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Decision Support System for Determining Social Assistance Recipients in Petuaran Hilir Village Using the SMART Method

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Abstract
The distribution of social assistance in rural areas is a strategic government effort to reduce social inequality and improve the welfare of underprivileged communities. However, in Petuaran Hilir Village, the process of determining aid recipients is still conducted manually, leading to various issues such as a lack of objectivity, potential unfairness, and mistargeting. Therefore, this study aims to design and implement a Decision Support System (DSS) using the Simple Multi-Attribute Rating Technique (SMART) method to determine social assistance recipients in a more systematic and transparent manner. The SMART method was chosen due to its effectiveness in simplifying multi-criteria decision-making and its practicality for implementation at the village level. The system was developed as a web-based application and tested using the black-box method, as well as validated against the manual selection results conducted by village officials. Testing results showed that the system can objectively identify and rank aid recipients based on final scores from five main criteria: income, number of dependents, home ownership status, housing condition, and type of employment. The system achieved 100% consistency with manual selection results and reduced the selection process time by up to 70%, enabling a fairer and more targeted distribution of aid based on systematically calculated scores. By eliminating manual bias in the selection process, the system significantly improves the accuracy of recipient rankings. This study also opens opportunities for further development, such as integrating real-time population data and advanced analytical features to support more responsive social policies.

1. Introduction

Social assistance is a form of government intervention aimed at alleviating the burdens faced by poor and vulnerable communities [1]. Poverty remains a significant issue in society, particularly in Indonesia and other developing countries. This problem is influenced by various interrelated factors such as income level, health,

education, access to goods and services, geographic location, and environmental conditions [2]. In rural areas, social assistance programs play a vital role in enhancing community welfare and accelerating equitable development. Petuaran Hilir Village is one such community that receives social assistance due to a high number of residents classified as beneficiaries.

The government provides social assistance selectively to individuals who meet social risk criteria. However, in practice, the distribution is often considered inaccurate [3]. According to the local hamlet head, the selection process is still conducted manually through basic record-keeping, resulting in data that is less valid and increasing the potential for errors in aid distribution. Furthermore, the absence of a system capable of objectively and measurably assessing each prospective recipient's condition renders the selection process vulnerable to subjectivity and unfairness.

Although several Decision Support Systems (DSS) for social assistance distribution exist, these systems tend to be generic and have not been fully adapted to the conditions of villages, which face limitations in data, resources, and technical capacity. Decision Support Systems (DSS) play a crucial role in assisting decision-makers to process data and resolve problems, especially in complex and unstructured situations [4]. Additionally, existing multi-criteria decision-making approaches are often complex and less practical for small-scale data processing at the village level. This study addresses these shortcomings by implementing the Simple Multi-Attribute Rating Technique (SMART) method, which integrates five key criteria systematically and is easy to apply in a village context. Therefore, the developed system is expected to be highly practical, efficient, and tailored to local needs.

Therefore, a decision support system is needed to assist village officials in objectively, efficiently, and transparently determining who is eligible for social assistance. One appropriate method for multi-criteria decision-making is the SMART method (Simple Multi-Attribute Rating Technique) [5]. This method is advantageous for its simplicity, ease of implementation, and suitability for small-scale data processing, such as at the village level. Previous studies have also shown that SMART is effective in supporting decision-making, as it produces systematic and accountable results. For example, in previous study the SMART method was used to select suppliers for UD. Bahtera and yielded effective and efficient multi-criteria decision analysis [6].

This study aims to develop and implement a Decision Support System (DSS) to determine the prospective recipients of social assistance in Petuaran Hilir Village. A system that assists decision-makers in conducting evaluations is essential, and one way to achieve this is through the application of the Simple Multi-Attribute Rating Technique (SMART) [7]. Therefore, the SMART method is selected to assist the selection process based on five main criteria [8]: income, number of dependents, house ownership status, house condition, and type of employment. It is hoped that the results of this research can provide a practical solution to improve the accuracy and fairness of social assistance distribution at the village level [9].

