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Application of Preference Selection Index Method in DSS for Determining Recipients of BLT-DD

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Abstract

The determination of Village Fund Direct Cash Assistance (BLT-DD) recipients at the village level often relies on manual procedures and subjective judgment, which can lead to inaccurate beneficiary selection and unequal aid distribution. This study implements the Preference Selection Index (PSI) method in a web-based Decision Support System (DSS) to support a more objective, transparent, and accountable BLT-DD recipient selection process in Lemahireng Village. We evaluate it using data from 40 prospective beneficiaries based on eight criteria: monthly income, number of dependents, age, housing status, vehicle ownership, occupation, history of chronic illness, and electricity capacity. This experiment selects the PSI method because it automatically determines criterion weights from data variation, eliminating the need for subjective weighting by decision-makers. We evaluate the proposed system through black-box testing, expert judgment, usability testing using the System Usability Scale (SUS), and a comparison with the Simple Additive Weighting (SAW) method. The black-box testing results show that all system functions operate according to the specified requirements. The expert judgment evaluation achieves a conformity rate of 75% between the system recommendations and the assessments of village officials. In addition, the usability evaluation produces a SUS score of 85.71, which falls into the Excellent category. The comparison between PSI and SAW generates identical ranking positions, confirming the consistency of the proposed approach while preserving the advantage of objective weight determination.

Keywords:
DSS; MCDM; Preference Selection Index; Social Assistance

1. Introduction

Poverty remains one of the major challenges in developing countries, including Indonesia. To mitigate the economic impact on the poor, the Indonesian government implements the Village Fund Direct Cash Assistance (BLT-DD) program, the distribution of which is based on the Integrated Social Welfare Data (DTKS). However, the selection process for aid recipients at the village level is still largely conducted manually through village deliberations, making it prone to subjectivity, inconsistent assessments, and misdirected aid [1][2]. This problem also occurs in Lemahireng Village, where the number of potential recipients exceeds the available aid quota. This situation highlights the need for a more objective, measurable, and transparent selection mechanism to ensure the accurate distribution of social assistance [3].

DSS are one approach that can be used to assist in the selection process for aid recipients through the systematic processing of multi-criteria data [4]. Various Multi-Criteria Decision Making (MCDM) methods, such as SAW, AHP, and WP, have been widely applied in social assistance cases [5][6][7][8]. However, the determination of criterion weights in these methods still depends heavily on expert judgment, which may affect the objectivity and consistency of the final ranking [9][10].

Advances in Artificial Intelligence (AI), particularly Generative AI, have transformed various decision-making processes through their ability to analyze data and provide recommendations automatically. However, in the public service sector, such as determining recipients of social assistance, transparency, accountability, and the ability to easily explain decision outcomes remain key requirements. Unlike AI approaches, which are often viewed as black boxes, the Multi-Criteria Decision Making (MCDM) method offers a more transparent and traceable decision-making process[11]. Therefore, the PSI method remains relevant because it can produce objective decisions that are accountable to stakeholders[12]. Although Generative AI can assist in data analysis and recommendation generation, its decision-making process is often difficult to audit and validate. In social assistance programs such as BLT-DD, decision transparency and explainability are critical because the results affect public welfare and government accountability. Therefore, transparent MCDM approaches such as PSI remain highly relevant and preferable for public-sector DSS.

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The PSI is a MCDM method capable of automatically determining criterion weights based on data variations without requiring manual weighting [13]. This characteristic makes the PSI more objective, efficient, and stable in producing alternative rankings. Previous studies have shown that the PSI performs well in cases of scholarship selection, performance evaluation, and the selection of top employees [14][15][16][17]. However, the application of the PSI in determining BLT-DD recipients remains relatively limited, particularly within web-based systems that support real-time and integrated selection processes [18][19]. The PSI method was selected because it can objectively determine criterion weights based on data variation without requiring predefined subjective weights. This characteristic is particularly suitable for BLT-DD recipient selection, where determining criterion priorities often depends on subjective judgments and may lead to inconsistencies. Furthermore, PSI simplifies the decision-making process while maintaining transparency and accountability in ranking alternatives[13].

Based on these issues, this study proposes the application of the PSI method in a web-based DSS to determine the recipients of BLT-DD in Lemahireng Village. This study not only implements PSI to produce a more objective and transparent selection process but also compares the results with those of the SAW method to evaluate the consistency and effectiveness of the ranking. The main contribution of this study lies in the integration of the PSI method into a web-based system capable of assisting the village government in improving the accuracy of social assistance distribution and supporting faster, more accountable, and more targeted decision-making [20][21].

The novelty of this study can be summarized in four main contributions. First, the PSI method is integrated into a web-based DSS specifically designed for determining Village Fund Direct Cash Assistance (BLT-DD) recipients. Second, unlike conventional decision-making methods that require predefined criterion weights, the proposed approach utilizes PSI to generate criterion weights objectively based on data variation. Third, the study applies the PSI method in the context of village-level social assistance distribution, where transparency, fairness, and accountability are essential. Fourth, the developed system is evaluated through expert judgment and usability testing, providing both practical and empirical evidence of its effectiveness in supporting beneficiary selection.

