JURNAL INFORMATIKA DAN REKAYASA PERANGKAT LUNAK (JATIKA)
Volume 6, Number 1, March 2025, Page 61-71
E-ISSN 2797-2011 P-ISSN 2797-3492
https://publikasi.teknokrat.ac.id/index.php/jatika/index
DOI: https://doi.org/10.33365/jatika.v6i1.35

Decision Support System for Providing Social Assistance for Poverty in Manyaran Village Semarang With AHP And Smart Methods

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Abstract: One of the problems still faced by Indonesia as a developing country is the problem of poverty. This poverty problem, Indonesia poverty has become part of the nation's long history, poverty in Indonesia is one of the diseases in the economy, so there must be a solution or policy to reduce poverty levels. By using the Analytical Hierarchy Process (AHP) and Simple Multi Attribute Rating Technique (SMART) methods used for alternative selection in poverty social assistance in the Manyaran Semarang village. The AHP method is used to determine the weight of each criterion, while the SMART method is used for ranking alternatives.The results obtained are the ranking order of alternatives, the first rank gets a value of 0.8609 obtained by (A05), while the last rank gets a value of 0.1497 obtained by (A06).

Keywords: alternative, performance, Selection, ranking, AHP, SMART.

1. INTRODUCING

Poverty is one of the most important indicators of successful development in a region. Some regions have strategies to achieve optimal economic growth and reduce poverty in the region. Low quality of life leads to low productivity and high poverty. Low productivity will lead to income that is below the minimum so that the poor cannot or are unable to meet their needs [5]

One of the problems faced by Indonesia as a developing country is the problem of poverty and efforts to overcome it. These problems mainly concern the development of rural and urban communities living on the poverty line. Poverty is a national and global phenomenon that is of great concern. From year to year, this poverty problem does not recede and even tends to increase along with the increasing needs of the community and the declining economic conditions of Indonesia [6]

In general, one that often experiences problems in the distribution of poverty social assistance is the Manyaran village where the distribution of poverty social assistance is still not optimal. Many parties protest because the distribution of assistance often does not match the data, they should get help but do not get help and vice versa. This is due to the lack of accurate data from the government and there is no good resolution system for determining recipients of poverty social assistance. Therefore, a decision support system with AHP and SMART methods is needed to sort alternatives from largest to smallest value.

According to [7]Analytical Hierarchy Process (AHP) is an approach created by Thomas L. Saaty as a tool to support the decision-making process in the 1970s. This decision model will divide complex problems that have many factors and criteria into a hierarchy. This hierarchy can be described as a complex problem in a multilevel structure, with objectives at the first level, factors and criteria at the second level, and so on to alternatives at the last level.

Yoga Agus Fauzhan: *Corresponding Author

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According to [8]The SMART method is a decision-making method that aims to collect information about all data related to several attributes (multi-attribute) and several criteria (multi-criteria). This parameter uses data before and data after, from this data a classification and relationship between one data and another data will be generated so that the final result will be the best solution. The purpose of this research is to create a system for determining poverty social assistance, namely by implementing the Analytical Hierarchy Process (AHP) method used to determine the weighting of each criterion [9]and Simple Multi Attribute Rating Technique (SMART) used for ranking [10]While the benefit of this research is to determine the recipients of poverty social assistance so that it is more effective, efficient and right on target for those in need.

The benefit of this research is to determine prospective recipients of poverty social assistance in Manyaran village to be more effective, efficient and right on target for those in need.

2. RESEARCH METHODOLOGY

Can be seen in Figure 1 This flow explains the process of designing a system that uses the methodAnalytical Hierarchy Process (AHP) and Simple Multi Attribute Rating Technique (SMART).

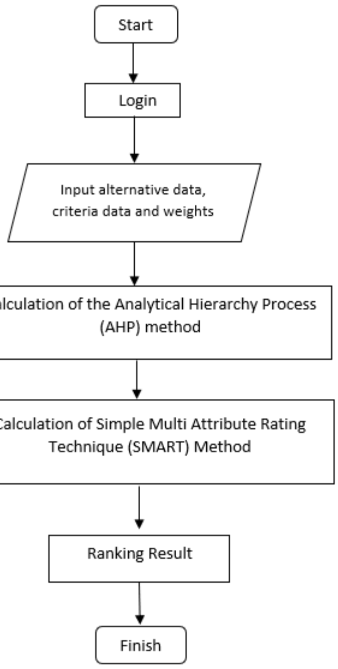

Figure 1. Flowchart of System Design with AHP and SMART methods.

