Decision Support System Determination of Food Recipients using Analytical Hierarchy Process

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***Abstract*— Technological developments are increasingly growing very rapidly, so that almost all activities or to solve problems are carried out using computer technology. This is also the case in the Cipameungpeuk Village Office, which at this time the program for determining the recipient of literary materials is still not optimal, so that assistance is not well targeted. To overcome these problems a decision support system is needed by using the AHP (Analytical Hierarchy Process) method. This method was chosen because it is able to select the best alternative from a number of alternatives based on specified criteria. The results of this research will produce a form of decision support system modeling in determining the recipient of literary food ingredients with the highest weight value from the calculation results of the method used.**

***Keywords*— SPK, AHP, Recipients of food**

I. INTRODUCTION (*HEADING 1*)

Technological developments are growing day by day, with the development of computer science, it is almost inseparable from everyday life, because almost all human activities are carried out by utilizing computer technology [1]., Universallycomputers are not new anymore today. Computers are not just demands that must be met, but changes that occur from time to time require the ability to quickly control various activities both personally and in groups. Along with the use of computers as human aids, which are developing very rapidly in the information needs of the community, supported by the development ofhardwareand software,sophisticated

Many fields of work have implemented information technology - one of them is management. In the field of management, computer-based information technology can be used to process data into quality information and be used as a decision-making tool using computer-based technology [3].

One of the computer-based technologies used at the management level is a Decision Support System [4]. Decision support system (DSS) is part of a computer-based information system, including a knowledge-based system (knowledge management) that is used to support decision making in an organization or a company [4]. The concept of a decision support system (DSS) or decision support system (DSS) was first expressed in the early 1970s by Michael S. Scott Morton with the term management decision system. Basically, DSS is designed to support all stages of decision making starting from identifying problems, selecting relevant data, determining the approach used in the decision-making process, to evaluating the selection [5].

The form of the decision-making process within the village/kelurahan government is the determination of the poverty level of the community. Poverty is one of the fundamental problems that is the center of attention of the government in any country [6]. Various poverty reduction programs or projects in our country have been carried out by the government, both central and regional, as well as private institutions. Poverty alleviation is the availability of accurate and targeted poverty data [6]. A reliable measurement of poverty becomes a formidable instrument for policy makers in focusing attention on the living conditions of the poor. Good poverty data can be used to evaluate government policies on poverty with the aim of improving their condition. To overcome poverty the government has tried to overcome it by distributing subsidized food which aims to reduce the burden of spending on poor families through fulfilling basic needs [3]. According to the 1945 Constitution of the Unitary State of the Republic of Indonesia, food is explicitly stated as a human right. To reduce the burden of spending on poor households due to the 1997/1998 economic crisis, the Government of Indonesia implemented a rice subsidy to fulfill some of the food needs of the poor.

The rice subsidy program for low-income people is known as "Rastra" - Beras Sejahtera [7]. Rastra is food assistance in the form of rice (in kind) provided by the government to be distributed every month to Beneficiary Families (KPM) without being charged a ransom fee/price. The rice distributed is 10 kg of medium quality rice. Rastra Social Assistance at first was Raskin/Rastra assistance distributed to beneficiaries of 15 Kg per family with a redemption fee of Rp. 1.600,-/kg. Then it transformed into Bansos Rastra and changed its function from a pattern of subsidized assistance to social assistance. The purpose of the Rastra Social Assistance Program is to reduce the expenditure burden of Beneficiary Families through the provision of medium quality rice in the amount of 10 Kg per month without being charged a ransom fee. So that it can provide the benefits of increasing access to food both physically (in kind/rice) and economically (without a ransom fee) [8]. In the selection of recipients of Rastra assistance, the selection of targets must be careful and reliable so that the assistance can be received by people who really need or are right on target. First, poverty data is needed, the use of assessment indicators must be really conceptualized, in order to get a decision that is in accordance with the actual situation [9].