2. Related Works

Research on DSS for determining social assistance recipients has been extensively conducted using various Multi-Criteria Decision Making (MCDM) methods. A previous study developed a DSS for social assistance recipients using the SAW method, demonstrating that this approach can facilitate the ranking of potential recipients more efficiently than manual processes [5]. However, the SAW method still has weaknesses in the weighting process, as it depends on the decision-maker's judgment and is sensitive to changes in normalization values, which can affect the consistency of selection results as the number of alternatives and criteria increases [5][8].

The Analytical Hierarchy Process (AHP) method has also been applied to determine social assistance recipients by representing decision priorities through pairwise comparisons between criteria [7]. Nevertheless, this method has limitations in maintaining consistency when the number of criteria increases, and still requires subjective weighting by decision-makers, which introduces the potential for bias in the final decision [7][10]. Another study further confirms that the use of manual weighting in social assistance selection systems remains a common challenge across various MCDM-based approaches [8].

Beyond SAW and AHP, the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method has also been utilized in social assistance DSS. A study applied a combination of AHP and TOPSIS to determine recipients of social vulnerability assistance, showing that TOPSIS is capable of ranking alternatives based on their proximity to the ideal solution [22]. However, this combined approach still relies on AHP for weight determination, meaning the objectivity of the results remains partially dependent on subjective expert judgment. This finding reinforces the argument that most existing social assistance systems have not fully addressed the issue of subjective weighting [8].

The PSI method has increasingly been applied across various multi-criteriadecision-making (MCDM) scenarios due to its ability to automatically determine criterion weights based on data variations, eliminating the need for manual weighting [13]. One study applied PSI to nurse performance evaluation and demonstrated that this method produces stable and objective rankings [16]. Another study utilized PSI in scholarship recipient selection and obtained more consistent results compared to conventional methods [14][15]. A systematic review further confirms that PSI performs competitively compared to other MCDM methods, particularly in cases involving high data variability [13]. Collectively, these studies demonstrate that PSI has significant potential for application in social assistance selection systems.

Several decision-support methods, such as SAW, AHP, and TOPSIS, have been widely implemented for social assistance selection [7][8][9][10]. However, these methods generally require predefined criterion weights determined by experts or decision-makers, which may introduce subjectivity into the evaluation process. In contrast, the PSI method automatically derives criterion weights based on actual data variation, reducing dependency on subjective judgment and improving decision objectivity. This characteristic makes PSI particularly suitable for BLT-DD recipient selection, where fairness, transparency, and accountability are essential considerations [13].

3. Proposed Method

This study began by identifying the problem through direct observation in Lemahireng Village to understand the existing BLT-DD beneficiary selection process, which relied heavily on manual procedures and subjective judgment. We then collected data using two approaches. First, we conducted structured interviews with the village head as the primary decision-maker to obtain information regarding the eligibility criteria used in determining BLT-DD recipients. Second, we performed a literature review of relevant scientific journals, government regulations related to BLT-DD, and previous studies on the application of the PSI method in decision support systems [15], [23]. Based on the interview results and regulatory requirements, we established the evaluation criteria and alternatives for the study. We further classified each criterion as either a benefit attribute, where higher values indicate better suitability, or a cost attribute, where lower values indicate better suitability, in accordance with the requirements of the PSI method [14]. The complete set of criteria used in this study is presented in Table 1.

Table 1. Criteria for determining BLT-DD recipients

No	Code	Criteria	Attribute Types
1	C_1	Monthly income	Cost
2	C_2	Number of dependents	Benefit
3	C_3	Age	Benefit
4	C_4	Housing status	Cost
5	C_5	Vehicles	Cost
6	C_6	Occupation	Cost
7	C_7	History of chronic illnesses	Benefit
8	C_8	Electricity capacity	Cost

Table 2. Score for each sub criterion

C_1-income	C_2-dependents	C_3-age	C_4-housing status	C_5-vehicles	C_6-occupation	C_7-history of chronic	C_8-electricity capacity	Score
<Rp 500.000	>=5	>=65 years	Hitchhike	Does not have	Not working	Disability	Connecting neighbors	5
>=Rp 500.000-Rp 1.000.000	4	55-64 years	Contract	Bicycle	Daily laborers	Chronic illness	<=450 VA	4
>Rp 1.000.000-Rp 1.500.000	3	45-54 years	The house does not yet have a certificate	Old motorcycle	Merchant	Outpatient care	900 VA	3
>Rp 1.500.000-Rp2.000.000	2	30-44 years	A simple home	New motorcycle	Private-sector employees	Sometimes mild pain	1300-2200 VA	2
>Rp 2.000.000	<=1	<30 years	A luxurious home	Private car	Civil Servants/Military/ Police	Healthy	>2200 VA	1

The evaluation criteria and subcriteria were determined based on BLT-DD beneficiary selection regulations, village administrative records, and consultations with village authorities. To ensure their relevance and suitability, the criteria were reviewed and validated by domain experts consisting of the Village Head, Village Secretary, and Head of Social Welfare Affairs. The validation process confirmed

that each criterion adequately represents the socioeconomic conditions considered in the BLT-DD recipient selection process and can be effectively used in the decision-making model.
The alternatives in this study are potential recipients of BLT-DD proposed through village deliberations, hereafter denoted as A_1, A_2, …, A_n.

a. PSI Algorithm

The PSI method is part of the Multi-Criteria Decision Making (MCDM) approach that automatically determines criterion weights based on variations in actual data across criteria without requiring subjective weighting by decision-makers [24][25]. The following are the calculation steps for the PSI method shown in Fig. 1:

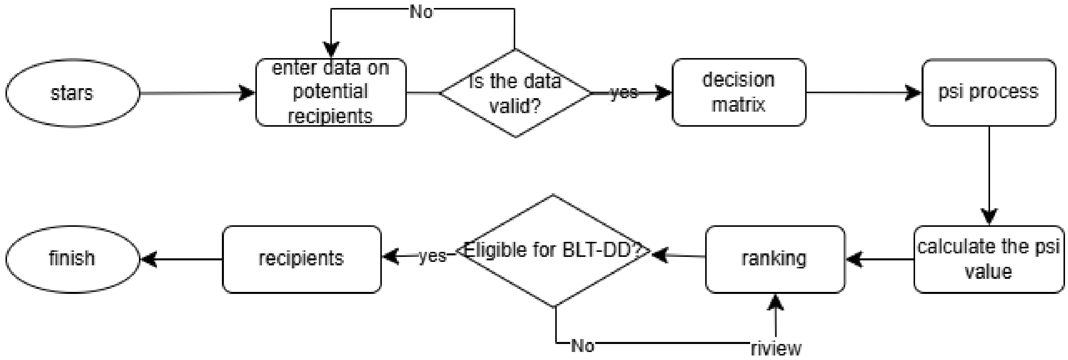

Fig. 1 Decision flow with PSI method

b. Creating a Decision Matrix

The first step in the PSI method is to construct an m × n decision matrix, where m represents the number of alternatives and n represents the number of criteria. Equation (1) is used for the decision matrix.

$$X_{i_j} = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \vdots & X_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ X_{m1} & X_{m2} & X_{m3} & X_{mn} \end{bmatrix} \quad \textbf{(1)}$$

c. Normalization of the Decision Matrix

Normalization is performed to standardize the scale of values across criteria so that comparisons can be made fairly. For the benefit attribute, higher values are more desirable. Equation (2) relates to the normalization of the decision matrix.

$$N_{ij} = \frac{X_{ij}}{X_j^{max}} \quad (2)$$

The normalization process transforms all criterion values into a comparable scale ranging from 0 to 1, thereby eliminating the influence of different measurement units and value ranges among criteria. This step ensures that each criterion contributes proportionally to the evaluation process and allows alternatives to be compared fairly. In benefit criteria, larger values indicate better performance; therefore, each criterion value is divided by the maximum value of the corresponding criterion.
Where:

- N_{ij} = normalized value of alternative i for criterion j
- X_{ij} = original value of alternative i for criterion j
- X_j^{max} = maximum value of criterion j

For the cost attribute, a smaller value is preferred, using equation (3).

$$N_{ij} = \frac{X_j^{min}}{X_{ij}} \quad (3)$$

Although Equation (3) can be used for cost criteria, it was not applied in this study because all assessment criteria were converted into benefit-based subcriterion scores ranging from 1 to 5. Therefore, the normalization process was performed using Equation (2) for all criteria.

d. Calculating the Mean

After all data has been normalized, the next step is to calculate the mean of the normalized values for each criterion, where n is the number of alternatives. Equation (4) is used to calculate the mean.

$$N = \frac{1}{n} \sum_{i=1}^{n} N_{ij} \quad (4)$$

The mean value represents the average performance of all alternatives for a particular criterion after normalization. This value serves as a reference point for measuring the variation of normalized values in the subsequent stage. By calculating the mean, the PSI method can identify how far each alternative deviates from the overall average performance of a criterion.

Where:

- N = mean value of the normalized criterion
- N_{ij} = normalized value of alternative i for criterion j
- n = total number of alternatives

e. Calculating the Preference Variation

Next, in equation (5), the preference variation (ϕ_j) is calculated based on the dispersion of the normalized values relative to their mean.

$$\phi_j = \sum_{i=1}^{n} \left[N_{ij} - N\right]^2 \quad (5)$$

Preference variation is used to measure the degree of dispersion among alternatives within a criterion. A higher variation value indicates that the criterion has a stronger ability to distinguish one alternative from another. Therefore, criteria with greater variation are considered more influential in the decision-making process because they provide more discriminatory information.

Where:

- ϕ_j = preference variation of criterion j
- N_{ij} = normalized value of alternative i for criterion j
- N = mean value of criterion j

f. Determining the Preference Deviation

The preference deviation (Ω_j) is calculated by subtracting the preference variance from one, as formulated in Equation (6).

$$\Omega_j = 1 - \phi_j \quad (6)$$

The preference deviation reflects the relative importance of each criterion based on the calculated variation. In the PSI method, deviation values are used as the foundation for determining criterion weights. Criteria with larger deviation values indicate greater significance in differentiating alternatives and therefore contribute more substantially to the final decision.

Where:

- Ω_j = preference deviation of criterion j
- ϕ_j = preference variation of criterion j

g. Determining Criterion Weights

The weight of each criterion is obtained by comparing the value of each deviation to the total of all deviations, as shown in Equation (7).

$$\omega_j = \frac{\Omega_j}{\sum_{j=1}^{m} \Omega_j} \quad (7)$$

Criterion weights are automatically generated from the preference deviation values. Unlike conventional Multi-Criteria Decision Making (MCDM) methods that require subjective weighting from experts or decision-makers, PSI determines criterion importance objectively based on data characteristics. This approach reduces bias and increases the consistency of the decision-making process.