The methods used in this development process are AHP and SMART methods used as research materials. Research on how to determine residents who are entitled to receive social assistance in Manyaran village through citizen data directly from the village and other related parts. The methods used are Analytical Hierarchy Process (AHP) and Simple Multi Attribute Technique (SMART). Based on the results of the research, 14 criteria were obtained including Eating As Much (C1), Medical Expenses (C2), Income (C3), Source of Lighting (C4), Cooking Fuel (C5), Latrine Facilities (C6), Type of Food (once a week) (C7), Floor Area (C8), Type of Wall (C9), Source of Drinking Water (C10), Savings (C11), Type of Floor (C12), Purchase of Clothes in a Year (C13), Education of the Head of Household (C14).

This research is located in Manyaran village which is located on Jl. Simongan No. 200. Phone: 024 7601414. Postal Code, : 50147. West Semarang District, Semarang City, Central Java Province.

Yoga Agus Fauzhan: *Corresponding Author

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2.1. AHP METHOD

The stages of completing the AHP method according to [11] are as follows:

1. Initialize the problem, select the solution, and compile a hierarchy.
2. Establish priority values by comparing pairwise and also determining the relative intensity of each element.
3. Performing pairwise comparison calculations to obtain priorities.
4. Consistency value is estimated.
5. calculating the Consistency Index (CI) value. The calculation of CI is shown by Equation 1.
   CI = (λ_max - n) / (n - 1) (1)
   Where:
   λ_max = maximum eigenvalue
   n = number of elements
6. Calculating the Consistency Ration (CR) value shown in equation 2. It is declared correct if the result of the CR value is <0.1 and incorrect if the CR value is >0.1.
   CR = CI/RI (2)
   Where:
   IR is the Random Consistency Index.
7. Determines the value of the IR shown in Table 1.

Table 1. IR value.

Matrix Size	IR
1,2	0,0000
3	0,5245
4 ….	0,8815 ….
9	1,4499
10	1,4854

2.2. SMART METHOD

The stages of solving the SMART method according to[12]are as follows:

1. Define the problem
2. Determine the criteria to be used
3. Determine the alternatives to be used
4. Giving weight to each criterion on alternatives
   $$\frac{Wj}{\Sigma Wj}$$
   Where:
   Wj is the weight value of a criterion.
   ΣWj is the total weight of all criteria.
5. Give the value of the criteria parameters to each criterion for each alternative.
6. Determine the utility value by converting the criterion value of each criterion into a standard data criterion value. The utility value is obtained using the equation:
   Cost formula :
   $$u_1(a_1) = 100\frac{\text{Cmax}-\text{Cout}}{\text{Cmax}-\text{Cmin}}\ \%$$
   Benefit formula :
   $$u_1(a_1) = 100\frac{\text{Cout}-\text{Cmin}}{\text{Cmax}-\text{Cmin}}\ \%$$
   Description:
   u_1 (ai): the utility value of the i-th criterion for the i-th alternative
   Cmax: maximum criterion value
   Cmin: minimum criterion value
   Cout: i-th criterion value

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7. Determine the final value of each criterion by transferring the value obtained from normalizing the standard data criteria value with the normalized value of the criteria weight. Then add up the values from the multiplication.

$$u(a_1) = \sum_j^m = i^W j^u i(a_1)$$

Where $u(a_1)$ is the total value of alternatives, Wj is the result of normalizing the weight of the criteria and $u_1(a)_1$ is the result of determining the utility value.

2.3. Data Collection Method

According to [13] qualitative research focuses on the meaning, social construction, and complexity of the phenomenon under study. The main objective of qualitative research is to gain a deep understanding of the phenomenon under study. Data collection techniques in qualitative research are:

1. Interview

Interviews aim to gain an in-depth understanding of the experiences, views, and perspectives of individuals related to the phenomenon under study. In this case, the researcher conducted an interview, namely by communicating with one of the officers at the Manyaran village social service in the data collection section to determine the distribution of poverty social assistance.

