Sutoyo developed a decision support system using TOPSIS method for selection and ROC as a weighting for each criterion. Based on SNMPTN results participant selection test using TOPSIS method and ROC as a weighting, it was proven to be able to display cumulative ranking results of each

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alternative based on the criteria value they have. From system testing and manual calculations results for new student candidates selection through SNMPTN pathway using TOPSIS and ROC methods, there was no difference in calculation results. A decision support system for selecting new student candidates for SNMPTN system uses TOPSIS method with ROC weighting to display results based on the cumulative ranking results of all alternative criteria. Next, policy makers can establish specific solutions from calculated values obtained [22].

Research results presented and published in the International Conference by Ginting et al. developed a DSS to compare the combination of the AHP-TOPSIS method with only AHP and only TOPSIS to recommend families eligible to receive FHP assistance. The criteria used included land area, house status, wall type, floor type, drinking water source, roof type, toilet facilities, lighting source, and cooking fuel. The combined AHP and TOPSIS methods yielded an accuracy of 80.36%, while the AHP-only method yielded an accuracy of 75% and TOPSIS without AHP 76.78% [23].

Previous research results show that using ROC and TOPSIS methods can produce high accuracy. No previous research has used ROC and TOPSIS methods to specify FHP aid receiver eligibility. From Noerul Hanin's research results which compared the combined ROC-TOPSIS, ROC-WP and ROC-Electre methods, it was concluded that the combined ROC-TOPSIS method was the best with the highest sensitivity percentage [24]. In this research, ROC method will be applied to assess importance level of each criterion used, and TOPSIS method will be used to undertake rankings so as it can help determine priorities for potential FHP aid recipients. Although DSS has been used for FHP, no research has yet applied combined ROC-TOPSIS for eligibility selection in this context. This research objectives include developing DSS by applying ROC and TOPSIS methods and also measuring level accuracy of DSS in decide prospective FHP recipients priority.

MATERIALS AND METHODS

Establishment of criteria refers to Regulation the Social Affairs Minister of Indonesia Republic in 2018 and is adjusted to data in Jetis village Sukoharjo Regency. This research uses data on prospective FHP assistance recipients in Jetis Village, Sukoharjo Regency in 2023. 150 data of prospective FHP assistance recipients in the form of participant name, NIK, village ID, address, village/sub-district, district, regency, province, gender, family dependents, family relationship, date of birth, marital status, occupation, income, education, risk of stunting. From these data, it is then sorted into the data needed with the criteria used, they are occupation, income, number of dependents, educational level, family relationships.

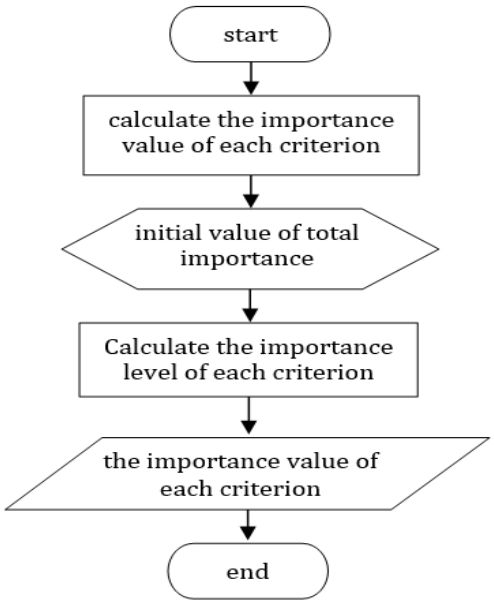
The criteria used are sorted according to higher priority, and determine criteria type (benefit or cost). There are five criteria used in this research, 2 criteria are included in the benefit type, it's meaning is the greater value is better, and 3 criterias are included in the cost type, meaning the smaller value is better. The criteria description can be seen in Table 1.