In accordance with the situation of poverty, there are many criteria discrepancies during the distribution of Rastra recipients, therefore it is necessary to apply techniques/methods in making uncertainty decisions, one of

which is using the Analytical Hierarchy Process (AHP) method. The Analytical Hierarchy Process (AHP) method is a decision support model developed by Thomas L. Saaty [10]. This decision support model will describe a complex multi-factor or multi-criteria problem into a hierarchy. Hierarchy is defined as a representation of a complex problem in a multi-level structure. Where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on down to the last level of alternatives. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic [11]. AHP is often used as a problem solving method compared to other methods [12]. AHP is designed to reflect real people's way of thinking [12]. This method allows the quantitative and qualitative aspects of the decision to be considered. AHP reduces complex decisions to a series of one-to-one comparisons which then gives accurate results [12].

Likewise in the Cipameungpeuk Village office, South Sumedang District, at this time the program for determining the distribution of food ingredients is still not optimal, there are many obstacles in the distribution of foodstuffs such as the determination of inappropriate criteria and the system that runs less effectively due to the lack of thoroughness of the employees who select the recipients. foodstuffs Based on the pre-survey of the beneficiaries of prosperous rice (Rastra) in Cipameungpeuk Village, there are 580 families from 850 families registered in Cipameungpeuk Village. Thus, causing social jealousy among the people. For example, people who should have the right to get assistance but they don't get it, and vice versa, people who should not have the right to get food assistance. To overcome this problem, a decision support system is needed that can assist the kelurahan in managing the recipients of Rastra food (Beras Sejahtera), so that the provision of food aid is right on target. Therefore, in this study the author will try to make a decision support system for determining recipients of subsidized food using the AHP (Analytical Hierarchy Process) method.

This method was chosen, because it is able to select the best alternative from a number of alternatives, in this case the intended alternative, namely the people who are entitled to receive Rastra food (Rice Prosperous) based on the specified criteria. The criteria used by the researcher are limited to 7 (seven) criteria that apply in Cipameungpeuk Village, namely: 1) occupation, 2) income, 3) number of dependents, 4) housing conditions, 5) house status, 6) education, and 7) age. . This system, will assess the population based on these criteria. Thus, residents can be categorized which are entitled and which are not entitled to receive Rastra food assistance.

II. METHOD

This research uses AHP (Analytical Hierarchy Process), AHP (Analytical Hierarchy Process) Method This method was chosen because it is able to select the best alternative from a number of alternatives based on the specified criteria.

The following are the research steps using the AHP (Analytical Hierarchy Process) method, namely:

a. Identifying problems and determining the desired solution, then compiling a hierarchy of problems encountered. Writing a hierarchy is to set goals that are the goals of the system as a whole at the top level.

b. Determining the Priority of Elements
   1) The first step in determining the priority of elements is to make a pair comparison, which is to compare elements in pairs according to the given criteria.
   2) The pairwise comparison matrix is filled in using numbers to represent the relative importance of an element to other elements.

c. Synthesis
   The considerations for pairwise comparisons are synthesized to obtain the overall priority. The things that are done in this step are:
   1) Sum the values of each column in the matrix.
   2) Divide each value from the column by the corresponding column total to obtain a normalized matrix.
   3) Add up the values of each row and divide by the number of elements to get the average value.

d. Measuring Consistency
   In making decisions, it is important to know how good the consistency is because we don't want judgmental decisions with low consistency. The things that are done in this step are:
   1) Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element and so on
   2) Sum each row
   3) The result of the row sum divided by the corresponding relative priority element
   4) Add the quotient above with the number of elements, the result is called max

e. Calculating Consistency Index CI with the formula:
   CI = (λmax - n) / (n)
   Where n = number of elements

f. CalculateConsistency Ratio (CR) with the formula:
   CR = CI / IR
   Where:
   1) CR = Consistency Ratio
   2) CI = Consistency Index
   3) IR = Index Random Consistency

g. Check hierarchy consistency, if the value is more than 10%, then the data judgment assessment must be corrected. However, if the consistency ratio (CI/IR) is less or equal to 0.1, then the calculation results can be declared correct.

III. RESULT AND DISCUSSION

A. Alternative Residents

The planned number of Alternatives or Respondents taken is 10 residents, namely as follows Ana, Karsoma, Dedi, Atay Juhana, Hakim,

Eem, Nana Wahidin, Mamat Rahmat, Unen, Rokayah.