2. Observation

Observation is a data collection technique that involves direct observation of participants and the context involved in the research phenomenon. Observation provides an opportunity for researchers to observe social interactions. In this study, researchers made observations by directly observing the object of research at the social service in Manyaran village. The activity carried out is to personally observe the process of selecting prospective recipients of poverty social assistance.

3. Documentation

Documentation involves collecting data from documents, archives, or other written materials related to the research phenomenon. The documents used by researchers are records, reports, letters, books, or other official documents. Documentation studies provide insight into the historical context, policies, events, and developments relevant to the phenomenon under study.

4. Literature Study

In this literature study, what is done is studying, researching, Data Flow Diagram (DFD), Entity Relation Diagram (ERD), and literature related to the case under study.

3. RESULT AND DISCUSSIONS

Results and discussion on decision support systems using the Analytical hierarchy process (AHP) andSimple Multi Attribute Rating Technique (SMART) methods in determining social assistance recipients in Manyaran village, through this method it is expected to determine residents who are entitled to receive social assistance easily and effectively. The development of system analysis on the selection of effective alternatives, the first is to enter the names of residents to be used as alternative data, as a process that includes the stages of the Analytical hierarchy process (AHP) and Simple Multi Attribute Rating Technique (SMART) methods.

The following is an explanation of the analysis of the system built, the system input built for this research consists of input, in the form of citizen names and criteria data where the names of citizens are used as alternative data, then the criteria for determining residents who are entitled to receive social assistance are used as a reference in decision making. The next step is to determine the preference value data where this data is the calculation standard which is used as the basis for applying calculations using the AHP and SMART methods, the next step is to give a weight value to each of the criteria then after that calculate the total value of each citizen by adding up the scores obtained from each criterion.

Based on the stages of this research method, an example case of selecting residents who are entitled to receive social assistance in Manyaran village is implemented as follows:

3.1. AHP Method Calculation

a. According to [14]Hierarchical Structure.
The Hierarchical Structure is in Figure 2.

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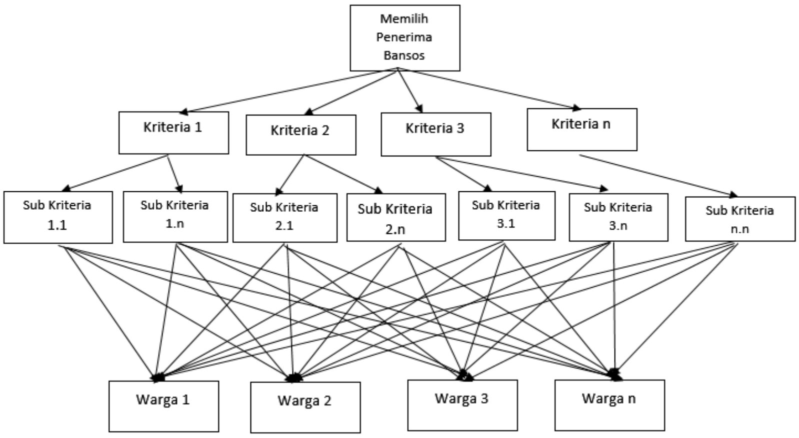

Figure 2. Hierarchical Structure.

b. Determining Criteria Weight

According to [15] In order to provide solutions to various problems using AHP, a scale of 1 to 9 is the best scale in expressing opinions, the following is illustrated in table 2.

Table 2. Criteria Weight.

Intensity of Interest	**Definition**	**Description**
1	Equal importance	Both elements are equally important
3	Slightly more important	One element is slightly more important than the other
5	More important	One element is clearly more important than the other
7	Very important	One element is more important than the other
9	Absolutely more important	If hesitant to give adjacent ratings
2,4,6,8	A value that falls between two nearly equal rating scales	The inverse value of the importance value of an element on a scale of 1-9

Creating a Comparison Matrix

The pairwise comparison matrix for criterion elements is obtained from the calculation of the assessment weights given by respondents from the questionnaire given earlier to be able to see the scale of comparison between criteria. This comparison matrix consists of 14 criteria which can be seen in table 3.

Table 3. Pairwise Matrix.

