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A Multi-Criteria Fuzzy AHP Approach to Determine PKH Recipients in Sumber Harapan Village

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Abstract

The development of information technology encourages the use of decision support systems to increase objectivity and efficiency in various fields, including the determination of social assistance recipients. In addition, through the main discussion carried out in this study aims to be able to analyze the process of determining the recipients of the Family Hope Program (PKH) in Sumber Harapan Village based on predetermined social and economic criteria and applying the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method to determine the importance weight of each criterion so that the assessment process becomes more objective, systematic, and transparent. And in addition, for the Research Method section used in this study is a qualitative approach through direct observation, interviews with village officials and related parties, and documentation studies of prospective PKH recipient data. The results of the study indicate that the Fuzzy AHP method is effective in determining the priority of aid recipients based on seven assessment criteria. Of the 15 alternatives analyzed, Lina Marlina (Alternative 8) obtained the highest priority value of 0.0920, followed by Siti Aminah (Alternative 2) with a value of 0.0895 and Nabila Sari (Alternative 12) of 0.0876, while Dedi Kurniawan (Alternative 5) obtained the lowest value of 0.0349. The developed web-based decision support system is able to automate the data management process, Fuzzy AHP calculations and present selection results quickly and accurately, thus helping village governments produce more targeted, transparent and accountable decisions in the distribution of PKH social assistance.

Keywords:
Decision Support System; Fuzzy AHP; Multi-Criteria; Family Hope Program; Priority Ranking of Aid Recipients; Sumber Harapan Village.

1. INTRODUCTION

The development of information technology in the digital era has brought about rapid changes in various aspects of life, including government, education, health, and public services. The use of information technology is no longer merely a medium for data storage and processing, but has evolved into a crucial instrument in supporting faster, more precise, and objective analysis and decision-making (Hasibuan et al., 2021) . Various government agencies have begun implementing technology-based systems to improve the quality of public services by providing accurate, transparent, and easily accessible information. The digitalization of public services is also a strategic step by the government to realize effective, efficient, accountable, and community-oriented governance. In this context, the implementation of Decision Support Systems (DSS) is a widely used solution to assist decision-makers when faced with various alternatives that must be evaluated based on a number of interrelated criteria (Husnaini, 2025).

One form of public service that requires precise decision-making is the distribution of social assistance to the community. Social assistance is a government program aimed at reducing poverty, improving community welfare, and expanding access to basic services such as education and healthcare. In Indonesia, one of the social assistance programs that plays a crucial role is the Family Hope Program (PKH), managed by the Ministry of Social Affairs of the Republic of Indonesia. (Badrudin et al., 2024) . PKH is a conditional social

assistance program provided to poor and vulnerable families based on certain criteria to improve the quality of life of beneficiaries by increasing access to education, health, and social welfare services. This program is one of the government's main instruments in supporting accelerated poverty alleviation while reducing social disparities in various regions (Firmansyah et al., 2023).

According to data from the Indonesian Ministry of Social Affairs, throughout 2024, the government distributed Family Hope Program (PKH) assistance to approximately 10 million Beneficiary Families (KPM) across Indonesia. The government also allocated tens of trillions of rupiah to ensure that assistance reached those who truly met the requirements. The large number of recipients demonstrates that PKH (Family Hope Program) has a strategic contribution to improving public welfare. However, the large number of recipients also presents a challenge, as the selection process must be carried out accurately to ensure assistance reaches families truly in need. Mistakes in determining recipients have the potential to lead to injustice, undermine public trust in the government, and reduce the program's effectiveness in achieving poverty alleviation goals (Azka Naufal Nurrahman et al., 2025).

Sumber Harapan Village is one of the villages that annually conducts a selection process for prospective recipients of the Family Hope Program. In its implementation, the process of determining aid recipients still faces various obstacles because it involves numerous criteria that must be considered simultaneously, such as family income level, living conditions, number of dependents, employment status of the head of the family, education level, health conditions, and asset ownership. This large number of criteria makes the evaluation process quite complex, requiring high precision in determining the priority of aid recipients. Based on the results of observations conducted, the selection process is still dominated by manual recording using administrative documents and subjective considerations by officers. This condition causes the data processing process to take a relatively long time, increases the possibility of errors in the calculation process and has the potential to produce inconsistent decisions if there are differences in perceptions between officers conducting the assessment.

These issues indicate that the process of determining PKH recipients requires a decision-making mechanism capable of systematically processing various criteria to achieve more objective, consistent, and transparent results. One possible solution is to develop a computer-based Decision Support System. A Decision Support System is an information system designed to assist decision-makers in solving semi-structured and unstructured problems through data processing, analyzing various alternatives, and developing decision recommendations based on specific methods. With this system, the recipient selection process can be carried out more quickly, accurately, and well-documented, reducing reliance on individual subjective assessments (Naufal et al., 2022).

