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DEVELOPMENT OF SAW (SIMPLE ADDITIVE WEIGHTING) METHOD FOR DECISION SUPPORT SYSTEM OF SEMBAKO PRICE CONTROL

(Case Study of the Office of Agriculture, Fisheries and Forestry, Sleman Regional Government)

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ABSTRACT

The Supporting System The decision to control basic food prices at the fisheries and forestry service is a system designed to assist relevant agencies in seeing prices of basic necessities which tend to increase at any time. At first the relevant agencies do recap calculations by storing data and still counting manually, so it requires a longer time, with the existence of this system it is expected to be able to help and provide solutions for consideration of decision making in accordance with the right calculations.

The decision support method of calculation used is the *SAW* method that takes the greatest value to be used as a decision-making ranking. In addition, other methods used are data collection methods by observation and interviews to identify problems in developing support systems for basic food price control decisions. Model design is described using *data flow diagrams* (DAD) and *entity relationship diagram* (ERD).

The system developed is able to record, calculate and provide alternative solutions effectively for relevant agencies. With this system, agencies are expected to be able to process the calculation of basic food prices better, select more accurate decisions, and take more effective alternative solutions.

Keyword : *Decision Support System*, *SAW* Method, Food Price Control.

1. INTRODUCTION

The Department of Agriculture of Fisheries and Forestry of the Sleman Regional Government is a government agency located in Sleman Yogyakarta which is responsible for agriculture, food security, forestry resources and community fisheries resources in the Sleman region, due to the wide range of fields handled by the agency within the agency, These sub-sections are made to take care of certain fields such as sub-sectors of agriculture, sub-sectors of food security, sub-sectors of forestry and so on.

The food security sub-sector is a sub-sector that only deals with food security, such as food distribution planning, food price control and basic needs, food resource planning and so on. One part that is taken care of by the sub-sector of food security is to control food prices and basic needs, to control the food security sub-sector must check market prices and do manual calculations to get the results of analysis of food price controls for further action.

Decision Support System is a system that can assist in decision making or supporting policy making. In this decision support system there are many methods that can be used in supporting decision making such as the SAW method, WP (Weighted Product) method, TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) and AHP method (Analytic Hierarchy Process).

Of the several methods above, the many and commonly used methods are the SAW method, because the calculation process has the fastest time and the results of the analysis obtained are effective and efficient to assist in getting a decision. Therefore the sub-sector of food security can process food prices for basic food and make decisions quickly within 2 hours using the SAW method. However, at this time, the processing of food staple food price control is still done manually and has not been detailed and requires a long time of 2 days in getting the results of the analysis to take the right decision.

With the time difference due to the absence of media that can help to process food price controls and basic needs quickly and precisely. With the Decision Support System using the SAW method, it is expected that the processing of food price and basic food prices can be done in a timely and accurate manner so that the food security sub-sector can take decisions and actions quickly and notify information to the public and other sub-sectors to obtain information. food prices are maximally, fast and accurate for further action. This is because the Decision Support System using the SAW method is one of the media that can be used to process food price control and basic needs quickly and precisely and provide information quickly, accommodating information on basic food prices that will be processed in large capacities and can used at any time without recognizing the limits of space and time.

2. Decision Support System

Decision support systems (DSS abbreviated systems) are part of computer-based information systems including knowledge-based systems (knowledge management) that are used to support decisions within an organization or company. It can also be said as a computer system that processes data into information to make decisions from specific semi-structured problems [1].

Stated that the stage of making a Decision Support System, namely [3]:

1. Search (intelligence)

Is the stage of defining the information needed that is related to the problems faced and the decisions that will be taken. This step really determines the accuracy of the decisions that will be taken, because before an action is taken, of course the problems faced must be clearly formulated first.

2. Design (Design)

It is the analysis phase in terms of finding or formulating alternative problem solvers. After the problem is well formulated, the next step is to design or build a problem solving model and arrange various alternative problem solvers.

3. Election (Choice)

By referring to the formulation of objectives and expected results, then management selects the alternative solutions that are estimated to be most appropriate The choice of this alternative will be easy to do if the desired results are measured or have certain quality values.