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**
C01	1	2	2	3	3	3	4	5	5	5	5	7	7	7
C02	0,5	1	2	3	3	3	3	3	3	4	5	5	5	5
C03	0,5	0,5	1	2	3	3	3	3	4	4	4	5	5	5
C04	0,3333	0,3333	0,5	1	2	2	3	3	3	3	3	3	5	5

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	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
C05	0,3333	0,3333	0,3333	0,5	1	2	2	2	3	3	3	3	4	5
C06	0,3333	0,3333	0,3333	0,5	0,5	1	2	3	3	3	3	3	4	4
C07	0,25	0,3333	0,3333	0,3333	0,5	0,5	1	3	3	3	3	3	3	4
C08	0,2	0,3333	0,3333	0,3333	0,5	0,3333	0,3333	1	2	2	3	3	3	3
C09	0,2	0,3333	0,25	0,3333	0,3333	0,3333	0,3333	0,5	1	2	2	3	3	3
C10	0,2	0,25	0,25	0,3333	0,3333	0,3333	0,3333	0,5	0,5	1	2	2	3	3
C11	0,2	0,2	0,25	0,3333	0,3333	0,3333	0,3333	0,3333	0,5	0,5	1	2	2	2
C12	0,1429	0,2	0,2	0,3333	0,3333	0,3333	0,3333	0,3333	0,3333	0,5	0,5	1	2	2
C13	0,1429	0,2	0,2	0,2	0,25	0,25	0,3333	0,3333	0,3333	0,3333	0,5	0,5	1	2
C14	0,1429	0,2	0,2	0,2	0,2	0,25	0,25	0,3333	0,3333	0,3333	0,5	0,5	0,5	1
Jumlah	4.4786	6.5498	8.1832	12.3998	15.2832	16.6665	20.2498	25.33332	28.9999	31.6666	35.5	41	47.5	51

c. Calculating Normalization and Weight Priority

The Criteria Priority Weight Matrix (or weight priority matrix) is an important part of the Analytical Hierarchy Process (AHP) method. AHP is used for decision making by decomposing complex problems into a hierarchy of criteria and alternatives, then assessing the relative preferences among these criteria and alternatives. The following is the normalization of criteria weights as in table 4.

Table 4. Normalization and Priority Weighting.

K	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	Prio	CM
C01	0,2232841	0,305352835	0,244403167	0,241939386	0,19629397	0,180002	0,197532815	0,19736946	0,172414388	0,157895069	0,14084507	0,170731707	0,147368421	0,137254902	0,193763361	15,2014713
C02	0,111642	0,152676418	0,244403167	0,241939386	0,19629397	0,180002	0,148149611	0,11842168	0,103448633	0,126316055	0,14084507	0,12195122	0,105263158	0,098039216	0,149242244	15,40522726
C03	0,111642	0,076338209	0,122201584	0,161292924	0,19629397	0,180002	0,148149611	0,11842168	0,13793151	0,126316055	0,11267606	0,12195122	0,105263158	0,098039216	0,129751359	15,50627349