This study used the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method as an approach to determining the priority of recipients of the Family Hope Program. The Fuzzy AHP method is a development of the Analytical Hierarchy Process (AHP) method that combines the concept of pairwise comparisons with fuzzy set theory. This approach is able to accommodate the uncertainty and subjectivity that often arise when decision-makers assess the level of importance of a criterion. Unlike conventional AHP which uses exact values (crisp values), Fuzzy AHP utilizes fuzzy numbers so that the assessment given is more flexible and able to represent real conditions that often cannot be stated with certainty. Therefore, this method is considered more suitable for solving problems involving many criteria with a relatively high level of uncertainty, such as the selection process for social assistance recipients (Siregar & Nababan, 2022).

However, the implementation of the Fuzzy AHP method also presents several challenges that require attention. One of the main challenges is the preparation of the pairwise comparison matrix, which still relies heavily on the experience, knowledge, and consistency of assessments of experts or decision-makers. Differences in perceptions in assigning levels of importance between criteria can affect the weighting results if consistency testing is not carried out properly. In addition, the process of transforming values into fuzzy numbers, calculating fuzzy synthesis values, defuzzification, and normalizing weights requires more complex calculation stages than the conventional AHP method. This complexity can increase the risk of errors if the calculation process is carried out manually. Therefore, the application of the Fuzzy AHP method will be more optimal if it is integrated into a web-based system that can automate the entire calculation process, reduce human error, accelerate data processing, and produce more consistent decision recommendations (Saputra et al., 2025).

Furthermore, observations conducted by researchers in Sumber Harapan Village indicate that there is currently no decision support system specifically designed to assist in the selection process for recipients of the Family Hope Program. All assessment stages are still conducted manually, resulting in lengthy evaluations, particularly as the number of potential recipients increases annually. In addition to slowing down aid distribution, this situation also has the potential to lead to inaccuracies in prioritizing recipients because the assessment process is not yet supported by a decision-making method capable of processing all criteria measurably. Therefore, a system is needed that can integrate the process of managing prospective recipient data, weighting each criterion, calculating using the Fuzzy AHP method, and automatically presenting ranking results, so that decisions are more objective, transparent, consistent, and easily accountable. (Zalzabila, 2026)

On the other hand, this study aims to analyze the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village based on predetermined social and economic criteria, while

applying the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method in determining the importance weight of each criterion so that the assessment process becomes more objective and systematic. Furthermore, this study aims to produce an accurate ranking of prospective PKH recipients through a multi-criteria decision-making approach based on the Fuzzy AHP method, so that recipients can be selected according to the priority level obtained from the calculation results. As an implementation of this method, this study also aims to be able to build a web-based decision support system using the PHP programming language and MySQL database that is able to manage PKH recipient data automatically, quickly, transparently and efficiently, so that it can support the village government in improving the accuracy, fairness and accountability of the social assistance distribution process (Irawan, F., 2020).

Based on these problems, the Fuzzy AHP Multi-Criteria Approach in determining PKH assistance in Harapan Village is very relevant to be carried out. This research is expected to produce an objective, transparent and accurate decision support system in determining PKH assistance recipients, thereby helping the village in increasing fairness and effectiveness of distributing assistance to people who really need it. The author is interested in raising the title of the thesis: "Fuzzy AHP Multi-Criteria Approach to Determine PKH Recipients in Sumber Harapan Village". This research is expected to help schools in making decisions more fairly, systematically and transparently, especially when having to consider various complex criteria (Alfaizi et al., 2023).

2. RESEARCH METHOD

Through the research method section, the stages are systematically arranged to ensure that the research process is directed, objective and can produce findings that can be accounted for. In this study, the research method is used as a guideline in identifying problems, collecting data, determining criteria and sub-criteria, calculating the weight of importance using the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method, to produce recommendations for recipients of the Family Hope Program (PKH) based on priority levels. Through structured stages, this study is not only aimed at increasing objectivity in the selection process for social assistance recipients, but also supports more accurate, transparent and consistent decision-making according to the conditions and needs of the community in Sumber Harapan Village (Syahputra & Mahmudi, 2025). Based on this, in this study the research framework used includes the following description and explanation.

2.1. Identifying the Problem

Based on the results of the problem identification, the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village still faces various obstacles that affect the accuracy and effectiveness of decision-making. To date, the selection process has been carried out manually, resulting in subjective assessments of potential recipients, potentially leading to inaccurate targeting of aid. Furthermore, the lack of a decision support system capable of managing, processing, and evaluating data on potential recipients in a structured manner results in a lengthy and inefficient selection process. This problem is further complicated by the fact that determining PKH recipients involves various social and economic criteria with varying degrees of importance, yet they have not been managed using a systematic and objective assessment mechanism. Furthermore, the lack of implementation of a multi-criteria approach based on the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) has resulted in elements of uncertainty and subjectivity in assigning weights to each criterion being optimally minimized (Dari et al., 2023).

