

Implementation Analytical Hierarchy Process Method to Improve the Effectiveness of Social Assistance Distribution

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Abstract - Based on the report of the central statistics agency, the number of poor people in Indonesia reached 26.16 million people. The government has made efforts to provide assistance to overcome this problem, one of which is beneficiaries. The distribution of beneficiaries which is being held is still not optimal because of the uneven distribution of aid to underprivileged communities. The purpose of this research is to implement a Decision Support System (DSS) to determine the right community to receive beneficiaries which will be given based on several criteria used, namely: education, employment, and place of residence. In this study, proposes to build a model that has a decision-making concept. The method used in this Decision Support System is the Analytical Hierarchy Process (AHP). The expected results in this study are a decision support system that can assist in determining beneficiaries.

Keywords :

*Decision Support System;
Assistance Distribution;
Analytical Hierarchy
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1. INTRODUCTION

From various countries around the world, poverty is an important matter to be discussed, because the factor of poverty is one of the obstacles in the process of development in a country. Poverty is caused by several factors, one of which is the lack of quality human resources, because less fortunate people tend to have inadequate education, so they cannot compete with many people. The increase in poverty rates is also due to the socio-economic impact of the current coronavirus pandemic. In an effort to reduce poverty levels, the Indonesian Ministry of Social Affairs has provided policies in the form of social assistance programs that are provided to underprivileged communities in various regions. One of the social assistance programs currently being provided is Non-Cash Food Assistance. Decision Support System (DSS) is a system that can provide problem solving, communicate for solving certain problems aimed at assisting decision making related to issues that are structured or unstructured, Decision Support Systems are used to support final decision making and increase the effectiveness of decision making decision on a problem solving, a Decision Support System is made by applying a high competency adaptation so that it can be used as an alternative in making a final decision. In this study, it proposes a Decision Support System to assist decision making that can determine citizens who are entitled to get BPNT based on the criteria used, namely: education, work, and place of expected to be able to clearly determine the target of beneficiaries. In designing this model, we use

the Analytical Hierarchy Process (AHP) method. The AHP method is used because it can solve complex multi- criteria problems into a hierarchy. Complex problems can be interpreted that the criteria for a problem are so many (multi criteria), Several previous studies, namely "Decision Support System for Determining Recipients of Family Hope Program Assistance Using the Analytical Hierarchy Process Method" obtained the result that the criteria for housing conditions are the first priority in determining residents who are entitled to PKH assistance [1]. Another study entitled "Application of the Analytical Hierarchy Process (AHP) Method in the Design of a Decision Support System for Selection of Candidates for Recipients of Non-Cash Food Assistance in Palangka Raya City" with the results of the main income category having the highest priority level in determining prospective Non-Cash Food Assistance recipients[2]. Based on the description above, the researcher wants to implement a Decision Support System which is expected to be able to determine beneficiaries with the criteria used to support the final decision so that the assistance provided can be distributed more effectively and on target. Based on the background above, we identify and formulate the problem, namely how to determine the right factors to determine whether the citizen is included in the category that meets or does not receive beneficiaries and how to implement the Decision Support System with the AHP method in determining beneficiaries?

The goal to be achieved in this research is to build a Decision Support System to determine prospective

beneficiaries and produce a system that functions as a decision-making tool to determine beneficiaries.

The expected benefits of this research are expected to be able to help all parties who have an interest in this research, including helping the government to be able to target recipients of assistance.

2. LITERATURE REVIEW

Definition of Decision Support System

Decision Support System is a computer- based system that can support semi-structured decision making, by utilizing data and then processing it into information in the form of suggestions that can assist in making final decisions [4]. Decision Support System consists of four stages of the process [6], namely:

- 1) *Intelligence*, is a process that identifies problems that require a decision to later be processed into relevant information to make a final decision.
- 2) *Design*, create, develop and perform analysis for each alternative that will be used in accordance with the problem to be analyzed.
- 3) *Choice*, choose the best alternative that has been evaluated and obtained based on the highest value of each alternative tested.
- 4) *Implementation*, implementation of the options that have been selected, if the implementation fails it will return to the modeling process.

Analytical Hierarchy Process Method

Analytical Hierarchy Processor is a form of decision making model with multiple complex criteria into a hierarchy that represents a problem in a multilevel structure where the level consists of criteria, sub criteria up to the last level, namely alternatives.