Where:

- ω_j = weight of criterion j
- Ω_j = preference deviation of criterion j
- m = total number of criteria

The total preference score for all attributes must equal one. This is shown in equation (8).

$$\sum_{j=1}^{n} \omega_j = 1 \quad (8)$$

Equation (8) ensures that the sum of all criterion weights equals one, thereby maintaining proportionality among criteria and enabling a balanced contribution of each criterion to the final PSI score.

h. Calculating the PSI Value

The PSI value for each alternative is calculated by summing the products of the normalization values and the weights of each criterion. This is expressed in Equation (9).

$$\theta_j = \sum_{j=1}^{m} N_{ij}\omega_j \quad (9)$$

The PSI value represents the overall performance score of an alternative after considering all criteria and their corresponding weights. A higher PSI value indicates that the alternative better satisfies the established evaluation criteria and is therefore considered more eligible for selection. The PSI value serves as the basis for ranking alternatives in the final stage of the decision-making process.

Where:

- θ_j = PSI value of alternative i
- N_{ij} = normalized value of alternative i for criterion j
- ω_j = weight of criterion j
- m = total number of criteria

After calculating the PSI values, we ranked all alternatives in descending order, where the alternative with the highest PSI value represented the most eligible BLT-DD recipient. This ranking process provided a clear prioritization of candidates based on their overall performance across all evaluation criteria, enabling decision-makers to identify beneficiaries in a transparent, objective, and systematic manner. We then implemented the proposed model in a web-based decision support system using PHP and MySQL. The system automatically executed all PSI calculation stages, allowing RT officers to input beneficiary data and instantly obtain ranking recommendations without performing manual calculations [26].

To evaluate the developed system, we conducted two testing phases. First, we applied black-box testing to verify system functionality by validating inputs and outputs without examining the internal program structure. Second, we assessed the quality of the recommendation results through expert judgment involving village heads and village officials who possessed direct knowledge of local socioeconomic conditions. Their evaluations were used to determine the consistency between the system recommendations and real-world assessments. In addition, we measured system usability using the System Usability Scale (SUS), which consists of ten statements rated on a five-point Likert scale. We interpreted the resulting SUS scores using predefined categories ranging from Very Unacceptable to Very Good to determine the overall usability and acceptance of the proposed system [27].

4. Result and Analysis

We conducted data collection through direct interviews with the head of Lemahireng Village and a literature review of the Ministry of Villages' regulations regarding eligibility criteria for BLT-DD recipients. A total of 40 households were proposed as potential recipients, while the available quota ranged from 15 to 20 households per period. From the total of 40 potential recipient records, four representative alternatives (A_1–A_4) were selected for illustrative calculation purposes based on the diversity of their socioeconomic characteristics. Each alternative was evaluated based on eight established criteria: monthly income (C_1), number of dependents (C_2), age (C_3), home ownership status (C_4), vehicles owned (C_5), type of employment (C_6), history of chronic illness (C_7), and installed electrical capacity (C_8), as presented in Table 3.

Table 3. Alternative values for each criterion

Alternative	C_1 (income)	C_2 (dependents)	C_3 (age)	C_4 (house)	C_5 (vehicles)	C_6 (occupation)	C_7 (history chronic)	C_8 (electricity)
A_1	400.000	0	63	A simple home	Bicycle	Merchant	Outpatient care	450 VA
A_2	1.200.000	3	40	The house is not yet certified	Old motorcycle	Private sector employees	Healthy	450 VA
A_3	1.700.000	2	37	A simple home	New motorcycle	Civil servants	Healthy	450 VA
A_4	500.000	0	65	A simple home	Does not have	Daily laborers	Sometimes mild pain	450 VA

The dataset consisted of 40 prospective BLT-DD recipients obtained from Lemahireng Village. The number of alternatives was determined based on the actual list of households proposed for evaluation during the BLT-DD beneficiary selection process. Therefore, this study adopted a census approach by including all available candidates rather than selecting a subset through sampling techniques. As a result, the analysis reflects the real conditions and decision-making context of the village during the study period. This variation serves as the primary basis for the PSI method in automatically determining the weight of each criterion based on the actual data distribution, without requiring subjective judgment from decision-makers.

4.1 PSI Algorithm Calculation

The PSI method is am MCD) approach that determines the importance of each criterion directly from the characteristics of the available data. Unlike conventional methods that require manually assigned criterion weights, PSI calculates weights objectively through preference variation analysis.

1. Initial Decision Matrix

Qualitative data for criteria C_1–C_8 were converted to an ordinal numerical scale based on the BLT-DD eligibility criteria, resulting in the following decision matrix.

$$\text{Matrix } X_{ij} = \begin{bmatrix} 5 & 1 & 4 & 2 & 4 & 3 & 3 & 4 \\ 3 & 3 & 2 & 3 & 3 & 2 & 1 & 4 \\ 2 & 2 & 2 & 2 & 2 & 1 & 1 & 4 \\ 4 & 1 & 5 & 2 & 5 & 4 & 2 & 4 \end{bmatrix}$$

From this matrix, the maximum and minimum values for each criterion are then determined.