4. Implementation (Implementation)

Is the implementing stage of the decisions that have been taken. At this stage a series of planned actions need to be formulated, so that the results of the decisions can be monitored or resolved if improvements are needed.

3. *SAW* (Simple Additive Weighting) Method

One method of solving MADM problems is by using the SAW method. The SAW method is often also known as the weighted sum method.

The basic concept of the SAW method is to find a weighted sum of performance ratings on each alternative of all attributes [2]. The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all available alternative ratings [4]. Equated as follows:

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{Max\, x_{ij}} & \text{jika j atribut keuntungan (benefit)} \\ \dfrac{Min\, x_{ij}}{x_{ij}} & \text{jika j atribut biaya (cost)} \end{cases}$$

Where rij is the normalized performance rating of the alternative Ai in the Cj attribute; i = 1,2, ..., m and j = 1,2, ..., n. The preference value for each alternative (Vi) is given as follows :

$$V_i = \sum_{J=1}^{n} w_j\, r_{ij}$$

Information :
Vi = Preference value
wj = ranking weight
rij = normalized performance rating
A larger Vi value indicates that the alternative Ai is more chosen [4].

The steps of the SAW method are as follows [4]:
1. Determine the criteria that will be used as a reference in decision making, namely C.
2. Determine the suitability rating of each alternative on each criterion.
3. Make a decision matrix based on criteria (C), then normalize the matrix based on equations that are adjusted to the type of attribute (attribute gain or cost attribute) so that the normalized R matrix is obtained.
4. The final results are obtained from the ranking process, namely the sum of the multiplication of normalized matrix R with the weight vector so that the largest value chosen as the best alternative is obtained (A) as a solution.

4. *Fuzzy* Set

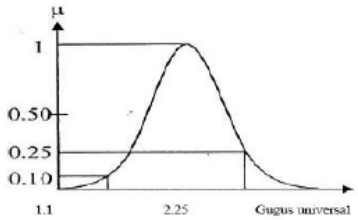
Fuzzy set is a set that can present and handle uncertainty problems which in this case can mean doubts, inaccuracies, lack of information, and partial truths [4].

In an ordinary set {crisp set) the membership of each universal set element in a set is stated with members or non-members of the set.

This membership is given by a function called the membership function. The membership function gives a value of 1 to declare members and 0 to declare non-members. Fuzzy sets are the development of ordinary sets.

The membership function does not only give a value of 0 and 1, but a value that is at a certain interval, usually in interval [0,1], so that an element can have membership degrees 0, 0.82 or 1.

The value given by the membership function is called membership degree (degree of membership). If U denotes a universal set and A is a fuzzy set in U, then A is a set of ordered pairs as berkut:
A = {(u, μ A (μ)) uεU}
With μA (u) is a membership function that gives the value of the degree of membership u to the fuzzy set A, namely: μA: U [0,1]. For example, the function of the fuzzy A set as shown in Figure 3, it can be seen that μA (l.l) = 0.10, and μA (2.25) = 0.



Picture 1. Fuzzy Set membership function

The fuzzy set has 2 attributes, namely:
a. Linguistics, namely naming a group that represents a certain condition or condition using natural language, such as: BIG, MEDIUM, SMALL.

b. Numerical, which is a value (number) that shows the size of a variable such as: 12,10,8, etc.

5. Membership Function

The membership function is a curve that shows the mapping of data input points into its membership value (often called the degree of membership) which has an interval between 0 to 1.

There are two ways to define membership in a fuzzy set, numerically and functionally[4]. The numerical definition expresses the function of the degree of membership as a vector of numbers that depends on the level of discretization. For example, the number of discrete elements in the universe of conversation.

The functional definition states the degree of membership as a boundary for analytical expressions that can be calculated. Certain standards or sizes in membership functions are generally based on universe X real numbers.
Linear Representation There are 2 possible fuzzy linear sets, namely: The increase in set starts at the domain value that has zero membership degree [0] moves right to the value of the domain that has a higher degree of membership.