Table 1. Criteria Description

Code	Name	Type
C1	Occupation	Cost
C2	Income	Cost
C3	Total dependents	Benefit
C4	Educational level	Benefit
C5	Family relationships	Cost

Source: (Research Results, 2025)

The ROC method flowchart can be seen in Figure 1.



Source: (Research Results, 2025)

Figure 1. The ROC Method Flowchart

The ROC method process begins by determining the criteria priority used based on their significance, then calculating the importance level assessment for each criterion according to the previously determined priority using equation (1).

$$W_i = \frac{1}{k} \sum_{i=1}^{k} \left(\frac{1}{i}\right) \quad (1)$$

In equation (1), the importance level is initialized as W, and W_i is the importance level for i^{th} goal, k is total criteria, and i is priority sequence value.

The forming an assessment scale process begins by breaking down the criteria into several sub-criteria, which aims to describe the aspects that contribute to the criteria. After that, giving a numerical value to the existing sub-criteria, this provides preferences and priorities that underlie the decision. It can be seen that each criterion used in this research has three sub criteria with an assessment scale of 1-3, the sub criteria determination and their values is based on the data used. Furthermore, the scale value will be input into the decision matrix so that it can be processed using the TOPSIS method. The assessment scale is to provide a numerical value for each sub criteria, the value given describes how important each sub criterioa used is shown in Table 2.

Table 2. Rating Scale

Criteria	Sub Criteria	Value
	private employee, entrepreneur	1
C1	fishermen/farmers/workers	2
	not working/not a worker	3
	>2.000.000	1
C2	1.000.000-2.000.000	2
	<1.000.000	3
	no dependents	1
C3	½	2
	>2	3
	passed high school	1
C4	Not passed high school	2
	no school	3
	Husband	1
C5	wife/child	2
	Other	3

Source: (Research Results, 2025)

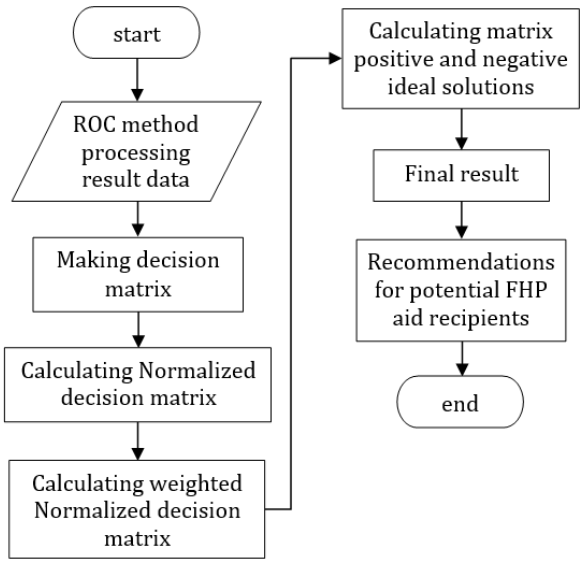
Table 3 presents some data from 150 prospective recipients of FHP assistance and an assessment scale using the ROC method.

Table 3. Data Processing Results

No.	Name	C1	C2	C3	C4	C5	V1	V2	V3	V4	V5
1	Samijo	Farmers	1.000.000-2.000.000	3	Passed elementary school	Husband	2	2	3	2	1
2	Sukimin	Workers	<1.000.000	2	no school	Husband	2	3	2	3	1
3	Hari Narwanto	Workers	1.000.000-2.000.000	1	passed junior high school	Other	2	2	2	2	3
4	Maharani	not working	<1.000.000	2	passed high school	wife	3	3	2	1	2
5	Edi Suprapto	Entrepreneur	1.000.000-2.000.000	3	passed high school	Husband	1	2	3	1	1
...	...	...	...	...	...	...	...	...	...	...	...
149	Takat Wiyono	Workers	<1.000.000	2	passed junior high school	Husband	2	3	2	2	1
150	Handayani	Entrepreneur	>2.000.000	4	passed high school	Wife	1	1	3	1	2

Source: (Research Results, 2025)

TOPSIS method flowchart can be presented in Figure 2.