In the AHP method, the process of calculating the comparison of pairwise comparison matrices and the weighting along with the level of importance is determined and adjusted according to the pairwise comparison rating scale [7], which is shown in the following table:

Interest Intensity	Information
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other elements
7	One element is clearly more important than the other elements
9	One element is absolutely more important than any other element
2,4,6,8	The value between two adjacent judgment values

Table 1. Rating Weight

SWOT Analysis Method

The SWOT analysis method is a method used in evaluating strengths, weaknesses, opportunities and threats in an ongoing business process. SWOT can also be utilized in determining the goals of the business

process, identifying existing factors both internal and external and helping to achieve the goals to be achieved [9]. The word SWOT consists of 4 components [10], including:

- 1) **Strengths(Strength)**, namely internal conditions which are the main factors of success in achieving the goals to be achieved.
- 2) **Weaknesses(Weakness)**, namely internal conditions that can hinder success in achieving the goals to be achieved.
- 3) **Opportunities(Opportunity)**, namely external conditions that can support success in achieving the goals to be achieved.
- 4) **Threats(Threat)**, namely external conditions that can be a threat or obstacle to success in achieving the goals to be achieved.

3. RESEARCH METHODOLOGY

Method of collecting data

According to V Wiratna Sujarweni, the data collection method is a method that researchers use to reveal or collect data from respondents or informants according to the data selected for research (Sujarweni, 2019). There are several research data collection techniques that are commonly used such as tests, interviews, observations, questionnaires or questionnaires, surveys, and document analysis. However, researchers used data collection techniques as follows:

1. Observation
 Observation is a formal observation and recording of symptoms that appear on the research object (Sujarweni, 2019). Observations are considered important by researchers, so
2. Interview
 Interview is one of the methods used to retrieve results orally. This is done in order to obtain detailed information according to the object being studied (Sujarweni, 2019).
3. Documentation
 Documents are information about past situations. Documents can also be in the form of writing, drawings, or monumental works. If accompanied by related documents, the analysis and interview findings will be more reliable (Sujarweni, 2019). Documentation is a method of collecting data as a support for the problem being studied.

Research Stages

The following is a further explanation of the research flowchart shown in the image above:

- 1) Data Collection Method
 In the early stages, researchers conducted literature studies and interviews to obtain the data needed during the research process.
- 2) Problem analysis
 At this stage an analysis of ongoing problems is carried out using the SWOT analysis method, this method is used because it can analyze a process

both internally and externally. In the problem under study, the SWOT method will be used to analyze the strengths, weaknesses, opportunities and threats to the performance of the designed system.

3) Data processing

It is a process where the data obtained from the first stage will be used in calculations using the AHP method, starting by comparing each criterion and then producing an average value for each criterion then comparisons are also made to the sub criteria and producing the same results then from the results of the comparison criteria and sub-criteria, then a ranking process is carried out based on the conditions of the residents. The final result is an alternative ranking of beneficiary candidates which can be used to support the final decision.

4) System planning

Is the stage where the system is designed starting with describing it in Unified Modelling Language form which consists of use case diagrams to describe business processes, activity diagrams describe the activities of business processes for each user, class diagrams describe the class design and its relationships and sequence diagrams describe the processes that occur between objects to one business process. This stage also describes a model that forms the basis for the process of designing DSS and describes how the database researchers can test the quality of the truth of a problem being tested. Structure is used which consists of database names, tables, fields and descriptions of each attribute.

5) Conclusions and recommendations

It is the conclusion of the research results and provides advice to someone who reads with the aim of being able to develop research for the better.

4. RESULTS AND DISCUSSION

The following is an analysis of calculating the comparison of criteria with the AHP method:

Table 1. Beneficiaries Assistance Criteria

Alias	Criteria	Weight Value
K1	Education	1
K2	Source of drinking water	3
K3	House wall	3
K4	Floor Condition	3
K5	Ability to buy clothes	3
K6	Roof	5
K7	Floor area	5
K8	Lighting source	5
K9	Work	5
K10	Food Consumption	7
K11	Treatment Ability	9

Table 2. Calculation of Comparison of Criteria

Criteria	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11
K1	1	0,5	0,3	0,3	0,3	0,2	0,2	0,2	0,2	0,1	0,1
K2	3	1	1	1	1	0,6	0,6	0,6	0,6	0,4	0,3
K3	3	1	1	1	1	0,6	0,6	0,6	0,6	0,4	0,3
K4	3	1	1	1	1	0,6	0,6	0,6	0,6	0,4	0,3
K5	3	1	1	1	1	0,6	0,6	0,6	0,6	0,4	0,3
K6	5	1,7	1,7	1,7	1,7	1	1	1	1	0,7	0,6
K7	5	1,7	1,7	1,7	1,7	1	1	1	1	0,7	0,6
K8	5	1,7	1,7	1,7	1,7	1	1	1	1	0,7	0,6
K9	5	1,7	1,7	1,7	1,7	1	1	1	1	0,7	0,6
K10	7	2,3	2,3	2,3	2,3	1,4	1,4	1,4	1,4	1	0,8
K11	9	3	3	3	3	1,8	1,8	1,8	1,8	1,3	1
Amount	49	16,33	16,33	16,33	16,33	9,8	9,8	9,8	9,8	6,995	5,44

Next is the normalization analysis of the comparison of Then the next analysis is a comparative calculation for each criterion which begins by comparing each weight value of each criterion:

criteria by dividing each value in the criteria column with the number per column from the results of the comparison of the criteria in the table below.

