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Decision Support System for Eligibility of Subsidized Livable Housing Using Simple Additive Weighting Method in Pulo Village

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ABSTRACT

Decision Support Systems (DSS) have been widely implemented in various human activities, particularly in determining eligibility for subsidized livable housing in Gampong Pulo, Samudera District, North Aceh Regency, Aceh Province, Indonesia. Currently, the evaluation process for determining eligibility for subsidized livable housing does not adhere to established criteria and relies solely on reports from the Hamlet Head and estimates, without valid supporting data. This Decision Support System is designed to facilitate decision-making in determining eligible recipients for subsidized livable housing using the Simple Additive Weighting (SAW) method. The tools employed include UML (Unified Modeling Language), with PHP (Personal Home Page) as the programming language and MySQL as the database. The results of this study demonstrate that the system simplifies the evaluation process for Gampong Pulo officials in determining eligibility for subsidized livable housing according to set criteria. This system offers several advantages over the current system, such as faster determination of aid recipients.

Keywords: Decision Support System, Subsidized Livable Housing, Simple Additive Weighting, MySQL

1. INTRODUCTION

The provision of subsidized livable housing is a critical component of social welfare programs aimed at improving living standards, particularly for low-income communities (1). In Gampong Pulo, located in the Samudera District of North Aceh Regency, Aceh Province, Indonesia, the process of determining eligibility for such housing has historically been fraught with challenges. Decisions have often been based on subjective reports from Hamlet Heads and rough estimates rather than on objective, data-driven criteria. This lack of a structured evaluation system has led to inconsistencies and potential unfairness in the distribution of housing assistance (2).

To address these issues, the implementation of a Decision Support System (DSS) can play a pivotal role. A DSS can enhance the decision-making process by providing a systematic approach to evaluating and selecting eligible recipients based on predefined criteria. Among the various methods available for decision support, the Simple Additive Weighting (SAW) method stands out for its simplicity and effectiveness in handling multiple criteria decision analysis (3).

This study aims to design and develop a DSS using the SAW method to streamline the process of determining eligibility for subsidized livable housing in Gampong Pulo. The system utilizes Unified Modeling Language (UML) for design, PHP for development, and MySQL for database management (4),(5). By leveraging these tools, the system aims to provide a transparent, efficient, and fair mechanism for evaluating and selecting housing aid recipients.

The introduction of this DSS is expected to offer several advantages over the current manual system. Primarily, it will ensure that decisions are made based on comprehensive and accurate data, thereby reducing bias and increasing fairness (6). Additionally, the system will expedite the evaluation process, making it possible to determine aid recipients more quickly and efficiently (7). Ultimately, the adoption of this

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technology-driven approach is anticipated to significantly improve the effectiveness of housing assistance programs in Gampong Pulo (8),(9),(10).

This paper is structured as follows: The next section reviews related work and the theoretical background of the SAW method. Following that, the methodology section details the design and implementation of the DSS. The results and discussion section presents the findings and evaluates the system's performance. Finally, the conclusion summarizes the contributions of this study and suggests directions for future research.

2. METHOD

The Simple Additive Weighting (SAW) method is a widely used multi-criteria decision-making (MCDM) technique. It is chosen for this project due to its simplicity, ease of implementation, and effectiveness in handling various decision criteria. The SAW method involves several key steps: normalization, weighting, aggregation, and ranking. Below are the detailed steps involved in the SAW method as applied in this study as shown in Figure 1.