B. Player Criteria
1. Job (JB), Sub indicators:
   a. Not Working (Very Good)
   b. Workers/Farmers/ (Good)
   c. Entrepreneur (Enough)
   d. PNS (Less)
2. Income (IN), Sub Indicators:
   a. < 500,000 (Very Good)
   b. 500,000-1,000,000 (Good)
   c. 1,000,000-2,000,000 (Enough)
   d. > 2,000,000 (Less)
3. Number of Dependents (ND), Sub Indicators:
   a. 4 People (Very Good)
   b. 4 People (Good)
   c. 3 People (Enough)
   d. < = 2 people (less)
4. House Conditions (HC), Sub Indicators:
   a. Stage (Very Good)
   b. Semi Permanent (Good)
   c. Permanent (Enough)
5. House Status (HS), Sub-Indicators :
   a. Riding (Very Good)
   b. Contract (Good)
   c. Owned (Enough)
6. Education (ED), Sub Indicators:
   a. Elementary School (Very Good)
   b. Junior High School (Good)
   c. Senior/Vocational High School (Enough)
   d. Bachelor (Less)
7. Age (AG). Sub Indicators:
   a. >50 (Very Good)
   b. 40 to 50 Years (Good)
   c. 30 to 40 Years (Enough)
   d. < 30 Years (Less)

3.1 Results of Priority Determination of Criteria

The steps that must be taken in determining the priority of criteria are: Create a Pairwise Comparison Matrix.

Description:
JB = Job
HS = House Status
HS = House Condition
ND = Number of Dependents
IN = Income
ED = Education
AG = Age

Table 3.1 Pairwise Comparison Matrix Table

Criteria	JB	HS	HC	ND	IN	ED	AG
Job	1	2	3	3	5	4	3
House Status	0.5	1	2	3	2	3	4
House Condition	0.33	0.5	1	3	5	4	3
Number of Dependants	0.33	0.33	0.33	1	2	3	4
Income	0.2	0.5	0.2	0.5	1	4	3
Education	0.25	0.33	0.25	0.33	0.25	1	2
Age	0.33	0.25	0.33	0.25	0.33	0.5	1
Total	2.95	4.92	7.12	11.08	15.58	19.50	20

The table above is a pairwise comparison matrix, explaining the comparison of one criterion with another, with prioritize more important criteria. For values 0.5 , 0.33 , 0.2 , 0.25 is the reciprocal value of each criterion.

The hardware design will be carried out by integrating all the components needed for this system so that the existing functions can be executed.

3.1.1 System Blok Diagram

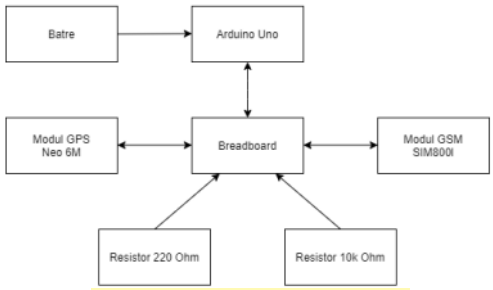


Figure 3.1 System Blok Diagram

To explain the general system design which is described in the block diagram of the working system which is shown by the 9V battery as the power source of all the components of the tool. Arduino uno as input/output that will process data. Then the U-blox NEO6M GPS module to get the coordinates of the longitude, latitude and GSM SIM800l module to send and receive data then the data is processed by Arduino UNO so that the data is forwarded via SMS, while the breadboard serves as a liaison between Arduino Uno,

GPS module, and GSM module. The capacitor that serves as a filter voltage electric current.

3.1.2 The System Module and How It Works

1. 9V battery: As the main power source of this system.
2. Arduino Uno: As the brain of the system created.
3. Breadboard: As a connecting board between Arduino UNO, GPS module, GSM Module, jumper cable, capacitor, and diode.
4. NEO 6M GPS module: Sends and receives vehicle location coordinates.
5. GSM SIM800l module: Sends vehicle location coordinates and receives messages from users using SMS.
6. Resistor 220 Ohm, and Resistor 10k Ohm: To control the voltage on GPS and GSM modules.