Source: (Research Results, 2025)

Figure 2. TOPSIS Method Flowchart

TOPSIS method process begins by inputting an assessment scale based on data that has been processed through ROC method, to form a decision matrix, after which TOPSIS calculation is carried out through five stages of TOPSIS calculation and produces output in the form of priority recommendations for prospective PKH assistance recipients.

A decision matrix is depicted by a table containing information about the alternatives and criteria used. Values in the decision matrix table describe alternative preferences that meet each criterion and are presented in Table 4.

Table 4. Decision Matrix

Code	C1	C2	C3	C4	C5
A-1	1	2	1	1	3
A-2	1	3	1	2	1
A-3	2	1	3	1	1

Source: (Research Results, 2025)

Normalized decision matrix aims to eliminate the scale differences between criteria, so that all criteria can be compared fairly. Normalized decision matrix process begins by calculating

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decision matrix (X) which is then divided by the divisor value according to equation (2).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i1}^{m} x_{ij}^2}} \quad (2)$$

r_{ij} : normalized decision matrix
x_{ij} : decision matrix

Weighted normalized decision matrix aims to show the importance of each criterion used. Equation 3 is to calculate the Weighted Normalized Decision Matrix.

$$y_{ij} = w_i \, x \, r_{ij} \quad (3)$$

[25]

y_{ij} : weighted normalized decision matrix
w_i: importance level of i

Positive and negative ideal solutions matrix is used to determine the closeness of each alternative to the positive ideal solution and the negative ideal solution and is calculated using equation 4 and 5.

$$D_i^+ = \sqrt{\sum_{j=1}^{j} \left(y_i^+ - y_{ij}\right)^2} \quad (4)$$

$$D_i^- = \sqrt{\sum_{j=1}^{j} \left(y_{ij} - y_i^-\right)^2} \quad (5)$$

D_i^+ : i-th alternative distance from positive ideal solution
D_i^- : i-th alternative distance from negative ideal solution
y_j^+ : positive ideal solution matrix
y_j^- : negative ideal solution matrix

Preference value calculation is used to determine the final ranking of each alternative as an indicator of how good an alternative is compared to other alternatives. The formula for calculating preference value can be seen in equation 6.

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

[26]
V_i: Preference Value of each Alternative

RESULTS AND DISCUSSION

1. ROC Process

By using equation (1), the importance level value obtained using the ROC method is presented in Table 5.

Table 5. ROC Method Calculation

Code	ROC	Importance Level
C1	(1+1/2+1/3+1/4+1/5)/5	0.457
C2	(1/2+1/3+1/4+1/5)/5	0.257
C3	(1/3+1/4+1/5)/5	0.157
C4	(1/4+1/5)/5	0.09
C5	(1/5)/5	0.04
	Total W	1

Source: (Research Results, 2025)

The values in table 6 describe the importance level for each criterion based on its priority level, with the provision that the first criterion will have the highest priority compared to the second criterion, and so on. The importance level value produced by the ROC method will be used as a weight in the TOPSIS method calculation in determining the normalized decision matrix.

2. TOPSIS Process

From the values in Table 4, the normalized decision matrix can be calculated using formula (2). Below are several calculations to determine the normalized decision matrix.

$$r_{11} = \frac{1}{\sqrt{1^2 + 1^2 + 2^2}} = 0.408$$

$$r_{12} = \frac{2}{\sqrt{2^2 + 3^2 + 1^2}} = 0.535$$

$$r_{13} = \frac{1}{\sqrt{1^2 + 1^2 + 3^2}} = 0.302$$

$$r_{14} = \frac{1}{\sqrt{1^2 + 2^2 + 1^2}} = 0.408$$

$$r_{15} = \frac{3}{\sqrt{3^2 + 1^2 + 1^2}} = 0.905$$

Those steps are carried out up to r_{35} so that it produces normalized decision matrix as follows:

$$r_{ij} = \begin{bmatrix} 0{,}408 & 0{,}535 & 0{,}302 & 0{,}408 & 0{,}905 \\ 0{,}408 & 0{,}802 & 0{,}302 & 0{,}816 & 0{,}302 \\ 0{,}816 & 0{,}267 & 0{,}905 & 0{,}408 & 0{,}302 \end{bmatrix}$$