Table 3. Normalized Comparison of Criteria

Criteria	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11
K1	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20	0,20
K2	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61
K3	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61
K4	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61
K5	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61	0,61
K6	0,102	0,102	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
K7	0,102	0,102	0,10	0,10	0,102	0,10	0,102	0,102	0,102	0,10	0,10
K8	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102
K9	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102	0,102
K10	0,143	0,143	0,143	0,143	0,143	0,143	0,143	0,143	0,143	0,143	0,143
0											
K1	0,184	0,184	0,184	0,184	0,184	0,184	0,184	0,184	0,184	0,184	0,184
1											
Amount	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Then analyze to obtain the Consistency Index (CI) and Consistency Ratio (CR) values which are used as a reference in seeing whether the calculations carried out can be said to be consistent or not by looking at the final results of the two values, if the final value exceeds 0.1 then the calculation considered inconsistent and had to be repeated.

Table 4. Criteria Comparison Results

Criteria		Number of lines	EIGEN	Lambda
K1	Education	0,224	0,02	0,999
K2	Source of drinking water	0,673	0,06	1,000
K3	House wall	0,673	0,06	1,000
K4	floor condition	0,673	0,06	1,000
K5	Ability to buy clothes	0,673	0,06	1,000
K6	Roof	1,122	0,10	1,000
K7	Floor area	1,122	0,10	1,000
K8	Lighting source	1,122	0,10	1,000
K9	Work	1,122	0,10	1,000
K10	Food consumption	1,572	0,14	0,999

In determining the CI value using the formula for calculating the total value of lambda minus the number of criteria then divided by the number of criteria – 1, it can be seen in the following calculations:

- CI value: $(\text{Lamda max} - n) / (n - 1)$

$$CI \text{ value: } (10,997 - 11) / (11 - 1) = - 0,0003133419216$$

Known : where n is the number of criteria used.

Then to calculate the CR value itself using a calculation formula by dividing the CI value by the Ratio Index (RI) value obtained based on the following table:

Table 5. Ratio Index Value

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48

The RI value is obtained based on the number of criteria used, namely 1.51, so the calculation to determine the CR value is:

- CR value : CI / RI
- CR Value : $-0,0003133419216 / 1,51 = -0,0002075112063$

From the final results, the CI and CR values obtained a

value of less than 0.1, so it can be said that the analysis of the calculations carried out previously was consistent and acceptable.

Of the eleven criteria used, they are then divided into three sub-criteria, each of which is used as an alternative assessment in determining the ranking of prospective beneficiaries recipients:

Table 6. Beneficiaries Assistance Sub Criteria

Criteria		Mark
K1	EDUCATION	
	Junior High School	5
	Senior High School	3
K2	College	1
	DRINKING WATER SOURCE	
	River	5
K3	Well	3
	Refilable	1
	HOUSE WALL	
K4	Bamboo	5
	Wood	3
	Wall	1
K5	FLOOR CONDITION	
	Land	5
	Cement ceramics	3
K6	ABILITY TO BUY CLOTHES	
	MARK	5
	Unable	3
K7	Not sure	1
	ROOF	
	Asbestos	5
K8	Zinc	3
	Rooftile	1
	FLOOR AREA	
K9	< 8 m2	5
	> 8m2	3
	> 16m2	1
K10	SOURCES OF INFORMATION	
	No electricity	5
	PLTS	3
K11	Electricity	1
	WORK	
	Don't have	5
K12	Not sure	3
	Have	1
	FOOD CONSUMPTION	
K13	Tofu and tempe	5
	Egg	3
	Meat	1
K14	TREATMENTABILITY	
	Unable	5
	Not sure	3
	Capable	1

In the table above, the sub-criteria and weight values in determining beneficiaries recipient candidates were obtained based on the results of interviews we conducted in random sampling and also based on previous research references [5].

Then a comparison of the weight values for each sub-criterion is carried out, the calculation process is the same as when carrying out a comparison of the criteria weight values, where each weight value is compared and whether the calculations carried out can be said to be consistent or not.