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C04	0,0744206	0,05088705	0,061100792	0,080646462	0,13086265	0,120001	0,148149611	0,11842168	0,103448633	0,094737042	0,08450704	0,073170732	0,105263158	0,098039216	0,095975417	15,50878463
C05	0,0744206	0,05088705	0,040729788	0,040323231	0,06543132	0,120001	0,098766408	0,07894778	0,103448633	0,094737042	0,08450704	0,073170732	0,084210526	0,098039216	0,079115754	15,2559286
C06	0,0744206	0,05088705	0,040729788	0,040323231	0,03271566	0,060001	0,098766408	0,11842168	0,103448633	0,094737042	0,08450704	0,073170732	0,084210526	0,078431373	0,073912167	15,22825776
C07	0,055821	0,05088705	0,040729788	0,026879466	0,03271566	0,03	0,049383204	0,11842168	0,103448633	0,094737042	0,08450704	0,073170732	0,063157895	0,078431373	0,064449348	15,08999691
C08	0,0446568	0,05088705	0,040729788	0,026879466	0,03271566	0,019998	0,016459422	0,03947389	0,068965755	0,063158028	0,08450704	0,073170732	0,063157895	0,058823529	0,048827377	14,67179287
C09	0,0446568	0,05088705	0,030550396	0,026879466	0,02180826	0,019998	0,016459422	0,01973695	0,034482878	0,063158028	0,05633803	0,073170732	0,063157895	0,058823529	0,04143626	14,43902828
C10	0,0446568	0,038169104	0,030550396	0,026879466	0,02180826	0,019998	0,016459422	0,01973695	0,017241439	0,031579014	0,05633803	0,048780488	0,063157895	0,058823529	0,0352985	14,33822216
C11	0,0446568	0,030535284	0,030550396	0,026879466	0,02180826	0,019998	0,016459422	0,01315665	0,017241439	0,015789507	0,02816901	0,048780488	0,042105263	0,039215686	0,028238992	14,46127134
C12	0,0319073	0,030535284	0,024440317	0,026879466	0,02180826	0,019998	0,016459422	0,01315665	0,011493143	0,015789507	0,01408451	0,024390244	0,042105263	0,039215686	0,023733088	14,58134105
C13	0,0319073	0,030535284	0,024440317	0,016129292	0,01635783	0,015	0,016459422	0,01315665	0,011493143	0,010525285	0,01408451	0,012195122	0,021052632	0,039215686	0,019468044	14,55208678
C14	0,0319073	0,030535284	0,024440317	0,016129292	0,01308626	0,015	0,012345801	0,01315665	0,011493143	0,010525285	0,01408451	0,012195122	0,010526316	0,019607843	0,01678809	14,73986169

d. Calculating Lamda Max

$$\lambda max = \frac{(\boldsymbol{A1}\ x\ \sum \text{baris 1})+..+(\text{An x} \sum \text{baris n})}{\boldsymbol{n}}$$

$$\lambda max = ((\frac{2,945488171}{0,193763361}) + (\frac{2,29911068}{0,149242244}) + (\frac{2,011960051}{0,129751359}) + (\frac{1,488462071}{0,095975417}) + (\frac{1,206984289}{0,079115754}) + (\frac{1,125553531}{0,073912167}) + (\frac{0,972540466}{0,064449348}) + (\frac{0,716385156}{0,048827377}) + (\frac{0,598299331}{0,04143626}) + (\frac{0,506117734}{0,0352985}) + (\frac{0,408371722}{0,028238992}) + (\frac{0,346060257}{0,023733088}) + (\frac{0,283300661}{0,019468044}) + (\frac{0,24745413}{0,01678809})) = \frac{208,9795441}{14} = 14,92711029$$

e. Calculating Criterion Consistency

$$CI = \frac{\lambda max - n}{n-1}$$

Calculate the CI value using the formula given above.

Determine the RI value corresponding to the number of criteria used. Calculate CR by dividing CI by RI.

$$CR = \frac{CI}{RI}$$

CR evaluation: If the CR is less than the set limit value of 0.1, then the scoring matrix

Yoga Agus Fauzhan: *Corresponding Author

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is considered consistent, if the CR exceeds the limit value, then the criteria need to be reviewed and may need revision in their relative scoring, And can proceed to SMART calculation.

$$CI = \frac{14{,}92711029-14}{14-1} = 0{,}071316176 \quad CR = \frac{0{,}071316176}{1{,}57} = 0{,}045424316$$

Based on the CR value obtained (0.045424316) <0.1, the weight of each criterion means consistent.

3.2. Smart Method Calculation

a. Alternative Assessment

Alternative assessment with the SMART method is used to assist decision making by considering various relevant criteria which can be seen in table 5.

Table 5. Alternative Assessment.

CODE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
A01	1	2	2	2	2	2	2	1	3	1	2	3	2	2
A02	2	1	1	1	1	3	3	1	2	2	2	2	2	2
A03	2	2	1	1	1	3	3	1	4	4	1	3	2	2
A04	1	1	2	2	2	2	2	1	1	4	1	3	1	3
A05	2	2	2	1	2	3	3	2	4	3	2	2	1	3
A06	1	1	1	1	1	2	2	1	4	2	2	2	2	1
A07	1	1	2	1	2	1	3	2	4	2	2	1	2	2
A08	1	1	1	2	1	2	2	1	3	2	1	1	2	1
A09	1	2	2	1	2	3	3	2	4	2	2	3	1	3
A10	1	1	1	1	1	2	3	1	2	2	1	2	2	2
Min	1	1	1	1	1	1	2	1	1	1	1	1	1	1
Max	2	2	2	2	2	3	3	2	4	4	2	3	2	3
Atribut	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit	benefit
Atribut	0.1938	0.1492	0.1298	0.096	0.0791	0.0739	0.0644	0.0488	0.0414	0.0353	0.0282	0.0237	0.0195	0.0168