Based on the importance level values in Table 6 and the normalized decision matrix results also using equation (3), a weighted normalized decision matrix can be determined. The following are some calculations using equation (3):

$$y_{11} = w_1 \, x \, r_{11} = 0.457 \, x \, 0.408 = 0.187$$
$$y_{12} = w_2 \, x \, r_{12} = 0.257 \, x \, 0.535 = 0.137$$
$$y_{13} = w_3 \, x \, r_{13} = 0.302 \, x \, 0.157 = 0.047$$
$$y_{14} = w_4 \, x \, r_{14} = 0.408 \, x \, 0.009 = 0.037$$
$$y_{15} = w_5 \, x \, r_{15} = 0.905 \, x \, 0.004 = 0.036$$

Those calculation is carried out up to y_{35} and will produce a weighted normalized decision matrix as follows:

$$y_{ij} = \begin{bmatrix} 0.187 & 0.137 & 0.047 & 0.037 & 0.036 \\ 0.187 & 0.206 & 0.047 & 0.073 & 0.012 \\ 0.373 & 0.069 & 0.142 & 0.037 & 0.012 \end{bmatrix}$$

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From the weighted normalized decision matrix, the positive and negative ideal solutions can be determined as follows:

$D_i^+ = [0.373 \quad 0.206 \quad 0.142 \quad 0.073 \quad 0.036]$

$D_i^- = [0.187 \quad 0.069 \quad 0.047 \quad 0.037 \quad 0.012]$

From the weighted normalized decision matrix and the positive and negative ideal solutions, then the distance between negative and positive ideal solution matrix values can be calculated, as follows:

$$S_1^+ = \sqrt{\begin{matrix}(0.187-0.373)^2+(0.137-0.206)^2+\\(0.047-0.142)^2+(0.037-0.073)^2+\\(0.036-0.036)^2\end{matrix}} = 0.223$$

$$S_1^- = \sqrt{\begin{matrix}(0.187-0.187)^2+(0.137-0.169)^2+\\(0.047-0.047)^2+(0.037-0.037)^2+\\(0.036-0.012)^2\end{matrix}} = 0.073$$

The above calculation will be carried out up to the 3rd alternative ($S_3^+ and\ S_3^-$), then will produce the following values:

$S_1^+ = 0.223 \quad S_2^+ = 0.211 \quad S_3^+ = 0.144$

$S_1^- = 0.073 \quad S_2^- = 0.046 \quad S_3^- = 0.141$

The preference value of each alternative can be calculated using equation (6) as follows:

$$V_1 = \frac{0.073}{0.073 + 0.223} = 0.246$$

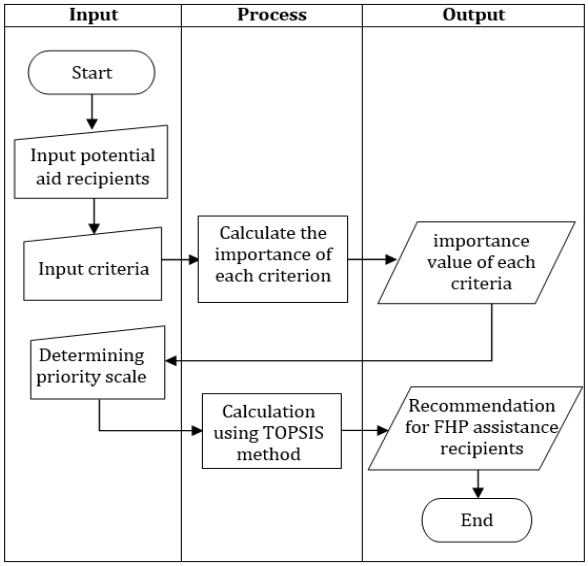
$$V_2 = \frac{0.046}{0.046 + 0.211} = 0.180$$

$$V_3 = \frac{0.141}{0.141 + 0.144} = 0.495$$

From calculation results using equation (6), the preference value (V) of each alternative is produced, which illustrates that alternative with the largest V value is the main priority for receiving FHP assistance. By sorting the V values and comparing them with the existing quota, data on potential recipients who are entitled to FHP assistance is obtained.