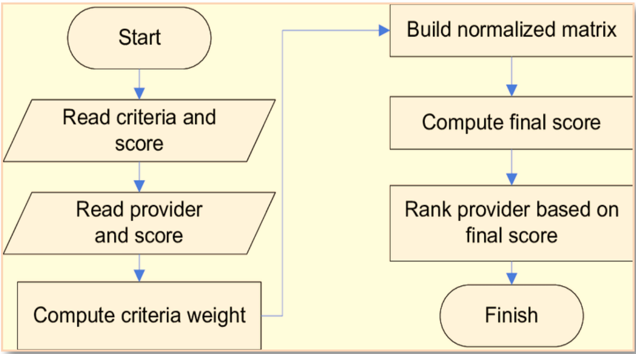

Figure 1. Research Method

2.1 Normalization

Normalization is the process of converting different criteria measurements to a common scale, typically ranging from 0 to 1. This ensures that all criteria contribute equally to the decision-making process, regardless of their original scales. The normalization formula used depends on whether the criterion is a benefit (higher values are better) or a cost (lower values are better):
For benefit criteria (11),(12),(13):

$$r_{ij} = \frac{x_{ij}}{\max x_{ij}} \qquad (1)$$

For cost criteria:

$$r_{ij} = \frac{\min x_{ij}}{x_{ij}} \qquad (2)$$

where r_{ij} is the normalized value of criterion j for alternative $_i$, x_{ij} is the actual value of criterion $_j$ for alternative $_i$, max x_{ij} is the maximum value among all alternatives for criterion j, min x_{ij} is the minimum value among all alternatives for criterion $_j$.

2.2. Weight Assignment

Each criterion is assigned a weight (w_j) representing its relative importance in the decision-making process. These weights are determined through consultations with stakeholders and experts. The sum of all weights should equal 1 (15), (16),(17):

$$\sum_{j=1}^{n} w_j = 1 \qquad (3)$$

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where *n* is the total number of criteria.

2.3 Weighted Sum

For each alternative (household), the normalized values are multiplied by their corresponding weights and summed to obtain a composite score. The formula for calculating the composite score (Si) for alternative i is (18), (19), (20):

$$S_i = \sum_{j=1}^{n} (w_j \cdot r_{ij}) \qquad (4)$$

Where *Si* is the composite score for alternative *i*, w*j* is the weight of criterion j, r*ij* is the normalized value of criterion *j* for alternative *i*.

2.4 Ranking

The alternatives (households) are ranked based on their composite scores. Higher scores indicate higher priority for receiving subsidized livable housing. The households are then prioritized for assistance based on these rankings.

3. RESULTS AND DISCUSSION

The following is an overview of the research findings on the Decision Support System (DSS) for determining eligibility for subsidized livable housing using the Simple Additive Weight (SAW) method.

3.1 Criteria Data

Table 1. Criteria

Criteria (Ci)	Description	Attribute	Weight
C1	Building Area	Benefit	15
C2	Wall Condition	Benefit	10
C3	Roof Condition	Cost	8
C4	Floor Condition	Benefit	7
C5	Occupation	Benefit	6
C6	Income	Benefit	5

Table 1 shows the criteria used for determining eligibility for subsidized livable housing. Each criterion is assigned a predefined weight.

3.2 Results of the Simple Additive Weighting (SAW) method calculations

Here are the results of the Simple Additive Weighting (SAW) method calculations:

$$R = \left\{ \begin{matrix} 1 & 1 & 0{,}25 & 1 & 1 & 1 \\ 0{,}8 & 0{,}8 & 0{,}875 & 0{,}8 & 0{,}8 & 0{,}8 \\ 0{,}7 & 0{,}75 & 1 & 0{,}75 & 0{,}8 & 0{,}8 \\ 0{,}7 & 0{,}8 & 0{,}7 & 0{,}8 & 0{,}7 & 0{,}75 \\ 0{,}8 & 0{,}75 & 0{,}875 & 0{,}75 & 1 & 0{,}8 \\ 0{,}8 & 0{,}75 & 1 & 0{,}8 & 1 & 0{,}8 \\ 0{,}8 & 0{,}75 & 0{,}875 & 0{,}8 & 0{,}8 & 0{,}75 \\ 0{,}8 & 0{,}8 & 0{,}875 & 0{,}8 & 1 & 0{,}8 \\ 0{,}8 & 1 & 0{,}7 & 1 & 1 & 0{,}75 \\ 0{,}8 & 0{,}8 & 0{,}875 & 0{,}8 & 0{,}8 & 0{,}75 \end{matrix} \right\}$$

Figure 2. Results of the normalization matrix calculations

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Next, we calculate the preference values. The vector W represents the predetermined weight values:

W = [15;10;8;7;10;5].

