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ANALYSIS OF THE DETERMINATION OF NON-CASH FOOD ASSISTANCE RECIPIENTS IN PRENDUAN VILLAGE USING THE SIMPLE ADDITIVE WEIGHTING METHOD

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(SPK) Decision Support System,
Metode Simple Additive Weighting,
Non-Cash Food Assistance.

Abstract

The Non-Cash Food Assistance Program (BPNT) is a national program of the Ministry of Social Affairs of the Republic of Indonesia that aims to distribute basic food assistance to the underprivileged in a targeted manner. However, in Prenduan Village, Pragaan District, Sumenep Regency, the selection process for prospective recipients is still carried out manually through RT proposals and simple verification without a standardized decision support system. This leads to subjectivity, long processes, and the potential for inaccuracy of targets, where the people who have the right are not recorded or vice versa. This research aims to design and build a web-based decision support system with the Simple Additive Weighting (SAW) method to support selection in an objective, transparent, measurable, and computerized manner. The criteria used include income, occupation, number of dependents, floor area, floor type, wall type, roof type, electrical power, and land ownership status. Each criterion is weighted based on the level of importance according to applicable guidelines. The system was tested using 150 potential recipient data, with 50% or 75 people designated as recipients based on the highest SAW ranking score. Black-box testing was performed on six scenarios: admin login, criteria input, filling in the score, validating data, calculating SAW, and displaying ranking results, with a 100% success rate. The results of the system's ranking are also proven to be 100% consistent compared to manual calculations. Thus, this system is expected to be able to increase accountability, transparency, and accuracy of BPNT distribution targets at the village level, as well as become a solution to social assistance selection problems in other regions. Web-based SAW implementation has proven to be effective and efficient in supporting fairer and more measurable decision-making for underprivileged communities.

INTRODUCTION

The development of information technology has brought significant changes in various sectors, including village government. The manual decision-making process is now starting to shift to computer-based systems to be more structured, transparent, and accountable (Supriadi et al., 2021)(Fikri et al., 2022)(An'syah & Widyasari, 2024). One of the uses of this technology is the Decision Support System (SPK), which is a computer-based system that assists the decision-making process through data processing and the application of certain methods objectively (Ridwan & Hadi, 2024)(Pradana et al., 2024). SPK functions as a tool so that the decisions taken are more rational and accountable, not to replace the role of human beings (Padli et al., 2024)(Vafaei et al., 2021). In village government, the implementation of SPK is very relevant to the selection process of social assistance recipients which requires accuracy and information disclosure (Azhari, 2024)(Rita & Guslendra, 2024).

The Non-Cash Food Assistance Program (BPNT) is a priority program of the Ministry of Social Affairs that aims to ensure that the food needs of the underprivileged community are met in a targeted manner. This program has been running in Prenduan Village since 2017 with 150 prospective recipients. However, the selection process is still carried out manually through RT proposals and simple verification without a computerized system, resulting in inaccuracies in targets, overlapping data, and potential social jealousy. Paper-based record-keeping also makes verification slow, poorly documented, and difficult to evaluate.

Previous research proves that SPK is able to produce more objective recommendations than manual processes (Wajida et al., 2025)(Hiswara et al., 2022)(Asameta et al., 2024). The Simple Additive Weighting (SAW) method is often chosen because it produces clear preference values and a transparent ranking process. Web-based SPK has also been proven to speed up and streamline the BPNT selection process (Djutalov, 2023)(An'syah & Widyasari, 2024)(Wajida et al., 2025)(Hiswara et al., 2022). However, previous studies have not accommodated specific assessment criteria in accordance with the socio-economic conditions of rural communities in Sumenep Regency, especially in Prenduan Village which has its own characteristics and problems. In addition, until now there is no web-based system specifically designed to assist local village officials in selecting BPNT recipients in a computerized, documented, and easily accessible manner.