3. System Implementation

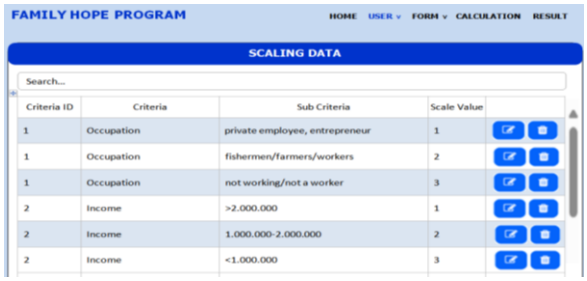
The system flowchart is a visual representation that illustrates the system flow and working mechanism of the PKH aid recipient system. This flowchart functions as a conceptual map that guides system development and implementation. The system flowchart used in this research can be seen in Figure 3.



Source: (Research Results, 2025)

Figure 3. System Flowchart

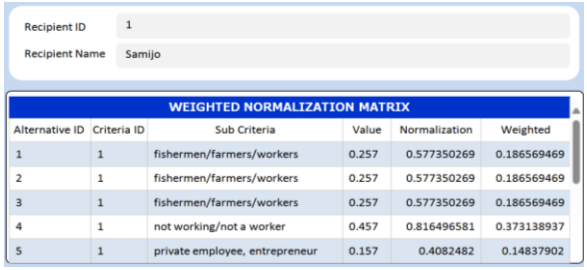
Figure 4 shows the scale form display and scale data information table. This scale form includes various input fields tailored to data collection needs, such as criterion ID, criterion name, sub-criteria, and scale value.



Source: (Research Results, 2025)

Figure 4. Scale Value Form Display

Figure 5 shows calculation process in the TOPSIS method display to determine the normalized importance level decision matrix. The weighted normalized decision matrix is obtained from the normalization matrix times the each corresponding criterion weight .



Source: (Research Results, 2025)

Figure 5. Weighted Normalization Matrix Display

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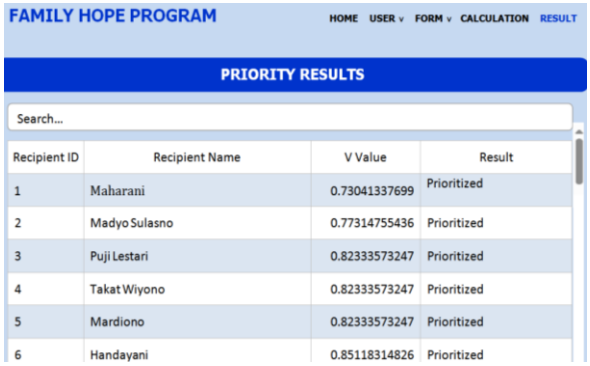
Figure 6 is a the TOPSIS method final calculation display, namely determining preference values. From this value, the alternatives proximity in a decision matrix to positive and negative ideal solutions can be determined. This final result is used as a recommendation to determine the eligible FHP assistance recipient candidates.