In addition, this system can help the village maintain a more organized and centralized database of aid recipients. With well-maintained data, evaluations in future periods can be carried out more easily. This, in turn, supports the efficiency of village officials in the sustainable management of social assistance programs. Through this research, it is expected that the village will gain a practical tool that can be used by anyone, even by village officials without a background in technology. The application of the SMART method in this decision support system is also a simple yet impactful first step toward digitalization to improve the quality of public service delivery [10].

The main objective of this study is to design and implement a Decision Support System (DSS) using the SMART method to help village officials select social assistance recipients more accurately, fairly, and efficiently. By applying five key criteria income, number of dependents, house ownership status, housing condition, and type of employment the system is expected to reduce subjectivity, minimize data errors, and speed up the selection process. This research offers a practical and user-friendly technological solution to support transparent decision-making and improve the management of social assistance programs at the village level.

2. Research Method

A decision support system is a system designed to assist the decision-making process within an organization or company. This system combines data, analytical methods, and mathematical models to generate optimal recommendations in support of decision-making. The main goal of a decision support system is to provide assistance to decision-makers in solving complex problems that require in-depth analysis. The implementation of decision support systems spans various fields, including business, finance, project management, healthcare, and other sectors [11].

Simple Multi Attribute Rating Technique (SMART) is a multi-criteria decision-making method used in decision support systems. This method was first developed by Edward in 1977 [12]. The Simple Multi Attribute Rating Technique (SMART) is a comprehensive decision-making method because it considers both qualitative and quantitative aspects. In this method, parameters act as decision factors with varying ranges of values and weights. These values are then used as the basis for determining the final decision [13]. This multi - criteria decision-making method is based on the theory that each choice consists of various criteria, each with its own value, and each criterion is assigned a weight reflecting its importance compared to other criteria [14]. This weighting is used to evaluate each alternative so that the best alternative can be obtained [15]. Each attribute is assigned a weight that reflects its level of importance compared to other attributes. The weights and rankings are used to evaluate each alternative in order to determine the best choice. The SMART method uses a weighting scale between 0 and 1, which facilitates the calculation and comparison of values from each alternative [16]. The general steps carried out in calculating the SMART method are as follows:

The first step is to establish the criteria to be used in the decision-making process. Information from the decision-maker is very important in this process to ensure that the selected criteria are relevant and appropriate to the problem being faced [17].

The weighting for each criterion was determined through direct interviews with the officials of Petuaran Hilir Village, who possess in-depth knowledge of the community's conditions and the priorities in social aid distribution. This process was participatory and based on consensus, in which the authorities provided assessments of the importance level of each criterion. The weights were assigned on a scale of 1 to 100 and then normalized for use in the SMART method calculations. This approach was chosen to ensure that the evaluation accurately and objectively reflects local conditions and needs [18].

After the weights are assigned, the next step is to calculate the normalized criteria weights by dividing each criterion's weight by the total weight of all criteria according to the following equation [19].

$$\text{Normalized Weight} = \frac{W_j}{\sum W_j}$$

Where :

W_j : Criterion weight score

$\sum W_j$: Total weight of all criteria

The utility value depends on the type of each criterion, as follows [20]:

For criteria where “the lower the value, the better” (cost criteria), the utility value is calculated using:

$$u_i(ai) = \frac{C_{max} - C_{out}}{C_{max} - C_{min}}$$

Where :

$u_i(ai)$: Utility value of the i^{th} criterion for alternative a_i

C_{max} : Maximum value of the criterion

C_{min} : Minimum value of the criterion

C_{out} : Value of the i[th] criterion for alternative a_i

For criteria where "the higher the value, the better" (benefit criteria), the utility value is calculated using:

$$u_i(ai) = \frac{C_{max} - C_{out}}{C_{max} - C_{min}}$$

Where :

$u_i(ai)$: Utility value of the i[th] criterion for alternative a_i

C_{max} : Maximum value of the criterion

C_{min} : Minimum value of the criterion

C_{out} : Value of the i[th] criterion for alternative a_i

The final score is calculated by summing all the products of the normalized weights of the criteria and the normalized utility scores of the criteria, based on standard data, as shown in Equation (4) below [21]:

$$u(a_i) = \sum_{j=1}^{m} W_j * u_j(a_i)$$

Where :

$ui(ai)$: Final score of alternative a_i

W_j : Normalized weight of criterion j

$U_j(a_i)$: Normalized utility value of criterion j for alternative a_i

Ranking is the process of ordering the final scores from the highest to the lowest. The best alternative is the one with the highest final score.