Picture 2. Graph of Linear Membership Functions Up

Membership Functions :

$$\mu[x] = \begin{cases} 0; & x \le a \\ (x-a)/(b-a); & a \le x \le b \\ 1; & x \ge b \end{cases}$$

The straight line starts from the value of the domain with the highest degree of membership on the left side, then moves down the value of the domain that has a lower degree of membership.

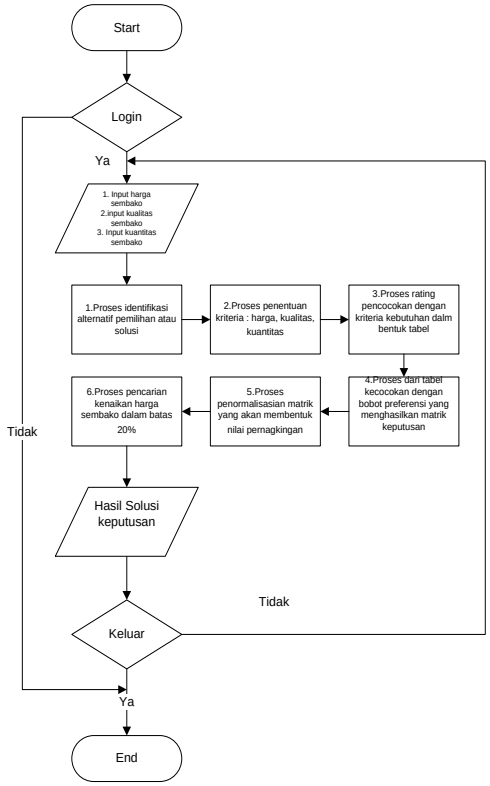
Picture 3. Graph of Linear Membership Functions Down

Membership Functions

$$\mu[x] = \begin{cases} (x-a)/(b-a); & a \le x \le b \\ 0; & x \ge b \end{cases}$$

6. Modeling

The following is a modeling of the system :

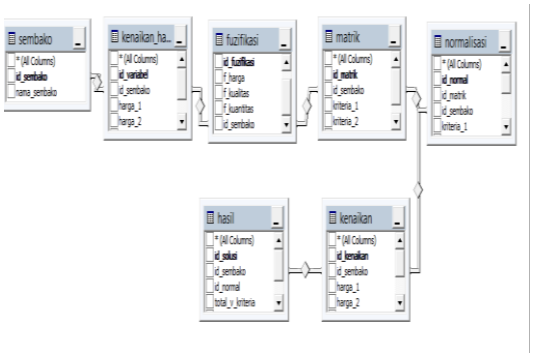


Picture 4. Flowchart System

Starting with a start that will display the program's initial display, and then the login menu will appear for granting access rights to the officer.

Then after logging in, the input process for each basic food data will be displayed, such as basic food prices, quantity of basic food after the process the input will be carried out by the process of determining the criteria value for each basic food data input, then it will determine the matching process with preference weights which will produce a decision matrix, after that the final weight and preference values will be processed, then the increase in the percentage of 20%.

Then the results of the solution or decision from the calculation process will be given after obtaining the results and then going out or repeating the process of calculating the prices of basic foods.



Picture 5. Table Relation

The basic food table and the increase in price table contain the data needed for the calculation process, in addition to the fuzification table obtained from the data entered in the basic food table and price increases, therefore the fuzification table is related to the two tables using the is_sembako field as a link data, after the fuzification table a matrix process will be carried out in which the data is retrieved from the fuzification process by using the id_sembako link, then the normalization table is obtained from the normalization process, the data is taken from the matrix table. who uses the id_sembako link.

7. Process Calculation With the *SAW* Method

At this stage it will be explained globally about the calculation process using the SAW method.

The data that will be used is the data that is not actually the one that will be used as a simulation to show the course of the calculation process, but for actual implementation the original data obtained from the service will be used. sleman fisheries and local government forestry.