Recipient ID	Recipient Name	V Value	Result
1	Maharani	0.73041337699	Prioritized
2	Madyo Sulasno	0.77314755436	Prioritized
3	Puji Lestari	0.82333573247	Prioritized
4	Takat Wiyono	0.82333573247	Prioritized
5	Mardiono	0.82333573247	Prioritized
6	Handayani	0.85118314826	Prioritized

Source: (Research Results, 2025)
Figure 6. TOPSIS Method Final Results Display

4. System Testing

System testing will be done through several processes. The first testing process is by inputting data from prospective aid recipients into the system via the data input page. Data on potential aid recipients and the required criteria components are entered one by one manually. After being inputted, system will work and calculate using ROC-TOPSIS method so that output data is eligible or not eligible to receive the aid. Next test is carried out manually by comparing the output data entered into the system with the original data to obtain an accurate level of system performance that has been created.

The calculation process results using the ROC and TOPSIS method are then compared with initial data obtained through the Jetis Village Selection Committee, Sukoharjo Regency in 2024. There are 121 data that match the list of 2024 aid recipients from 150 candidates. From these data, system precision and accuracy can be determined with the following calculations:

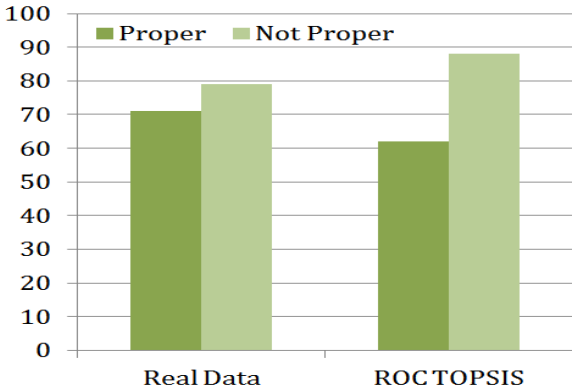
Table 6. Data Confusion Matrix

n=150	(+)	(-)	
(+)	True Positive=108	False Positive=13	121
(-)	False Negative=13	False Positive=9	23
	121	23	

Source: (Research Results, 2025)

$$\text{Precision} = \frac{107}{121} x\ 100\% = 89.3\%$$

$$\text{Accuracy} = \frac{117}{143} x\ 100\% = 81.8\%$$



Source: (Research Results, 2025)
Figure 6. Comparison Chart

The 19% difference in evaluation results between the ROC and TOPSIS method and manual assessment is due to two factors. First, the ROC and TOPSIS method uses an algorithm that calculates criteria weights systematically and mathematically, different from the weights that may be given subjectively in manual scoring. The assessment scales and considers the distance between positive and negative ideal solutions, which is not fully reflected in manual methods. This results in more detailed and objective evaluations, especially in dealing with extreme data or anomalies that might be overlooked in manual scoring. Second, the ROC and TOPSIS method provides more consistent results because it is not influenced by the assessor's subjectivity, while manual assessments can vary based on individual experience or perception.

CONCLUSION

This research has successfully applied the ROC and TOPSIS methods to determine the priorities of potential recipients of FHP assistance using data from the FHP selection committee of Jetis Village, Sukoharjo Regency in 2024. There are 150 alternatives in the form of FHP assistance registrants and five criteria used and each criterion has 3 sub-criteria along with weight values. The five criteria used are occupation, income, total dependents, educational level, and family relationships. Of the 150 data on potential FHP recipients assistance in 2024, 71 people were declared eligible for FHP assistance. The system developed in this researh resulted in 62 eligible people. There are 121 data that have the same results between real data and system results.

The data accuracy rate of 81,8% was obtained by comparing the original data (without the ROC and TOPSIS methods) with the calculated data using the ROC and TOPSIS methods. From this level of accuracy, the ROC and TOPSIS methods The

data accuracy rate of 81% was obtained by comparing the original data (without the ROC and TOPSIS methods) with the calculated data using the ROC and TOPSIS methods. From this level of accuracy, the ROC and TOPSIS methods show the potential to improve accuracy and fairness in determining the priority of candidates who are entitled to receive FHP assistance.

In future research, it is important for researchers to construct more comprehensive datasets, covering a larger total number and diverse data groups per feature. It is necessary to try using other methods can be within DSS scope or machine learning. Using other methods is expected to produce more precise recommendations and higher accuracy.

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