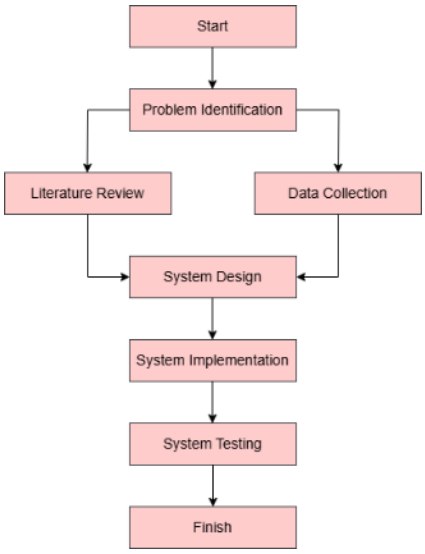

Figure 1. Research Stages

The problem identification stage aims to recognize the issues present in the selection process of social aid recipients. Based on observations and interviews with the officials of Petuaran Hilir Village, it was found that the selection process is still conducted manually and lacks objectivity. This situation leads to a risk of mistargeting and unfairness in the distribution of aid to those in need.

To strengthen the theoretical foundation of this research, a literature review was conducted. The reviewed literature includes the concept of Decision Support Systems (DSS), the SMART (Simple Multi-Attribute Rating Technique) method as a multi-criteria decision-making approach, and previous relevant studies in the areas of social aid distribution and the development of computer-based systems.

Data for the study was collected through interviews with village officials, documentation, and the distribution of questionnaires. The collected information includes eligibility criteria for aid recipients such as income level, number of dependents, housing conditions, and employment status. Additionally, data on potential aid recipients was gathered to be used in the system testing phase.

The system was designed using a modular approach, covering the design of the user interface, database structure, and the calculation logic based on the SMART method. Each criterion was assigned a weight according to its level of importance, and the system was built to calculate the final score of each candidate. These scores were then used to determine the priority order for aid distribution. Figure 2 shows the system flowchart that illustrates the data flow from input to output in the decision support system using the SMART method.

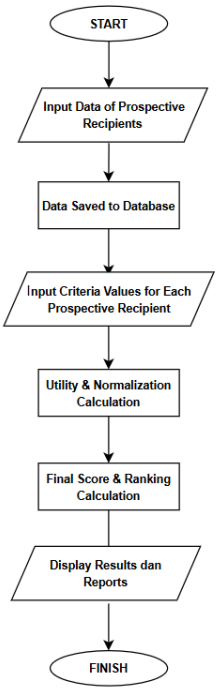

Figure 2. System Flowchart

The implementation stage involved the development of the system based on the previously prepared design. The system was developed using the PHP programming language, with testing and development carried out locally using Laragon. MySQL was used as the database management system to store information related to criteria, alternatives, and calculation results. For the user interface, the Bootstrap framework was utilized, along with libraries such as jQuery, Chart.js, and Datatables to support interactive displays and data visualization. In addition, the system employed CSS for more efficient styling management. The SMART method was integrated into the system to enable an automated, efficient, and objective selection process for aid recipients.

Once the system was developed, testing was conducted using the black-box method to evaluate its functionality and result accuracy. Additionally, the system's output was compared with the manual selection results provided by the village officials as a form of validation. The purpose of this testing stage was to ensure that the system can deliver accurate recommendations and is feasible for use in fair and well-targeted aid distribution.

3. Result and Discussions

In this study, five main criteria are used as the basis for decision-making: income, number of dependents in the family, home ownership status, housing condition, and the type of occupation of the head of the household. Each of these criteria plays an important role in assessing the eligibility of social aid recipients.

Each criterion has its own characteristics that influence the evaluation process. Therefore, the criteria are categorized into two assessment groups: benefit and cost. Details regarding the criteria scheme and the conversion of sub-criteria are further explained in Table 1 and Table 2.