Based on the research gap, this study aims to design and build a web-based Decision Support System using the Simple Additive Weighting (SAW) method to determine BPNT recipients in Prenduan Village in a more objective and transparent manner. The novelty of this research lies in the use of nine assessment criteria that are adjusted to the socio-economic conditions of the local community, including income, occupation, number of dependents, floor area, type of floor, type of wall, type of roof, electrical power, and land ownership status. With this system, the selection process for prospective BPNT recipients is expected to take place faster, objectively, transparently, and accountably, so that the distribution of non-cash food assistance is really on target for the people who are most entitled to receive it.

LITERATURE REVIEW

The research conducted by Suherwin and Junaid (2025) entitled "Decision Support System for Non-Cash Food Assistance Recipients Using the Simple Additive Weighting Method" applied the SAW method in the selection of BPNT recipients in Bontoduri Village, Makassar City. The results of the study prove that SAW-based SPK has proven to be effective in increasing accuracy and efficiency in the selection process and distribution of social assistance (Suherwin & Junaid, 2025).

The research conducted by Nisa, Irawan, and Wahyuningsih (2024) entitled "Decision Support System for Non-Cash Food Assistance Receipt Applying the Simple Additive Weighting (SAW) Method" used the SAW method to determine BPNT recipients in Silang Village, Brebes Regency with 5 assessment criteria. The results of the study showed that the system was able to produce a ranking of prospective BPNT recipients with the highest preference value of 1.00 (Nisa et al., 2024).

Research conducted by Riyansuni and Devitra (2020) entitled "Analysis and Design of Decision Support System for Non-Cash Food Assistance Recipients (BPNT) with Simple Additive Weighting (SAW) at the Jambi City Social Service" proves that the design of SAW-based SPK is able to significantly accelerate and streamline the selection process for BPNT recipients (Riyansuni & Devitra, 2020).

Decision Support System (SPK) is a computer-based system designed to help the decision-making process through data processing and the application of certain methods. SPK is not intended to replace human roles, but rather as a tool to make decisions more rational, objective, and accountable(Rahmansyah & Lusinia, 2021)(Winarno et al., 2024). In this study, SPK is used as the basis for system development to assist the Prenduan Village apparatus in determining prospective BPNT recipients in a more structured and transparent manner.

The Simple Additive Weighting (SAW) method is a weighted addition method that seeks the sum of the performance ratings of each alternative based on the assigned attributes (Riyansuni & Devitra, 2020; Right, 2021). This method normalizes the decision matrix by distinguishing the benefit and cost criteria, then calculates the preference value by multiplying each normalization result to the criterion weight and summing it as the basis for ranking.

Non-Cash Food Assistance (BPNT) is food social assistance that is distributed non-cash to Beneficiary Families (KPM) every month through an electronic account, which is used to buy food at E-Warong. The main goal is to build social protection based on food security for the poor so that household food needs are met in a structured and sustainable manner (Dara Citra Pratiwi & Imsar, 2022; Sukma, 2025). Understanding this mechanism is the basis for determining the selection criteria for KPM who are truly entitled to receive assistance in Prenduan Village.

RESEARCH METHODS

A. Research Stages

This research aims to design and build a web-based SPK with the SAW method to determine BPNT recipients in Prenduan Village. The research stages include problem identification, literature study, data collection, data analysis, SAW method test, and results, as shown in Figure 1 below.