Max Value $5 \quad 3 \quad 5 \quad 3 \quad 5 \quad 4 \quad 3 \quad 4$

Min Value $2 \quad 1 \quad 2 \quad 2 \quad 2 \quad 1 \quad 1 \quad 4$

2. Normalization of the Decision Matrix

Since all values have been converted into subcriterion scores on a scale of 1 to 5, where higher values reflect a higher level of suitability, all criteria are treated as benefit criteria and normalized using Equation (2). The results of the normalization are presented in Table 4.

Table 4. Normalization of the Decision Matrix

Alt	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
A_1	1,000	0,333	0,800	0,667	0,800	0,750	1,000	1,000
A_2	0,600	1,000	0,400	1,000	0,600	0,500	0,333	1,000
A_3	0,400	0,667	0,400	0,667	0,400	0,250	0,333	1,000
A_4	0,800	0,333	1,000	0,667	1,000	1,000	0,667	1,000
Total	**2,800**	**2,333**	**2,600**	**3,000**	**2,800**	**2,500**	**2,333**	**4,000**

The normalization results indicate that all criteria have been transformed into a comparable scale ranging from 0 to 1. This process ensures that differences in measurement scales do not affect the final evaluation results. Based on Table 4, alternative A_4 demonstrates relatively high normalized values across several important criteria, particularly C_3, C_5, and C_6. This indicates that A_4 possesses stronger characteristics associated with BLT-DD eligibility compared with the other alternatives.

3. Calculating the Average Value, Preference Variation, and Criterion Weights

The average value (N), preference variation (ϕ_j), deviation (Ω_j), and criterion weights (ω_j) are calculated based on the normalization matrix. A summary of the calculation results is presented in Table 5.

Table 5. Average score, preference variation, and criterion weights

Criteria	Average Value (N)	Preference Variation (φj)	deviation (Ωj)	Criterion Weights (ωj)
C_1	0,700	0,200	0,800	0,127
C_2	0,583	0,306	0,694	0,110
C_3	0,650	0,270	0,730	0,115
C_4	0,750	0,083	0,917	0,145
C_5	0,700	0,200	0,800	0,127
C_6	0,625	0,313	0,688	0,109
C_7	0,583	0,306	0,694	0,110
C_8	1,000	0,000	1,000	0,158
Total			**6,323**	**1,000**

The criterion weight calculation reveals that C_8 obtained the highest weight value (0,158), indicating that this criterion provides the greatest discriminatory power among the evaluated alternatives. According to the PSI concept, criteria with greater data variation tend to contribute more significantly to the decision-making process. Conversely, criteria such as C_2, C_6, and C_7 obtained relatively lower weights because the variation among alternatives was less substantial. These findings demonstrate the ability of PSI to objectively determine criterion importance without relying on expert-assigned weights.

4. Calculating the PSI Value

The PSI value ($\boldsymbol{\theta}_j$) for each alternative is calculated using Equation (9), which is the sum of the products of the normalized values and the weights of each criterion.

Table 6. PSI value

Alt	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	Total
A_1	0,127	0,037	0,092	0,097	0,101	0,082	0,110	0,158	0,803
A_2	0,076	0,110	0.046	0,145	0,076	0,054	0,037	0,158	0,702
A_3	0,051	0,073	0,046	0,097	0,051	0,027	0,037	0,158	0,539
A_4	0,101	0,037	0,115	0,097	0,127	0,109	0,073	0,158	0,817

The PSI values presented in Table 6 represent the overall eligibility of each alternative after evaluating all criteria. A higher PSI value indicates a greater priority for receiving BLT-DD assistance. The results show that A4 achieved the highest PSI value of 0.817, followed by A1 (0.803), A2 (0.702), and A3 (0.539). A4 obtained the highest score because it consistently exhibited greater socioeconomic vulnerability across several key criteria, including age, employment status, vehicle ownership, and electricity capacity. In contrast, A3 received the lowest score due to its relatively better economic condition, reflected by more stable employment and ownership of productive assets.

5. Alternative Ranking

The results of the calculations for the alternative data on potential aid recipients using the PSI method are as follows:

Table 7. Ranking of Potential Recipients

Alternative	Value	Ranking
A_1	0,803	2
A_2	0,702	3
A_3	0,539	4
A_4	0,817	1

The PSI method ranks A4 as the best alternative with a preference value of 0.817, followed by A1 (0.803), A2 (0.702), and A3 (0.539). These results indicate that A4 is the most eligible candidate for BLT-DD assistance based on the eight evaluation criteria. The ranking also reflects the socioeconomic conditions of the households, where alternatives with lower income, greater family responsibilities, and more vulnerable living conditions receive higher priority.

4.2 Comparison with SAW Method

To evaluate the consistency of the ranking results produced by the PSI method, a comparison was conducted using the SAW method. The same dataset and normalized decision matrix presented in Table 4 were used in the comparison process. Since no predefined expert weights were available, equal weights were assigned to all criteria ($w_j = 0{,}125$). This normalization process transforms the original criterion values into comparable values ranging from 0 to 1. The alternative with the highest value for a criterion receives a normalized score of 1, while the other alternatives receive proportional values relative to the maximum criterion value.