Tabel 1. Criteria Data

Criteria Code	Criteria	Type of Criteria	Weight
C1	Income	Cost	35
C2	Number of Dependents	Benefit	25
C3	Home Ownership Status	Cost	15
C4	Housing Condition	Cost	15
C5	Occupation	Cost	10

Tabel 2. Sub-Criteria Data

Criteria	Sub Criteria	Weight
Income	< Rp.500.000	2
	Rp.500.00- Rp1.000.000	4
	Rp.1.000.001 - Rp.1.500.000	6
	Rp.1.500.001 - Rp.2.000.000	8
	>Rp.2.000.000	10
Number of Dependents	>5 People	10
	4 People	8
	3 People	6
	2 People	4
	1 People	2
Home Ownership Status	No House (living with relatives)	4
	Rent/Lease	7
	Own House	10
Housing Condition	Very Inadequate	2
	Inadequate	4
	Fairly Adequate	6
	Livable	8
	Very Livable	10
Occupation	Unemployed	2
	Daily Laborer	4
	Farmer / Small-Scale Fisherman	6
	Non-Permanent Employee	8
	Civil Servant / Permanent Employee	10

After all the data for alternatives and criteria have been collected, the next step is to apply the SMART (Simple Multi-Attribute Rating Technique) method to the data. This process is used to support decision-making in determining candidates for social assistance among underprivileged families.

Several criteria used in this study are qualitative in nature, such as home ownership status, housing condition, and the occupation of the head of the household. Therefore, these qualitative values need to be converted into numerical form to allow for systematic processing. The results of this qualitative-to-quantitative conversion are presented in Table 3.

Tabel 3. Criteria Value Conversion

No	Name	C1	C2	C3	C4	C5
1	Mahyuni	4	2	10	8	4
2	Aneka	10	6	10	10	10
3	Yudi	10	8	10	10	10
4	Juriansyah	10	2	4	8	4
5	Fauzi	10	4	4	8	10
6	Agus	10	6	10	10	4
7	Anto	10	4	10	10	4
8	Sholehat	10	2	10	10	4
9	Subur	10	4	10	10	4
10	Marno	10	4	10	8	4
11	Weni	4	4	10	6	4
12	Terimo	6	6	10	6	4
13	Adi	10	4	7	6	4
14	Kaderik	6	6	10	6	4
15	Boimen	6	2	10	8	4

Based on the characteristics of each criterion, the number of dependents is categorized as a benefit, while income, home ownership status, housing condition, and type of occupation are classified as costs, since lower values are considered more eligible. The utility value for each type of criterion is calculated using the formulas previously explained in the methodology section.

Tabel 4. Utility Value

No	Name	C1	C2	C3	C4	C5
1	Mahyuni	1	0	0	0.5	1
2	Aneka	0	0.666	0	0	0
3	Yudi	0	1	0	0	0
4	Juriansyah	0	0	1	0.5	1
5	Fauzi	0	0.333	1	0.5	0
6	Agus	0	0.666	0	0	1
7	Anto	0	0.333	0	0	1
8	Sholehat	0	0	0	0	1
9	Subur	0	0.333	0	0	1
10	Marno	0	0.333	0	0.5	1
11	Weni	0	0.333	0	1	1
12	Terimo	0	0.666	0	1	1
13	Adi	0	0.333	0.5	1	1
14	Kaderik	1	0.666	0	1	1
15	Boimen	0.666	0	0	0.5	1

After all the criteria values have been converted and calculated using the utility function, the final step is to multiply each utility value by the corresponding criterion weight, and then sum the results. This final score is used to determine who is eligible to receive the assistance.