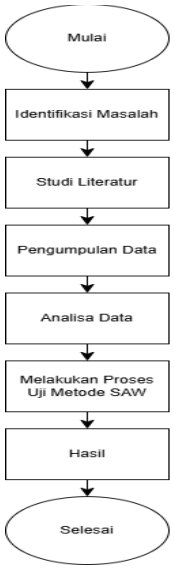

Image 1 Research Stage

1. Problem Identification: Conducting direct observation of the selection process of BPNT recipients in Prenduan Village which is still running manually and has not been computerized.
2. Literature Study: Reviewing relevant journals, books, and previous research related to SPK and the SAW method as a theoretical foundation.
3. Data Collection: Collect data through village documentation, interviews with village officials, and field observations to obtain data on 150 prospective BPNT recipients along with nine assessment criteria.
4. Data Analysis: Determine the criteria, weight of assessment, and compile a decision matrix as the basis for the calculation of SAW.
5. SAW Method Test Process: Normalize the decision matrix, calculate preference values, and rank alternatives from highest to lowest.
6. Results: Produced a web-based decision support system that is able to display the ranking of prospective BPNT recipients automatically and objectively.

Data was collected through village documentation, interviews, and field observations of 150 prospective BPNT recipients. A total of 75 people (50%) were designated as recipients based on the results of the SAW ranking.

B. Analysis of Criteria and Subcriteria

The criteria for determining BPNT recipients in Prenduan Village amounted to 9 variables that refer to the regulations of the Ministry of Social Affairs and field observations. Each criterion has a weight and *cost* or *benefit* attribute as shown in Table 1. The total weight of all criteria is 1.00 (100%).

Table 1 Weight Criteria and Values

Code	Criteria Name	Value Weight	Attributes
C01	Income	0.15	Cost
C02	Jobs	0.10	Benefit
C03	Number of dependents	0.10	Benefit

Code	Criteria Name	Value Weight	Attributes
C04	Floor Area	0.05	Cost
C05	Floor Type	0.10	Benefit
C06	Wall Type	0.10	Benefit
C07	Roof Type	0.10	Benefit
C08	Electric Power	0.05	Cost
C09	Land Title Certificate	0.25	Benefit

The subcriteria of each criterion are detailed in Table 2 with a value range of 1–5, where the value of 5 = most feasible and the value of 1 = least feasible. For cost criteria (C01, C04, C08), the normalization of the SAW will reverse the value automatically. A value of 0 on C09 is given as a penalty for the condition of "Not Owning" the land.

Table 2 Subcriteria and Values

Code	Criteria	Subcriteria (Values)
C01	Income	< Rp500,000 (5); IDR 500,000–IDR 1,000,000 (4); IDR 1,000,000–IDR 2,000,000 (3); IDR 2,000,000–IDR 4,000,000 (2); > IDR 4,000,000 (1)
C02	Jobs	Does not work (5); Freeladies/daily workers (4); Small entrepreneurs (3); Medium Entrepreneurs (2); Civil Servants/Permanent Workers (1)
C03	Number of dependents	> 5 (5) people; 4–5 people (4); 3 (3) people; 2 (2) people; 0–1 person (1)
C04	House Floor Area	< 20 m² (5); 20–<30 m² (4); 30–<40 m² (3); 40–<60 m² (2); ≥ 60 m² (1)
C05	Floor Type	Soil/Bamboo (5); Cement/Coarse Board (4); Rough ceramics (3); Medium ceramics (2); Granite/Luxury (1)
C06	Wall Type	Bamboo/Deck (5); Medium wood (4); Brick without plaster (3); Plastered bricks (2); Reinforced Walls/Concrete (1)
C07	Roof Type	Straw/Leaves (5); Bamboo/Asbestos Thin (4); Thin zinc (3); Medium zinc/Ground tiles (2); Ceramic/Concrete Tiles (1)
C08	Electric Power	Tidak Berlistrik (5); 450 VA (4); 900 VA (3); 1.300 VA (2); > 1,300 VA (1)
C09	Land Ownership Status	Own (5); Permits (3); None (0)

C. Implementation of the Simple Additive Weighting Method

The Simple Additive Weighting (SAW) method is used to determine the ranking of prospective BPNT recipients in Prenduan Village. The steps for calculating SAW are as follows:

- Step 1: Determining the Result Matrix (X)

The decision matrix is formed from the value of each alternative against each criterion. In this study, there are 150 alternatives (prospective recipients) and 9 criteria (C01–C09).