3.2 Priority Weight Matrix

After the comparison of the matrix is then carried out the priority weighting of each criterion is carried out. This is intended to obtain the priority value of each criterion. In Table 2 the matrix is obtained by the formula: New column row value = Old column row value / total of each old column. For example, the value of 0.34 in the job comparison is obtained from the comparison value in the previous table (the job column whose value is 1) divided by the other values. While the value of 2.11 in the column for the number of rows of work is obtained from the sum of each row. For the Priority Value, the criteria are obtained from the calculation of the value of the number of rows divided by the number of criteria, in this case there are 7 criteria. For example, the priority value of work is 2.11 / 7 which is 0.30 , as well as for the priority value of other criteria.

Table 3.2 Paired Matrix

Criteria	JB	HS	HC	ND	IN	ED	AG	Tot.	Prio.
JB	0.34	0.41	0.42	0.27	0.32	0.21	0.15	2.11	0.30
HS	0.17	0.20	0.28	0.27	0.13	0.15	0.20	1.41	0.20
HC	0.11	0.10	0.14	0.27	0.32	0.21	0.15	1.30	0.19
ND	0.11	0.07	0.05	0.09	0.13	0.15	0.20	0.80	0.11
IN	0.07	0.10	0.03	0.05	0.06	0.21	0.15	0.66	0.09
ED	0.08	0.07	0.04	0.03	0.02	0.05	0.10	0.39	0.06
AG	0.11	0.05	0.05	0.02	0.02	0.03	0.05	0.33	0.05

3.3 Consistency Measurement Results

3.3.1 The Addition Matrix of Each Row

Table 3.3 Addition Matrix of Each Row

Criteria	JB	HS	HC	ND	IN	ED	AG	Tot.
JB	0.30	0.40	0.56	0.34	0.47	0.22	0.14	2.44
HS	0.15	0.20	0.37	0.34	0.19	0.17	0.19	1.61
HC	0.10	0.10	0.19	0.34	0.47	0.22	0.14	1.56
ND	0.10	0.07	0.06	0.11	0.19	0.17	0.19	0.89
IN	0.06	0.10	0.04	0.06	0.09	0.22	0.14	0.71
ED	0.08	0.07	0.05	0.04	0.02	0.06	0.09	0.40
AG	0.10	0.05	0.06	0.03	0.03	0.03	0.05	0.35

The column values in Table 3 are obtained from the multiplication of the comparison matrix in Table 1 which is multiplied by the priority value in Table 2. Suppose the value of 0.30 in the job comparison is obtained from the value of the comparison of jobs in Table 1, which is 1, multiplied by the value the priority work in Table 2 is 0.30, while the total column is obtained from the sum of each row in Table 3, for example in the work row, namely 0.30 + 0.40 + 0.56 + 0.34 + 0.47 + 0.22 + 0.14 = 2.44.

3.3.2 Consistency Ratio Matrix

Table 3.4 Consistency Ratio

Criteria	Number of Rows	Priority	Total
JB	2.44	0.30	2.74
HS	1.61	0.20	1.81
HC	1.56	0.19	1.75
ND	0.89	0.11	1.00

IN	0.71	0.09	0.81
ED	0.40	0.06	0.46
AG	0.35	0.05	0.39
Total			8.96

1) Measuring Consistency
(Sum of Result values) = 8.96
N (Number of Criteria) = 7
λ maks ($\frac{\Sigma}{N}$) = 1.28

2) Calculating Consistency Index

$$(CI) = \frac{\lambda \text{ maks} - N}{N}$$

$$CI = \frac{\lambda \text{ maks} - N}{N} = \frac{1.28 - 7}{7} = -0.817$$

3) Calculating Consistency Ratio
(CR) = CI/IR
CR = -0.817 / 1.32 = -0.619

Note:
CR = Consistency Ratio
CI = Consistency Index
IR = Random Consistency Index

If the value of CR < 0.1 then the criterion value is consistent, if CR > 0.1 then the criterion value is inconsistent and repeat the priority determination stage until it produces a consistent value.