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \quad (10)$$

where:

- r_{ij}= normalized value of alternative i on criterion j
- x_{ij}= value of alternative i on criterion j
- $\max(x_{ij})$ = maximum value of criterion j

Since the comparison was conducted using the same dataset without predefined expert weights, equal weights were assigned to all criteria. With eight criteria, each criterion received a weight of 0,125.
The final preference value of each alternative is calculated using the weighted sum model:

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (11)$$

where:

- V_i = preference value of alternative i
- w_j= weight of criterion j
- r_{ij}= normalized value of alternative i on criterion j
- n = number of criteria

Table 8. SAW Score

Alternative	SAW Score	SAW Rank
A_1	0.800	2
A_2	0.679	3
A_3	0.514	4
A_4	0.808	1

Table 9. Comparison of Psi and SAW Calculations

Alternative	PSI Score	PSI Rank	SAW Score	SAW Rank
A_1	0.803	2	0.800	2
A_2	0.702	3	0.679	3
A_3	0.539	4	0.514	4
A_4	0.817	1	0.808	1

The comparison results show that both PSI and SAW produced the same ranking order, namely A_4, A_1, A_2, and A_3. The comparison results show that the PSI method produces rankings that are consistent with those generated by the SAW method. Although minor differences appear in the final preference scores, both methods rank the alternatives in the same order, indicating that PSI provides reliable and stable decision outcomes. This consistency confirms that PSI effectively identifies eligible BLT-DD recipients while maintaining comparable performance to established MCDM techniques. These advantages make PSI particularly suitable for social assistance allocation, where accountability and unbiased decision-making are essential. Furthermore, when this study applies equal weights to all criteria, the resulting ranking remains unchanged, demonstrating that the PSI model is robust and stable for the evaluated dataset.

4.3 System Assessment

This study evaluates the proposed system through two testing phases. First, we apply black-box testing to verify system functionality by examining input and output behavior without considering the internal program structure. Second, we assess the quality of recommendation results through expert evaluation involving village officials and measure system usability using the System Usability Scale (SUS).

Table 10. Black-box testing results

Input	Process	Output	Result
Enter the correct username and password	Access the dashboard page	Displaying the dashboard	Successful
Entering the wrong username or password	The system is refusing the login	“Invalid Login Credentials” Notification	Successful
Fill out the prospective recipient's information form completely	The data is stored in a database	The data is displayed in a list table	Successful
Clicking “Save” with an empty field	The system prevents storage	A validation message appears	Successful
Editing existing beneficiary data	The data has been updated in the database	The data is displayed according to the changes	Successful
Removing a potential recipient from the list	The data was deleted from the database	The data does not appear in the table	Successful
Click the “Calculate” button on the entered data	The system runs the PSI algorithm	Normalization, weight, and PSI are displayed	Successful
Accessing the PSI calculation results page	The system generates alternative sequences	Sorted by highest PSI	Successful
Download the report on the recommendations (PDF)	The system processes exports	The PDF file has been successfully downloaded	Successful
Click the logout button on the navigation bar	The user session has ended	Redirected to the login page	Successful

The black-box testing results show that all ten test scenarios were completed successfully, indicating that every system function operated according to its intended requirements. These results confirm that the proposed application is reliable and capable of supporting the BLT-DD recipient selection process effectively. This study also conducted an expert judgment evaluation involving three respondents consisting of village heads and village officials. The evaluators compared the recommendations generated by the system with their own assessments based on field observations and the same beneficiary data. Table 11 presents the comparison results between the system recommendations and the expert assessments.

Table 11. Comparison of System Recommendations and Village Assessments

No	candidate's name	PSI value	System Ranking	Village Recommendat	Compatibility
1	Painah	0,817	1 (highly recommended)	recommended	Compatible
2	Sucipto	0,803	2 (recommended)	recommended	Compatible
3	Rusmini	0,702	3 (somewhat recommended)	not recommended	Incompatible
4	Sri Wahyuni	0,539	4 (not recommended)	not recommended	Compatible
Total				**75%**	

The level of agreement between the system’s recommendations and the village officials’ assessments reached 75% (3 out of 4 alternatives). A discrepancy occurred regarding Rusmini, whom the system recommended as eligible based on a PSI score of 0,702, while the village officials deemed her ineligible to receive BLT-DD. Although the agreement level indicates that the proposed system is reasonably aligned with expert assessments. Consequently, the validation results should be interpreted within the context of the study area. Involving a larger number of experts from different institutions may improve the robustness and generalizability of future evaluations.

In this paper, we also conducted the SUS assessment with ten statements on a 1–5 Likert scale, involved 7 respondents from the village apparatus. Scores were calculated using a standard formula with a range of 0–100, and the results are presented in Table 12.

Table 12. SUS Assessment Results

Respondent	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	Score
R_1	4	4	5	2	5	2	4	2	5	2	82,2
R_2	5	2	4	2	4	2	5	1	5	2	85,0
R_3	4	2	5	1	5	2	4	2	4	1	85,0
R_4	5	1	4	2	5	1	5	2	5	1	90,0
R_5	4	2	4	2	4	2	4	2	5	2	82,2
R_6	5	2	5	1	4	2	4	1	5	2	87,5
R_7	4	1	5	2	5	1	5	2	4	1	87,5
The average value											85,71

5. Conclusion

This study successfully implements the PSI method in a DSS for selecting Village Fund Direct Cash Assistance (BLT-DD) recipients in Lemahireng Village. We apply the PSI method to rank prospective beneficiaries based on their socioeconomic conditions and obtain the highest PSI score for alternative A4 (0.817), followed by A1 (0.803), A2 (0.702), and A3 (0.539). These results demonstrate that the PSI method effectively identifies and prioritizes eligible BLT-DD recipients according to the established criteria. We also evaluate the system's performance through functional and usability testing. The black-box testing results confirm that all system functions operate according to the specified requirements without errors. Furthermore, village officials conduct an expert judgment evaluation and achieve a conformity rate of 75% between the system recommendations and field-based assessments. The usability evaluation produces an average SUS score of 85.71, indicating a high level of user acceptance.