- Step 2: Normalization of the Matrix (R)
  Normalization is carried out based on the type of criterion attributes, with the formula:
  1. For the benefit criteria:
  $$r_{\{ij\}} = \frac{xij}{max(xij)} \qquad (1)$$
  2. For cost criteria:
  $$\boldsymbol{r_{\{ij\}} = \frac{min(xij)}{xij}} \qquad (2)$$
  Description:
  - *RIR* = Alternative Normalization Value I in the Jth Criterion
  - X_{ij}= the original value of the ith alternative to the jth criterion
  - $\max X_{ij}$= the maximum value of all alternatives in the J criterion
  - $\min X_{ij}$= the minimum value of all alternatives in the J criterion
- Step 3: Calculate the Preference Value (V)
  The preference value of each alternative is calculated by adding the result of multiplication between the normalization value and the weight of the criteria:
  $$\boldsymbol{V_i = \sum_{j=1}^{n} (w_j r_{ij})} \qquad (3)$$
  Description:
  Vi = the value of the i alternative preference
  Wj = J criterion weight
  RIR = Alternative Normalization Value I in the Jth Criterion
  n = number of criteria
- Step 4: Ranking
  All alternatives are sorted by the highest preference value. The alternative with the highest score is the most deserving prospective BPNT recipient. A total of 75 people (50%) of the 150 candidates were determined as recipients based on the ranking.

RESULTS AND DISCUSSION

A. Results of the SAW Method Calculation

1. Prospective Recipient Assessment Data
   The assessment data for prospective BPNT recipients consists of 150 alternatives with 9 criteria. The following is the assessment data for 5 prospective recipients as a sample calculation:

Table 3 Assessment of Prospective Recipients

No	Alternatif	C1	C2	C3	C4	C5	C6	C7	C8	C9
1	MOH JAKFAR	4	4	3	2	1	3	2	1	3
2	ABD. FAQIH	1	3	3	3	4	5	3	5	0
3	ZUBAIDI	3	2	3	1	4	3	2	5	0
4	APRILIYANTO DWI S.	4	5	4	3	3	4	4	4	5
5	Abu Siri	5	2	3	5	2	2	3	5	3

2. SAW Formula
   Normalization is carried out using a formula for *cost* and *benefit attributes:*
   1) Cost Formula for Criteria (C1, C4, C8)::

$$r_{\{ij\}} = \frac{min(xij)}{xij} \qquad (1)$$

   2) Benefit Formula for Criteria (C2, C3, C5, C6, C7, C9):

$$r_{\{ij\}} = \frac{xij}{max(xij)} \qquad (2)$$

   3) Preference Formula:

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

3. Normalization Calculation Results
   The following table shows the results of normalizing the values of each alternative based on the subcriteria using the SAW method.

Table 4 Normalization Calculation Results

No	Old	C1	C2	C3	C4	C5	C6	C7	C8	C9
1	A1	0.25	0.80	0.75	0.50	0.25	0.60	0.50	1.00	0.60
2	A2	1.00	0.60	0.75	0.3333	1.00	1.00	0.75	0.20	0.00
3	A3	0.3333	0.40	0.75	1.00	1.00	0.60	0.50	0.20	0.00
4	A4	0.25	1.00	1.00	0.3333	0.75	0.80	1.00	0.25	1.00
5	A5	0.20	0.40	0.75	0.20	0.50	0.40	0.75	0.20	0.60

4. Preference Results
   After the normalization process is carried out, each normalization value is multiplied by the weight of the criteria to obtain the preference value. The weights used refer to the criterion table C1=0.20; C2=0.10; C3=0.10; C4=0.10; C5=0.10; C6=0.10; C7=0.10; C8=0.05; C9=0.15.
   The following are the results of the calculation of the preference value for each prospective BPNT recipient:

Table 5 Preference Calculation Results

No	Alternatif	Calculation	Value Preferences
1	A1	(0,25 × 0,20) + (0,80 × 0,10) + (0,75 × 0,10) + (0,50 × 0,10) + (0,25 × 0,10) + (0,60 × 0,10) + (0,50 × 0,10) + (1,00 × 0,05) + (0,60 × 0,15)	**0,5525**
2	A2	(1,00 × 0,20) + (0,60 × 0,10) + (0,75 × 0,10) + (0,33 × 0,10) + (1,00 × 0,10) + (1,00 × 0,10) + (0,75 × 0,10) + (0,20 × 0,05) + (0,00 × 0,15)	**0,5867**
3	A3	(0,33 × 0,20) + (0,40 × 0,10) + (0,75 × 0,10) + (1,00 × 0,10) + (1,00 × 0,10) + (0,60 × 0,10) + (0,50 × 0,10) + (0,20 × 0,05) + (0,00 × 0,15)	**0,4350**
4	A4	(0,25 × 0,20) + (1,00 × 0,10) + (1,00 × 0,10) + (0,33 × 0,10) + (0,75 × 0,10) +	**0,7717**

No	Alternatif	Calculation	Value Preferences
		(0,80 × 0,10) + (1,00 × 0,10) + (0,25 × 0,05) + (1,00 × 0,15)	
5	A5	(0,20 × 0,20) + (0,40 × 0,10) + (0,75 × 0,10) + (0,20 × 0,10) + (0,50 × 0,10) + (0,40 × 0,10) + (0,75 × 0,10) + (0,20 × 0,05) + (0,60 × 0,15)	**0,4800**

5. Ranking Results
   Based on the results of the calculation of preference values using the SAW method, the ranking results of prospective BPNT recipients were obtained as shown in Table 6 of the Ranking Results below.

Table 6 Ranking Results

Alternatif	Peringkat	Value Preferences
Alt 4	1	0,7717
Alt 2	2	0,5867
Alt 1	3	0,5525
Alt 5	4	0,4800
Alt 3	5	0,4350

Based on the ranking results, Alt 4 obtained the highest preference value of 0.7717 so that it ranks first. In this study, the recipients of assistance were determined as much as 50% of the total prospective recipients. With the number of candidates as many as 5 alternatives in the sample, the 3 alternatives with the highest preference value are recommended as BPNT recipients, namely Alt 4, Alt 2, and Alt 1.

B. Results of Manual System Calculation Accuracy Test
The accuracy test was carried out by comparing the results of the calculation system using the SAW method with manual calculations for 5 data of prospective BPNT recipients. The purpose of this test is to ensure that the system has worked correctly and produces outputs consistent with manual calculations. Based on the results of the comparison, the following data was obtained:

Table 7 Difference in System and Manual Comparison Values

No	Alternatif	System Results	Manual Results	Differences
1	Alt 1	0.5525	0.5525	0.0000
2	Alt 2	0.5867	0.586666667	0.000033333
3	Alt 3	0.4350	0.4350	0.0000
4	Alt 4	0.7717	0.771666667	0.000033333
5	Alt 5	0.4800	0.4800	0.0000
Total Difference				**0.000066666**

From the table above, the total difference between the system output and the manual output is 0.000066666. Error calculation using Mean Absolute Error (MAE) is carried out with the formula:

$$\text{MAE} = \frac{\text{Total Selisih}}{\text{Jumlah Data}} \qquad (1)$$

Based on this formula, the calculation of the error value (MAE) and the accuracy level of the system are obtained as follows:

$$\text{MAE} = \frac{0.000066666}{5} = 0.0000133332$$

The accuracy level of the system is then calculated by the formula:

Accuracy = 100 − (MAE × 100)

Accuracy = 100 − (0.0000133332 × 100) = 99.99866668%

From these calculations, the system accuracy level was obtained of 99.99866668%. These results prove that the decision support system for the selection of BPNT recipients is very precise and reliable. As proof of conformity, a comparison of the system display and manual calculation are presented in Figure 2 of the Preference Value Calculation Results in the System and Figure 3 of the following Manual Calculation Results.