Table 3.5 Index Random Consistency (IR)

N (Matrix Size)	IR
1	0,00
2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1.45
10	1.49
11	1,51
12	1,48
13	1,56
14	1,57
15	1,59

4) Checking Consistency
Based on the results of (CR/IR) (-0.619), the calculation results are declared correct and consistent. because the CR is less than 0.1.

3.4 Sub-criteria Priority Determination Results

Calculation of sub-criteria is carried out on sub-sub of all criteria. In this case there are 7 criteria which are explained as follows

3.4.1 Job Subcriteria Pairwise Comparison Matrix

Table 3.6 Job Subcriteria Pairwise Comparison Matrix

Job	Very Good	Good	Enough	Less
Very Good	1	3	4	5
Good	0.33	1	3	5
Enough	0.25	0.33	1	3
Less	0.20	0.25	0.33	1
Jumlah	1.78	4.58	8.33	14

This step is the same as the pairwise comparison matrix of criteria values in table 3.1.

3.4.2 Job Subcriteria Priority Weight Matrix

Table 3.7 Job Subcriteria Priority Weight Matrix

Job	Very Good	Good	Enough	Less	Tot.	Priority	Sub Prioritas
Very Good	0.56	0.66	0.48	0.36	2.06	0.52	1
Good	0.19	0.22	0.36	0.36	1.12	0.28	0.55
Enough	0.14	0.07	0.12	0.21	0.55	0.14	0.27
Less	0.11	0.04	0.04	0.07	0.27	0.07	0.13

This step is basically the same as calculating the matrix of criteria values in table 3.2, the difference is that there is an additional priority sub-criteria column. The value in the priority sub-criteria column is obtained by finding the highest value in the priority column, then each priority value column is divided by the highest value. In Table 7, the highest value in the priority column is 0.52. The value of 1 in the priority sub-criteria column is obtained by dividing the priority column with the largest value (0.52 / 0.52). The value of 0.55 in the priority sub-criteria column is obtained by dividing the priority column with the largest value (0.28 / 0.52).

3.4.3 Matrix Sum of Each Row of Job Subcriteria

Table 3.8 Matrix Sum of Each Row of Job Subcriteria

Job	Very Good	Good	Enough	Less	Tot.
Sangat Baik	0.51	0.84	0.55	0.33	2.24
Baik	0.17	0.28	0.41	0.33	1.20
Cukup	0.13	0.09	0.14	0.20	0.56
Kurang	0.10	0.06	0.05	0.07	0.27

Thw matrix in Table 4.8 is obtained by adding up each row of the job subcriteria

3.4.4 Job Subcriteria Consistency Ratio

Table 3.9 Job Subcriteria Consistency Ratio

Job	Number Of Row	Priotity	Total
Very Good	2.24	0.52	2.76
Good	1.19	0.28	1.47
Enough	0.56	0.14	0.70
Less	0.76	0.07	0.83
Total			5.75

1) Measuring Consistency

(Sum of Result values) = 5.75

N (Number of Criteria) = 4

λ maks ($\frac{\sum}{N}$) = 1.44

2) Calculating Consistency Index

$(CI) = \frac{\lambda \text{ maks} - N}{N}$

$CI = \frac{\lambda \text{ maks} - N}{N} = \frac{1.44 - 4}{4} = -0.64$

3) Calculating Consistency Ratio

(CR) = CI/IR

CR = -0.64 / 0.90 = -0.712

4) Checking Consistency

Based on the result of (CI/IR) i.e. (-0.712) then the calculation results are declared correct and consistent. Because the CR is less than 0.1.

3.4.5 Calculation of Results

After calculating the weights of the criteria and sub-criteria, a table of weight information can be made such as the table below:

Table 3.10 Information on the Weight of Criteria and Sub-criteria

Job	House Status	House Condition	Number of Dependants	Income	Education	Age
0.20	0.20	0.19	0.11	0.09	0.06	0.05
Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
1	1	1	1	1	1	1
Good	Good	Good	Good	Good	Good	Good
0.55	0.64	0.50	0.77	0.77	0.77	0.77
Enough	Enough	Enough	Enough	Enough	Enough	Enough
0.27	0.27	0.15	0.38	0.38	0.38	0.38
Less	Less	Less	Less	Less	Less	Less
0.13	-	-	0.23	0.23	0.23	0.23

After getting the weights of each character and sub-character, the case study is selected, following the completion of the study cases in tabular form.