To further assess the effectiveness of the proposed approach, we compare the PSI method with the SAW method using the same dataset. The comparison shows that both methods generate identical ranking positions. However, PSI automatically determines criterion importance from data characteristics, whereas SAW requires predefined criterion weights. This capability improves objectivity and reduces potential bias during the decision-making process. Despite these positive outcomes, this study has several limitations. We conduct the evaluation using only 40 alternatives from a single village, which may limit the generalizability of the findings. In addition, we involve only a small number of evaluators in the expert validation process and do not perform sensitivity analysis to examine the robustness of the ranking results. Therefore, future studies should utilize larger datasets from multiple villages and regions, perform sensitivity analysis to evaluate ranking stability, and compare the PSI method with other contemporary MCDM approaches, such as TOPSIS, MARCOS, MOORA, and hybrid PSI-based models.

References

[1] S. Suprapto, E. Edora, and F. A. Pasaribu, "Sistem Pendukung Keputusan Calon Penerima Program Bantuan Sosial (BANSOS) Menggunakan Metode Simple Additive Weighting (SAW)," *MALCOM Indones. J. Mach. Learn. Comput. Sci.*, vol. 4, no. 1, pp. 188–197, 2024, doi: 10.57152/malcom.v4i1.1057.

[2] M. D. Zulfahmi, M. Y. Rahmana, A. T. Nugroho, N. H. Hermaya, and D. Novita, "Analisis Metode Pengembangan Sistem Pendukung Keputusan Penerima Bantuan Sosial Korban Bencana Alam: Systematic Literature Review," *Device J. Inf. Syst. Comput. Sci. Inf. Technol.*, vol. 4, no. 2, pp. 158–170, 2023

[3] H. Pasarela, Wardhiah, R. Juanda, Fuadi, and Arliansyah, "Kebijakan Pengentasan Kemiskinan di Indonesia: Sebuah Fakta di Indonesia," *Socius J. Penelit. Ilmu-Ilmu Sos.*, vol. 2, no. 1, pp. 73–79, 2024.

[4] M. Y. Haffandi and B. Hendrik, "Analisa Metode Sistem Pendukung Keputusan dalam Konteks Perusahaan: Systematic Literature Review," 2024. doi: 10.37985/jer.v5i4.1959.

[5] J. Riyono, C. E. Pujiastuti, and F. N. R. Putri, "Studi Kasus: Sistem Pendukung Keputusan Penentuan Penerima Bantuan Sosial Menggunakan Simple Additive Weight," *JTIK (Jurnal Tek. Inform. Kaputama)*, vol. 7, no. 1, pp. 67–74, 2023, doi: 10.59697/jtik.v7i1.36.

[6] L. Sitanayah, R. A. Kansil, and V. D. Kumenap, "Sistem Pendukung Keputusan Seleksi Penerima Bantuan Sosial Menggunakan Metode Simple Additive Weighting," *JOINTER J. Informatics Eng.*, vol. 5, no. 01, pp. 14–19, 2024, doi: 10.53682/jointer.v5i01.313.

[7] M. Joss and C. Cahyaningtyas, "Sistem Penilaian Prioritas Penerima Bantuan Langsung Tunai Dengan AHP Sebagai Metode Pendukung Keputusan," *J. Komput. Teknol. Inf. Sist. Inf.*, vol. 4, no. 2, pp. 587–597, 2025, doi: 10.62712/juktisi.v4i2.473.

[8] S. Ratulangi, "Analisis Komparatif Dan Tren Implementasi Metode Multi-Criteria Decision Making (Saw, Ahp, Topsis) Pada Sistem Pendukung Keputusan," vol. 10, no. 7, pp. 1–7, 2025.

[9] Rofid, R. Hidayatullah, and H. F. Akbar, "Sistem Pengambilan Keputusan Multikriteria Menggunakan Entropy, AHP, dan TOPSIS pada Seleksi E-Wallet di Indonesia," *Portal Ris. dan Inov. Sist. Perangkat Lunak*, vol. 2, no. 3, pp. 154–161, 2024, doi: 10.59696/prinsip.v2i3.162.

[10] A. N. Hakim and D. Setiawan, "Multi-Criteria Decision Making (MCDM) Analysis in Vendor Selection Decision-Making Using the Analytical Hierarchy Process (AHP) Method," *Qomaruna*, vol. 2, no. 2, pp. 10–21, 2025, doi: 10.62048/qjms.v2i2.89.

[11] A. Tlili *et al.*, "What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education," *Smart Learn. Environ.*, vol. 10, no. 1, 2023, doi: 10.1186/s40561-023-00237-x.