The calculation process that will be carried out by the system is as follows:

1. Identify alternative choices or solutions (A)

Alternative choices or solutions will be described as follows:

A1 = Rice
A2 = Egg
A3 = Sugar
A4 = Cooking oil
A5 = Milk
A6 = Meat
A7 = Vegetables
A8 = Salt
A9 = LPG gas

2. Criteria that will be used as a reference in decision making (C)

C1 = Price
= {Very cheap, cheap, medium, expensive, very expensive}
C2 = Quality
= {Very good, good, medium, good, very good}
C2 = Quantity
= {Very many, many, medium, few, very few}

3. Rating of suitability of each alternative on each criterion

For a suitability rating of each alternative on each criterion given a value from numbers 1 to number 5 and will be described as follows:

C1 = Price
1 = Very cheap
2 = Cheap
3 = Medium
4 = Expensive
5 = Very expensive
C2 = Quality
1 = Very good
2 = Good
3 = Medium
4 = Bad
5 = Very bad

C3 = Quantity
1 = Very much
2 = Lots
3 = Medium
4 = Little
5 = Very little

4. Level of importance on the value of reality needs

The importance of each criterion is also given grades 1 through 5, with details as follows:
1 = Very Low
2 = Low
3 = Enough
4 = High
5 = Very High

5. Match rating table using the criteria for needs

ALTERNATIF	KRITERIA		
	C1 = Harga	C2 = Kualitas	C3 = Kuantitas
A1	3	2	3
A2	3	2	3
A3	4	3	3
A4	3	2	3
A5	3	3	3
A6	5	2	3
A7	3	3	3
A8	1	1	3
A9	4	3	3

6. Weight Preference given in decision making

Weight The preference given in decision making is as follows =
W = {5, 3, 4}

7. Decision Matrix formed from a match table

Decision Matrix formed from the match table is as follows =

$$X = \begin{bmatrix} 3 & 2 & 3 \\ 3 & 2 & 3 \\ 4 & 3 & 3 \\ 3 & 2 & 3 \\ 3 & 3 & 3 \\ 5 & 2 & 3 \\ 3 & 3 & 3 \\ 1 & 1 & 3 \\ 4 & 3 & 3 \end{bmatrix}$$

8. Normalization of Matrix X Each Criteria

Normalization of the matrix is done to find the solution data to reach the actual value, normalization is done in the following way :

$$R11 = \frac{3}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{3}{5} = 0{,}6$$

$$R21 = \frac{3}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{3}{5} = 0{,}6$$

$$R31 = \frac{4}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{4}{5} = 0{,}8$$

$$R41 = \frac{3}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{3}{5} = 0{,}6$$

$$R51 = \frac{3}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{3}{5} = 0{,}6$$

$$R61 = \frac{5}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{5}{5} = 1$$

$$R71 = \frac{3}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{3}{5} = 0{,}6$$

$$R81 = \frac{1}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{1}{5} = 0{,}2$$

$$R91 = \frac{4}{\max\{3;3;4;3;3;5;3;1;2\}} = \frac{4}{5} = 0{,}8$$

$$R12 = \frac{2}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{2}{3} = 0{,}667$$

$$R22 = \frac{2}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{2}{3} = 0{,}667$$

$$R32 = \frac{3}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{3}{3} = 1$$

$$R42 = \frac{2}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{2}{3} = 0{,}667$$

$$R52 = \frac{3}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{1}{3} = 1$$

$$R62 = \frac{2}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{2}{3} = 0{,}667$$

$$R72 = \frac{3}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{3}{3} = 0{,}667$$

$$R82 = \frac{1}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{1}{3} = 0{,}334$$

$$R92 = \frac{3}{\max\{2;2;3;2;3;2;3;1;3\}} = \frac{3}{3} = 1$$

$$R13 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R23 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R33 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R43 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R53 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R63 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R73 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R83 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

$$R93 = \frac{3}{\max\{3;3;3;3;3;3;3;3;3\}} = \frac{3}{3} = 1$$

9. The results of the normalized matrix are as follows, X =

0.6	0.666667	1
0.6	0.666667	1
0.8	1	1
0.6	0.666667	1
0.6	1	1
1	0.666667	1
0.6	1	1
0.2	0.333333	1
0.8	1	1