Table 3.11 Determination of Sub-criteria Results

Name	JB	HS	HC	ND	IN	ED	AG
Ana	Not Working	Owning a House	Permanent	<=2 Person	< 500.000	Elementary	>50
Karsoma	Laborer	Owning a House	Permanent	> 4 Person	< 500.000	Elementary	40 s/d 50
Dedi	Laborer	Owning a House	Permanent	4 Person	< 500.000	Elementary	>50
Atay Juhana	Wiraswasta	Owning a House	Permanent	3 Person	1.000.000 - 2.000.000	JHS	40 s/d 50
Hakim	Self-employed	Owning a House	Permanent	3 Person	> 2.000.000	Bachelor	35 s/d 40
Eem	Laborer	Owning a House	Permanent	3 Person	< 500.000	Elementary	>50
Nana Wahidin	PNS	Owning a House	Permanent	<=2 Person	> 2.000.000	Bachelor	>50
Mamat Rahmat	Laborer	Owning a House	Permanent	<=2 Person	< 500.000	Elementary	>50
Unen	Laborer	Owning a House	Permanent	4 Person	< 500.000	Elementary	40 s/d 50
Rokayah	PNS	Owning a House	Permanent	3 Person	> 2.000.000	Bachelor	>50

Table 3.12 Determination of Alternative Ranking Results

Name	JB	HS	HC	ND	IN	ED	AG	TOT.	Status
Ana	0.3	0.054	0.0285	0.0253	0.09	0.060	0.050	0.6078	Worthy
Karsoma	0.165	0.054	0.0285	0.11	0.09	0.060	0.039	0.5460	Worthy
Dedi	0.165	0.054	0.0285	0.0847	0.09	0.060	0.050	0.5322	Worthy
Atay Juhana	0.081	0.054	0.0285	0.0418	0.0342	0.046	0.039	0.3242	Unworthy
Hakim	0.081	0.054	0.0285	0.0418	0.0207	0.014	0.019	0.2588	Unworthy
Eem	0.165	0.054	0.095	0.0418	0.09	0.060	0.050	0.5558	Worthy
Nana Wahidin	0.039	0.054	0.0285	0.0253	0.0207	0.014	0.050	0.2313	Unworthy
Mamat Rahmat	0.165	0.054	0.095	0.0253	0.09	0.060	0.050	0.5393	Worthy
Unen	0.165	0.2	0.0285	0.0847	0.09	0.060	0.039	0.6667	Worthy
Rokayah	0.039	0.054	0.0285	0.0418	0.0207	0.014	0.012	0.2093	Unworthy

In Table 3.12 above we can see that the alternative with the largest total is Unen (0.6667), followed by Ana (0.6078) as the second place, Eem (0.5558) position Third, Mamat (0.5393) took fourth place, Karsoma (0.5460) fifth position, and Dedi for sixth place (0.5322). The six participants are eligible to receive Rastra foodstuffs.

IV. Conclusion

Based on the results of the final project research that has been carried out regarding the recipients of Rastra food ingredients using the AHP (Analytical Hierarchy Process) method, the following conclusions can be drawn:

1. A decision support system that can help determine the recipients of Rastra food ingredients in Cipameungpeuk Village.
2. By applying weighting between criteria using aspects of the AHP (Analytical Hierarchy Process) which can be completed quite well, easily and efficiently.
3. Decision Support Systems can help and support decision making with objective value in a more effective time.
4. The results of the calculation of SPK for recipients of food ingredients using the AHP (Analytical Hierarchy Process) method from 10 alternatives showed that the candidate (top rank) eligible to receive rastra food ingredients was Unen (0.6667) in first position, followed by Ana (0.6078) as second, Eem (0.5558) third position, Mamat Rahmat (0.5393) fourth position, Karsoma (0.5460) fifth position, and Dedi for sixth position (0.5322).

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