[12] R. Kumar and D. Pamucar, "A Comprehensive and Systematic Review of Multi-Criteria Decision-Making (MCDM) Methods to Solve Decision-Making Problems: Two Decades from 2004 to 2024," *Spectr. Decis. Mak. Appl.*, vol. 2, no. 1, pp. 177–196, 2025, doi: 10.31181/sdmap21202524.

[13] M. S. Obeidat, H. Al Sliti, and A. Obeidat, "The Preference Selection Index (PSI) in Multi-Criteria Decision-Making: A Systematic and Critical Review of Applications, Integrations, and Future Directions," *Math. Comput. Appl.*, vol. 30, no. 6, pp. 1–25, 2025, doi: 10.3390/mca30060124.

[14] Y. R. Sebayang, N. F. Saragih, and M. Yohana, "Sistem Pendukung Keputusan Kelayakan Pendaftaran

Bantuan Dana KIP Pada SMKS Dwiwarna Medan Dengan Metode Preference Selection Index," vol. 3, no. 1, pp. 88–99, 2023.
[15] A. Kurniawan, Yovi Apridiansyah, Yulia Darmi, and Harry Witriyono, "Implementasi Metode Preference Selection Index Dalam Penentuan Penerimaan Beasiswa Pada SMA Negeri 2 Bengkulu Selatan," 2023. doi: 10.54650/jukomika.v6i2.495.
[16] D. Supitri Suharjun, Liza Yulianti, and Lena Elfianty, "Penerapan Metode Preference Selection Index (Psi) Dalam Sistem Pendukung Keputusan Penilaian Kinerja Perawat," *JSAI (Journal Sci. Appl. Informatics)*, vol. 6, no. 2, pp. 123–132, 2023, doi: 10.36085/jsai.v6i2.5220.
[17] Saharuddin, "Penerapan Metode Preference Selection Index Dalam Penentuan Karyawan Terbaik Pada Pt. Prima Jaya Karya Makassar," 2023. doi: 10.56708/siberpro.v7i2.358.
[18] M. F. Iman, F. Santoso, and L. F. Lidimilah, "Sistem Pendukung Keputusan Penerimaan Bantuan Langsung Tunai Dana Desa (BLT-DD) Dengan Metode KNN Pada Desa Ketowan," *G-Tech J. Teknol. Terap.*, vol. 8, no. 2, pp. 1251–1260, 2024, doi: 10.33379/gtech.v8i2.4240.
[19] K. Anwarudin, Y. Nabila, and B. Sosial, "Sistem Pendukung Keputusan Seleksi Penerima PKH Menggunakan Metode SAW : Pendekatan Kontekstual dan Operasional," pp. 138–149, 2026, doi: https://doi.org/10.47134/jacis.v6i1.174.
[20] D. T. Do, V. D. Tran, V. D. Duong, and N.-T. Nguyen, "Investigation of the Appropriate Data Normalization Method for Combination with Preference Selection Index Method in MCDM," 2023. doi: https://doi.org/10.31181/oresta101122091d.
[21] N. T. Mai, "Hybrid Multi-Criteria Decision Making Methods: Combination of Preference Selection Index Method with Faire Un Choix Adèquat, Root Assessment Method, and Proximity Indexed Value," 2025. doi: 10.48084/etasr.9235.
[22] D. Safitri, E. S. Susanto, Y. Mulyanto, and I. M. Widiarta, "Sistem Pendukung Keputusan Penerima Biaya Kerawanan Sosial Masyarakat Menggunakan Metode AHP dan Topsis," *Digit. Transform. Technol.*, vol. 5, no. 2, pp. 158–164, 2025.
[23] I. Abdillah, V. Sihombing, I. R. Munthe, and U. Labuhanbatu, "Sistem pendukung keputusan pemilihan umkm terbaik menggunakan metode preference selection index," vol. 7, pp. 785–792, 2024, doi: 10.37600/tekinkom.v7i2.1546.
[24] E. Kurniawan, Y. Yuhandri, and S. Sumijan, "Penerapan Preference Selection Index (PSI) dalam Pengangkatan Karyawan di Yayasan XYZ," *J. Nas. Teknol. dan Sist. Inf.*, vol. 9, no. 1, pp. 78–85, 2023, doi: 10.25077/teknosi.v9i1.2023.78-85.
[25] S. N. Fazira, P. Purwadi, and S. Kusnasari, "Sistem Pendukung Keputusan Dalam Rekrutmen Tim Direct Sales Menggunakan Metode PSI," *J. Sist. Inf. Triguna Dharma (JURSI TGD)*, vol. 4, no. 2, pp. 253–264, 2025.
[26] Nelly Khairani Daulay, Asep Toyib Hidayat, and Shelfia Shepty, "Penentuan Program Indonesia Pintar (PIP) Pada Siswa Kurang Mampu dengan Metode Preference Selection Index (PSI) Berbasis Web," *Bull. Comput. Sci. Res.*, vol. 4, no. 1, pp. 121–128, 2023, doi: 10.47065/bulletincsr.v4i1.296.
[27] I. M. Herawati and D. Azahra, "Evaluasi Usability Website Jasuda.Net Menggunakan System Usability Scale (Sus)," *JIPI (Jurnal Ilm. Penelit. dan Pembelajaran Inform.*, vol. 9, no. 2, pp. 994–1000, 2024, doi: 10.29100/jipi.v9i2.4328.