Tabel 5. Final Value

Rank	Nama	C1	C2	C3	C4	C5	Vinal Value
1	Weni	0.35	0.83	0	0.15	0.1	0.68
2	Terimo	0.23	0.16	0	0.15	0.1	0.65
3	Kaderik	0.23	0.16	0	0.15	0.1	0.65
4	Mahyuni	0.35	0	0	0.07	0.1	0.52
5	Adi	0	0.08	0.07	0.15	0.1	0.40
6	Boimen	0.23	0	0	0.15	0.1	0.40
7	Juriansyah	0	0	0.15	0	0.1	0.32
8	Fauzi	0	0.08	0.15	0	0.1	0.30
9	Agus	0	0.16	0	0	0.1	0.26
10	Marno	0	0.08	0	0	0.1	0.258
11	Yudi	0	0.25	0	0	0	0.25
12	Anto	0	0.08	0	0	0.1	0.18
13	Subur	0	0.08	0	0	0.1	0.18
14	Aneka	0	0.16	0	0	0	0.16
15	Sholehat	0	0	0	0	0.1	0.1

Below are the features of the web-based decision support system (DSS) for determining recipients of social assistance that we have developed. The following section discusses the implementation SMART. This page serves as the entry point for users to access the SMART DSS. Users are required to enter their username and password.

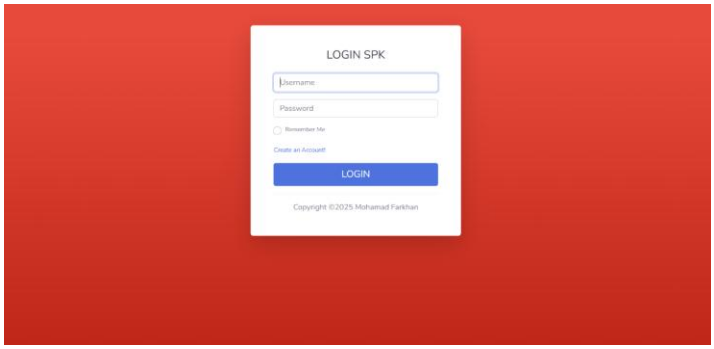

Figure 3. Login Page

After a successful login, users are directed to the dashboard. This page displays a summary of the number of members, criteria, scores, and final results. It also provides a brief description of the SMART method.

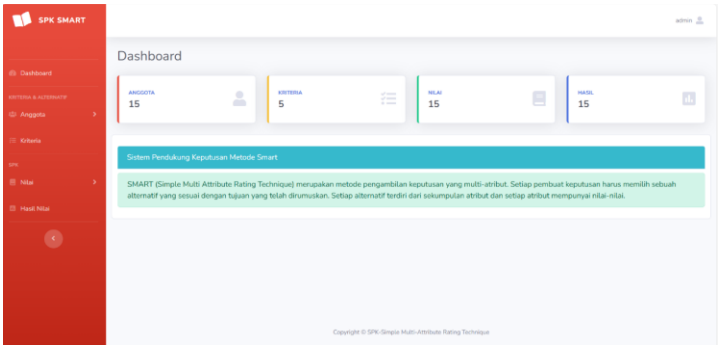

Figure 4. Dashboard Page

This page is used to add data for potential social assistance recipients. The provided form includes fields such as name, income, number of dependents, home ownership status, housing condition, and occupation. The added data are displayed in a table that allows users to easily view, edit, or delete member records.

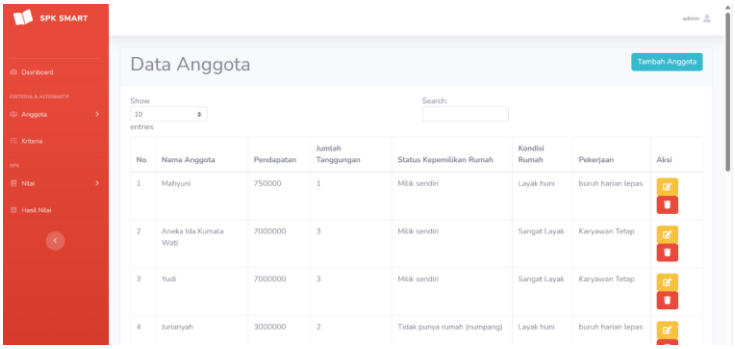

Figure 5. Member Records Page

The criteria page is used to manage the criteria data applied in the SMART calculation. Here, users can add, edit, or delete criteria that form the basis of the decision-making process, such as income, number of dependents, home ownership status, housing condition, and occupation.