Description: 1 = Very Poor, 2 = Poor, 3 = Fair, 4 = Good, 5 = Very Good.

b. Normalization of Criteria Weight

$$u_1(a_1) = 100\frac{\text{Cout}-\text{Cmin}}{\text{Cmax}-\text{Cmin}}\ \%$$

Description :
$u_1(a_1)$: the utility value of the i-th criterion for the i-th alternative.
Cmax : maximum criterion value.
Cmin : minimum criterion value.
Cout : i-th criterion value.

Table 6. Normalization of Criterion Weights.

CODE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
A01	0	1	1	1	1	0.5	0	0	0.667	0	1	1	1	0.5
A02	1	0	0	0	0	1	1	0	0.333	0.333	1	0.5	1	0.5
A03	1	1	0	0	0	1	1	0	1	1	0	1	1	0.5
A04	0	0	1	1	1	0.5	0	0	0	1	0	1	0	1
A05	1	1	1	0	1	1	1	1	1	0.667	1	0.5	0	1

Yoga Agus Fauzhan: *Corresponding Author

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E-ISSN 2797-2011 P-ISSN 2797-3492
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DOI: https://doi.org/10.33365/jatika.v6i1.35

A06	0	0	0	0	0	0.5	0	0	1	0.333	1	0.5	1	0
A07	0	0	1	0	1	0	1	1	1	0.333	1	0	1	0.5
A08	0	0	0	1	0	0.5	0	0	0.667	0.333	0	0	1	0
A09	0	1	1	0	1	1	1	1	1	0.333	1	1	0	1
A10	0	0	0	0	0	0.5	1	0	0.333	0.333	0	0.5	1	0.5

c. Weighted Normalization

$$vij = vij \cdot \omega j$$

Description :
vij is the weighted normalized value.
ωj is the j-criteria weight, with $\sum \omega j = 1$.

Table 7. Weighted Normalization.

CODE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
A01	0	0.149	0.13	0.096	0.079	0.037	0	0	0.028	0	0.028	0.024	0.019	0.008
A02	0.194	0	0	0	0	0.074	0.064	0	0.014	0.012	0.028	0.012	0.019	0.008
A03	0.194	0.149	0	0	0	0.074	0.064	0	0.041	0.035	0	0.024	0.019	0.008
A04	0	0	0.13	0.096	0.079	0.037	0	0	0	0.035	0	0.024	0	0.017
A05	0.194	0.149	0.13	0	0.079	0.074	0.064	0.049	0.041	0.024	0.028	0.012	0	0.017
A06	0	0	0	0	0	0.037	0	0	0.041	0.012	0.028	0.012	0.019	0
A07	0	0	0.13	0	0.079	0	0.064	0.049	0.041	0.012	0.028	0	0.019	0.008
A08	0	0	0	0.096	0	0.037	0	0	0.028	0.012	0	0	0.019	0
A09	0	0.149	0.13	0	0.079	0.074	0.064	0.049	0.041	0.012	0.028	0.024	0	0.017
A10	0	0	0	0	0	0.037	0.064	0	0.014	0.012	0	0.012	0.019	0.008

d. Rankings

$$S_i = \sum_{j=1}^{m} (\upsilon_{ij} \cdot \omega_j)$$

Description :
S_i = Total utility score for the i-th alternative.
υ_{ij} = Utility score of the i-th alternative on criterion j (normalized result).
ω_j = Weight of criterion-j (given by the decision maker).
m = Number of criteria.

Table 8. Rangkings.