Here are the calculations:

V1 = (15x1) + (10x1) + (8x0,7)+ (7x1)+(10x1)+(5x1) = 52.6

V2 = (15x0,8)+(10x0,8)+(8x0,875)+(7x0,8)+(10x0.8)+(5x0,8) = 44.6

V3 = (15x0,7)+(10x0,75)+(8x1)+(7x0,75)+(10x0,8)(5x0,8) = 43.45

V4 = (15x0,7) + (10x0,8) + (8x0,7)+ (7x0,7)+(10x0,8)+(5x0,8) = 40.45

V5 = (15x0,8)+(10x0,75)+(8x0,875)+(7x0,75)+(10x1)+(5x0,8) = 45.75

V6 = (15x0,8)+(10x0,75)+(8x1)+(7x0,8)+(10x1)(5x0,8) = 47.1

V7 = (15x0,8) + (10x0,75) + (8x0,875)+ (7x0,8)+(10x1)+(5x0,8) = 43.85

V8 = (15x0,8)+(10x0,8)+(8x0,875)+(7x0,8)+(10x0,8)+(5x0,8) = 44.6

V9 = (15x0,8)+(10x1)+(8x0,7)+(7x1)+(10x1)(5x0,75) = 48.35

V10 = (15x0,8) + (10x10,8+ (8x0,875)+ (7x0,8)+(10x0,8)+(5x0,75) = 44.35

From the multiplication of matrices W×R, the final decision values are obtained as follows:

Table 2. Ranking Results

Alternatif	Ranking Result	Ranking
Nuraini	52.6	1
Nurdin	48.35	2
Rohani	47.1	3
Ibrahim	46.6	4
M. Yunus	45.75	4
Mayedin	44.6	5
Hasbalah	44.35	6
Razali	43.85	7
M. Rasyib	43.25	8
Sakdiah	40.45	9

Table 2 displays the ranking results. After conducting the ranking process among V1, V2, V3, V4, V5, V6, V7, V8, V9, and V10, the highest score was achieved by V1, as seen in the limit values table. The final score of the SAW method shows that the eligible recipient of the subsidized housing is V1, Nuraini, with the highest score of 52.6. The results page of the calculation shows data ranked from highest to lowest score, where individuals with the highest scores will qualify as recipients of the subsidized housing.

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3.3 Implementation

Figure 3. System Implementation

3.4 Testing

The testing phase aims to verify if each system function operates according to the design specifications. Black box testing was employed during this phase. Below are the results of the black box testing conducted:

Table 3. Test Results

Description	Expected Outcome	Actual Outcome
User login	User successfully logs in with correct username and password	Successful
Click criteria button	Displays criteria data	Successful
Click subcriteria button	Displays subcriteria data	Successful
Click alternatives button	Displays alternative data	Successful
Click assessment button	Displays assessment page	Successful
Click calculation button	Displays calculation data	Successful
Click final result button	Displays final result	Successful
Click logout button	Logs out from the system	Successful

This table summarizes the expected and actual outcomes of each black box test conducted on the system's functionalities.

4. CONCLUSIONS

Based on the research conducted to develop the Decision Support System (DSS) for determining eligible recipients of subsidized livable housing in Pulo Village, Samudera District, the study concludes that the system significantly enhances efficiency and accuracy in decision-making processes. By employing the Simple Additive Weighting (SAW) method, the DSS ensures transparent and fair allocation based on objective criteria and predefined weights for each criterion. Results indicate improved operational efficiency, user satisfaction with system usability, and timely provision of housing assistance to deserving residents. Overall, the DSS represents a crucial advancement in managing subsidized housing allocations, fostering equitable distribution and enhancing community welfare in Pulo Village.

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