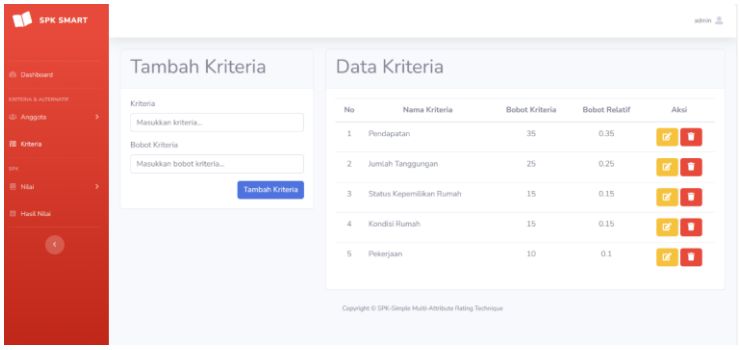

Figure 6. Criteria Page

This page allows users to input the scores for each predefined sub-criterion. The assessment includes several aspects such as income, number of dependents, home ownership status, housing condition, and occupation. Once entered, the data are displayed in a score table to facilitate easy viewing and management.

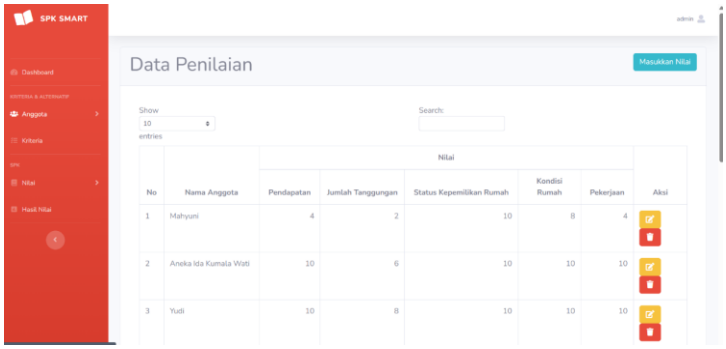

Figure 7. Score Data Page

This page displays the final calculation results using the SMART (Simple Multi-Attribute Rating Technique) method. Each member is shown along with the utility value for each criterion and the final score, which serves as the basis for ranking candidates eligible for social assistance.

Figure 8. Results Page

Based on the results of the SMART method calculation for determining potential recipients of social assistance, a final score and ranking were obtained for each alternative (resident's name) based on the utility value of each criterion. From the final results, it can be observed that the higher the total score, the more eligible a person is considered for receiving the assistance. This score is the accumulation of utility values from the criteria: income, number of dependents, home ownership status, housing condition, and occupation. The score distribution also indicates that the combination of values from cost and benefit attributes has a significant impact on the final outcome. For example, participants with highcost values and low benefit values tend to have lower final scores. Conversely, a combination of lowcost values and high benefit values results in better scores.

4. Conclusions and Future Works

This study successfully developed a Decision Support System (DSS) using the SMART method to assist in determining social assistance recipients in Petuaran Hilir Village. By integrating five main criteria—income, number of dependents, home ownership status, housing condition, and type of employment—the system was able to produce recipient rankings that are more objective and accurate compared to manual methods. The testing results showed significant improvements in transparency and fairness during the decision-making process. Additionally, the system achieved 100% accuracy when validated against manual selection results conducted by village officials, demonstrating its reliability. Most notably, the system was able to reduce the time required for the recipient selection process by up to 70%, enabling faster and more efficient aid distribution. Despite its many advantages, the system still relies on manual data input, which may limit its scalability. Therefore, future developments can be directed toward the following key aspects. Integration with National Databases: Connecting the system with real-time population data from national databases such as electronic ID (e-KTP) or social registries like DTKS would expedite the verification process and improve data accuracy. Mobile-Friendly Version: Developing a mobile or responsive version would enable field officers and village staff in remote areas or those with limited computer access to use the system more effectively. Machine Learning Integration: Applying machine learning algorithms to dynamically optimize the weights of criteria based on historical data or changing socio-economic conditions could enhance the system's adaptability and decision-making quality over time. These developments aim to make the system more automated, scalable, and intelligent, thus providing a fairer and more responsive mechanism for aid distribution at both local and national levels.

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