10. The multiplication process of each alternative with preferential weight W

The following is the ranking process with preference weight (V) as follows:
W = {5, 3, 4}

A1 = (5 X 0.6) + (3 X 0.667) + (4 X 1) = 9
A2 = (5 X 0.6) + (3 X 0.667) + (4 X1) = 9
A3 = (5 X 0.8) + (3 X 1) + (4 X 1) = 11
A4 = (5 X 0.6) + (3 X 0.667) + (4 X 1) = 9
A5 = (5 X 0.6) + (3 X 1) + (4 X 1) = 10
A6 = (5 X 1) + (3 X 0.667) + (4 X1) = 11
A7 = (5 X 0.6) + (3 X 1) + (4 X 1) = 10
A8 = (5 X 0.2) + (3 X 0.3) + (4 X 1) = 6
A9 = (5 X 0.8) + (3 X 1) + (4 X 1) = 11

11. The search process increases 20% for each alternative criterion

The process is obtained from the new price and reduced by the new price then multiplied by 100%, if it reaches 20% the increase in basic food is so high that it will be prioritized and will be dealt with immediately to overcome the price increase :

SEMBAKO	HARGA LAMA	HARGA BARU	SELISIH	PROSENTASE	PEMBULATAN	SOLUSI
BERAS	6000	6500	500	7.69230769	8%	T
TELUR	7500	8000	500	6.25	7%	T
GULA	9000	10000	1000	10	10%	T
MINYAK GORENG	10000	11000	1000	9.09090909	10%	T
SUSU	12500	13000	500	3.84615384	4%	T
DAGING	75000	90000	15000	16.6666666	17%	Y
SAYURAN	5000	6000	1000	16.6666666	17%	Y
GARAM	1000	1100	100	9.09090909	10%	T
GAS ELPIJI	12000	14000	2000	14.2857142	15%	T

12. Conclusions and Solutions,

From the simulation calculation above, some data can be drawn, namely criteria data, calculation data with SAW, calculation of price increases with percentage prices and solutions, for information solutions can be symbolized N for normal and Y for abnormal and need to be addressed first, the description as follows :

KRITERIA	HASIL V	PROSENTASE	SOLUSI
A1	9	8%	N
A2	9	7%	N
A3	11	10%	N
A4	9	10%	N
A5	10	4%	N
A6	11	17%	Y
A7	10	17%	N
A8	6	10%	N
A9	11	15%	N

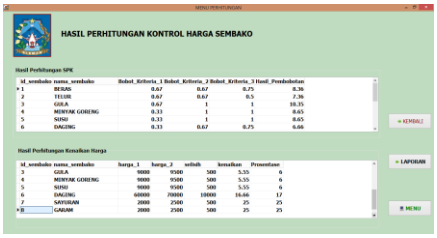
In the above simulation, the priority is alternative A6 or meat, with the above calculation can be given a decision support that is basic necessities which must be given intense attention, namely in meat that has very expensive prices with price increases of up to 17% and almost reaches an increasing threshold value of 20 %.

8. Process Calculation With the *SAW* Method with the System

In this main menu there is an icon which, if clicked, will display other new menus, which are needed by the basic food price control decision support system

Picture 6. Home System

The calculation results are displayed using the SAW method and the increase in the prices of basic foods



Picture 7. Calculation results

Report on the results of calculations using the SAW method that has been displayed in the form of ranking that is in accordance with the results of the calculation and inside it is completed with the results of the percentage increase in basic food prices in percent.

Picture 8. Report Calculation results

9. Conclusion

Based on the discussion and also observations that have been made, conclusions can be drawn including:

This Decision Support System Application can quickly and efficiently carry out a solution process regarding the problem of price control of basic foods which prices are increasing, so that supporting information for the solutions obtained is faster, with faster information the officers can quickly take the decision to deal with the issue of basic food prices control, so that officers can more quickly take appropriate steps that will later be delivered to the public.

In developing the Application for Decision Support System for the Control of Food Prices, the calculation process can be carried out by querying the program, which requires more time in the development process, and must be efficient in making it due to errors in querying program calculations. will cause an error and will cause a failure in the calculation process and the database will experience an error

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