- Calculating the comparison of educational sub criteria (K1):

Table 7. Calculation of Comparison of Sub Criteria

	College	SENIOR HIGH SCHOOL	JUNIOR HIGH SCHOOL
College	1	0,3	0,2
SENIOR HIGH SCHOOL	3	1	0,6
JUNIOR HIGH SCHOOL	5	1,666	1
Amount	9	2,999	1,8

Information :

- The Higher Education sub-criteria has an importance level of 0.333 times compared to the Higher Education criteria, while the Higher Education criteria has an importance level of 3 times compared to the Higher Education criteria.
- The higher education sub-criteria has an importance level of 0.2 times compared to the junior high school criteria, while the junior high school criteria has an importance level of 5 times compared to the college criteria.
- The SMA sub-criteria has an importance level of 0.6 times compared to the SMP criteria while the SMP criteria has an importance level of 1.666 times compared to the SMA criteria.

Then normalization is carried out from the results of the comparison of the sub-criteria weight values in table below.

Table 8. Normalization of Comparison of Sub Criteria

	College	SENIOR HIGH SCHOOL	JUNIOR HIGH SCHOOL	Amount line	EIGEN	Lambda
College	0.111	0.111	0.111	0.333	0.11	1,000
SENIOR HIGH SCHOOL	0.333	0.333	0.333	1,000	0.33	1,000
JUNIOR HIGH SCHOOL	0.556	0.556	0.556	1,667	0.55	1,000
Amount	1,000	1,000	1,000	3,000	1.00	3,000

Then look for CI and CR values, namely:

- CI value: $(3.000 - 3) / (3 - 1) = -0.0002333740877$
known: number 3 is the number of sub criteria
- CR value : $-0.00023337408 / 0.58 = -0.0004023691167$

chart: the number 0.58 is the RI value obtained based on the number of sub-criteria used, for a list of RI values can be seen in table 8.

The calculation of the consistency ratio for the other 10 sub-criteria is also the same.

Alternative Ranking

Then calculations are carried out using sample data which is used as an alternative to prospective beneficiaries recipients and a trial calculation is carried out using Google Spreadsheet. The following is the trial sample data used:

Table 9. Test Data on Residents' Conditions

No	Candidate recipient	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11
1.	Alternative 1	3	1	3	1	3	5	3	1	3	5	1
2.	Alternative 2	3	3	5	3	5	3	5	3	3	3	1
3.	Alternative 3	5	5	5	1	5	3	1	3	5	3	3
4.	Alternative 4	1	3	1	1	1	1	5	5	1	1	5
5.	Alternative 5	1	1	1	5	1	5	3	1	1	5	5

From the trial data in the table, then a multiplication of the priority value of the criteria is then carried out with the priority value of the sub criteria that is in accordance with the conditions of the residents [18]. Then the following results are obtained:

Table 10. Final Comparison Results

No	Candidate	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11
1.	Alternative 1	0.007	0.007	0.020	0.007	0.020	0.056	0.033	0.011	0.033	0.078	0.020
2.	Alternative 2	0.007	0.020	0.034	0.020	0.034	0.033	0.033	0.033	0.033	0.046	0.020
3.	Alternative 3	0.011	0.034	0.034	0.007	0.034	0.033	0.011	0.033	0.056	0.046	0.059
4.	Alternative 4	0.002	0.020	0.007	0.007	0.007	0.011	0.056	0.056	0.011	0.015	0.101
5.	Alternative 5	0.002	0.007	0.007	0.034	0.007	0.056	0.033	0.011	0.011	0.078	0.101

Then do the sum for each alternative by adding up the value of each row in table 13, then the following results are obtained:

Table 11. Ranking Alternatives

No	Candidates	Number of Rows	Rank
1.	Alternative 1	0.291	5
2.	Alternative 2	0.311	3
3.	Alternative 3	0.357	1
4.	Alternative 4	0.292	4
5.	Alternative 5	0.346	2

Based on the results obtained in table 14, it can be concluded that alternative 3 is the main priority for potential beneficiaries recipients by obtaining the final result of 0.357.

5. CONCLUSIONS

a. Conclusion

From the results of research conducted, the system can assist in determining potential recipients of beneficiaries based on the criteria and sub-criteria used. Implementing this system can help the ministry in making decisions to determine clearly whether the resident is included in the category that meets or does not receive beneficiaries assistance. Based on the results of the calculations, it is known that alternative 3 is the top priority for the potential recipients of Non-Cash Food Assistance based on the conditions experienced by these residents with a final result of 0.357, followed by alternative 5 with a final result of 0.346. The AHP method is used as a tool in determining prospective Non-Cash Food Assistance beneficiaries based on the validity level of hierarchical consistency determined

based on the CI value: -0,

b. Suggestion

In this study, suggestions that can be given for further research are to expand the scope of the research area, add other types of social assistance and perfect the application program that is made so that it can be accessed online and makes it easier for residents, officers and heads of sub-districts to verify potential beneficiaries.

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