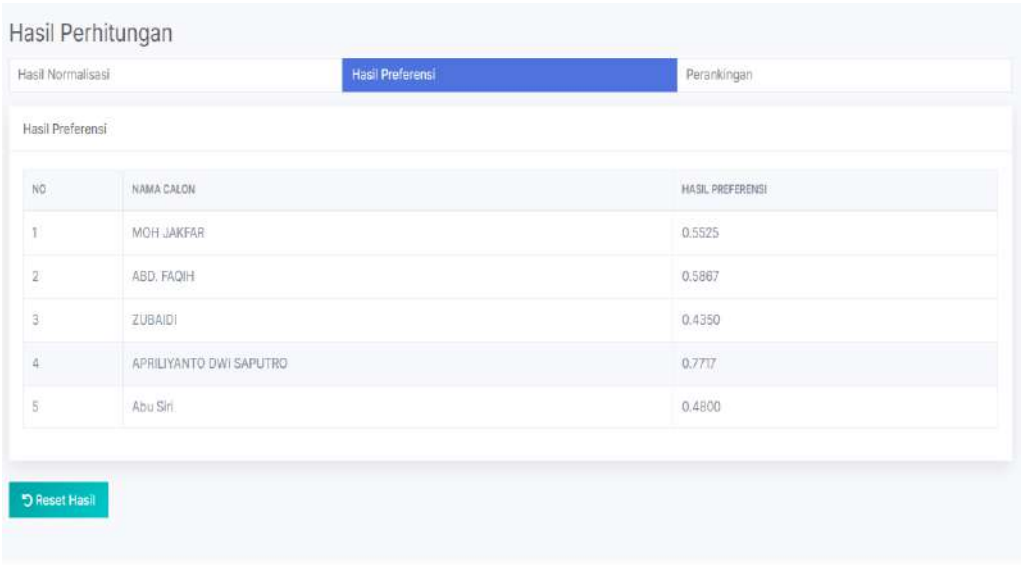

Image 2 Results of Calculation of Preference Values in the System

Rumus Perhitungan SPK Menggunakan Metode SAW
(Studi Kasus: Seleksi Penerimaan Bantuan Pangan Non-Tunai [BPNT] di Desa Prenduan)

cost benefit	cost	benefit	benefit	cost	benefit	benefit	benefit	cost	benefit
Kepentingan	0,15	0,1	0,1	0,05	0,1	0,1	0,1	0,05	0,25
ALTERNATIF/KRITERIA	Penghasilan	pekerjaan	jumlah tanggungan	luas lantai	jenis lantai	jenis dinding	jenis atap	daya listrik	shm
Moh Jakfar	4	4	3	2	1	3	2	1	3
ABD. Faqih	1	3	3	3	4	5	3	5	0
Zubaidi	3	2	3	1	4	3	2	5	0
Aprilyanto Dwi S	4	5	4	3	3	4	4	4	5
Abu Siri	5	2	3	5	2	2	3	5	3
Pembagi	**1**	**5**	**4**	**1**	**4**	**5**	**4**	**1**	**5**
Normalisasi	0,25	0,8	0,75	0,5	0,25	0,6	0,5	1	0,6
	1	0,6	0,75	0,333333333	1	1	0,75	0,2	0
	0,333333333	0,4	0,75	1	1	0,6	0,5	0,2	0
	0,25	1	1	0,333333333	0,75	0,8	1	0,25	1
	0,2	0,4	0,75	0,2	0,5	0,4	0,75	0,2	0,6

Hasil	
0,5525	Moh Jakfar
0,586666667	ABD. Faqih
0,435	Zubaidi
0,771666667	Aprilyanto Dwi S
0,48	Abu Siri

Image 3 Manual Calculation Results

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