Code	Total	Rank
A05	0,8609	1
A09	0,6673	2

Yoga Agus Fauzhan: *Corresponding Author

JURNAL INFORMATIKA DAN REKAYASA PERANGKAT LUNAK (JATIKA)
Volume 6, Number 1, March 2025, Page 61-71
E-ISSN 2797-2011 P-ISSN 2797-3492
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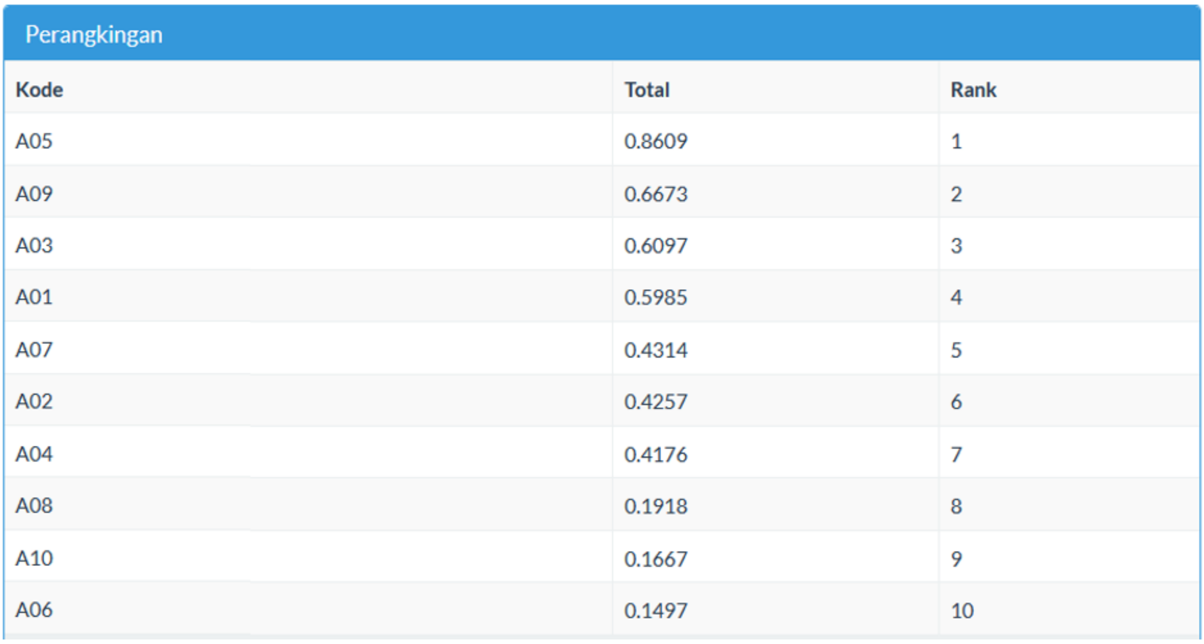
A03	0,6097	3
A01	0,5985	4
A07	0,4314	5
A02	0,4257	6
A04	0,4176	7
A08	0,1918	8
A10	0,1667	9
A06	0,1497	10

From the ranking results above, it is obtained that the ranking order of alternative social assistance in the Manyaran village ranked first gets a value of 0,8609 obtained by (A05), while the last rank gets a value of 0,1497 obtained by (A06). Figure 7 below is the system will display the ranking of Alternatives with the SMART method.



Perangkingan

Kode	Total	Rank
A05	0.8609	1
A09	0.6673	2
A03	0.6097	3
A01	0.5985	4
A07	0.4314	5
A02	0.4257	6
A04	0.4176	7
A08	0.1918	8
A10	0.1667	9
A06	0.1497	10

Figure 3. Ranking Page

The ranking page is an alternative that is selected to get poverty social assistance according to the results of the smart method calculation.

4. CONCLUSION

The results showed that AHP and SMART methods were applied in the Alternative selection system in Manyaran village. Evaluation criteria include eating as much as possible, medical expenses, income, source of lighting, cooking fuel, toilet facilities, type of food (once a week), floor area, type of wall, source of drinking water, savings, type of floor, purchase of clothes in a year, and education of the head of household. The AHP and SMART-based decision support system makes it easier for Manyaran village to provide social assistance and choose alternatives with better efficiency. The use of a computerized system increases accuracy, speed, and reduces errors in calculations, and provides ranking of optimal alternatives. The result is that the first rank gets a value of 0.8609 obtained by (A05), while the last rank gets a value of 0.1497 obtained by (A06).

Yoga Agus Fauzhan: *Corresponding Author

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