2.2. Population and Sample

The population in this study was all residents registered as prospective recipients of the Family Hope Program (PKH) in Sumber Harapan Village and who met the administrative requirements for the selection process. This population has diverse characteristics based on social and economic conditions, so an assessment process using several criteria is necessary to ensure more objective decisions. The research sample used a purposive sampling technique, namely the selection of samples based on the consideration that the data used has represented the characteristics of prospective PKH recipients. The number of samples analyzed was 15 prospective recipients, coded A1 to A15. Each alternative was evaluated based on seven criteria: the income of the head of the family (C1), the number of dependents (C2), the condition of the residence (C3), the employment status of the head of the family (C4), asset ownership (C5), the number of school-age children (C6), and the family's health condition (C7), (Naufal et al., 2022).

2.3. Data Collection Technique

Data collection techniques in this study were conducted through observation, interviews, and documentation studies to ensure accuracy and reflect field conditions. Direct observations were conducted at the Sumber Harapan Village Office to understand the manual mechanism for determining recipients of the Family Hope Program (PKH). Interviews were conducted with village officials and officers responsible for the selection process to obtain information on the assessment criteria and obstacles encountered during the recipient selection process. Furthermore, a documentation study was conducted by collecting data on 15

alternative PKH recipients (A1–A15), each containing seven assessment criteria: head of household income, number of dependents, living conditions, employment status, asset ownership, number of school-age children, and family health (Wijaya et al., 2021).

2.4. Data Set

The dataset used in this study is primary data obtained from the data collection of prospective recipients of the Family Hope Program (PKH) in Sumber Harapan Village. The data consists of 15 alternative recipients, coded A1 to A15, with each resident's identity and information on their social and economic conditions as the basis for the assessment process. Each alternative is evaluated based on seven criteria: the head of the family's income (C1), the number of dependents (C2), the living conditions (C3), the head of the family's employment status (C4), asset ownership (C5), the number of school-age children (C6), and the family's health condition (C7). Variations in the values for each criterion, such as income level, number of dependents, housing condition, type of employment, asset ownership, number of children still in school, and health condition, provide an overview of the eligibility level of each potential recipient (Ramadhani & Supriyanto, 2022). The following is the data (table 1).

Table 1. Raw Data on PKH Social Assistance Recipients

Code	Resident Name	Head of Family Income (C1)	Number of Dependents (C2)	Housing Conditions (C3)	Employment Status (C4)	Asset Ownership (C5)	School Age Children (C6)	Health Conditions (C7)
A1	Ahmad Fauzi	≤ Rp1,000,000	5 people	Not feasible	daily laborer	Have no assets	2 children	Quite healthy
A2	Siti Aminah	Rp1,000,001– Rp2,000,000	≥ 6 people	Totally unworthy	Doesn't work	Have no assets	≥ 4 children	Often sick
A3	Budi Hartono	Rp2,000,001– Rp3,000,000	4 people	Quite decent	Contract workers	Medium assets	1 child	Healthy
A4	Rina Wahyuni	≤ Rp1,000,000	5 people	Totally unworthy	Doesn't work	Very few assets	3 children	Often sick
A5	Dedi Kurniawan	Rp3,000,001– Rp4,000,000	≤ 2 people	Worthy	Self-employed	Quite a lot of assets	There isn't any	Healthy
A6	Nurhayati	Rp1,000,001– Rp2,000,000	≥ 6 people	Not feasible	daily laborer	Very few assets	≥ 4 children	Quite healthy
A7	Joko Santoso	Rp2,000,001– Rp3,000,000	5 people	Quite decent	daily laborer	Medium assets	2 children	Quite healthy
A8	Lina Marlina	≤ Rp1,000,000	≥ 6 people	Totally unworthy	Doesn't work	Have no assets	3 children	Chronic illness/severe disability
A9	Arif Setiawan	Rp3,000,001– Rp4,000,000	4 people	Worthy	Self-employed	Quite a lot of assets	1 child	Healthy
A10	Dewi Lestari	Rp1,000,001– Rp2,000,000	5 people	Not feasible	Contract workers	Very few assets	2 children	Often sick
A11	Hendra Saputra	Rp2,000,001– Rp3,000,000	≤ 2 people	Quite decent	Contract workers	Quite a lot of assets	1 child	Healthy

A12	Nabila Sari	≤ Rp1,000,000	≥ 6 people	Not feasible	Doesn't work	Very few assets	≥ 4 children	Often sick
A13	Yudi Pratama	Rp1,000,001– Rp2,000,000	4 people	Quite decent	daily laborer	Medium assets	1 child	Quite healthy
A14	Diamond Gems	≤ Rp1,000,000	5 people	Totally unworthy	daily laborer	Have no assets	3 children	Often sick
A15	Rudi Haryanto	Rp3,000,001– Rp4,000,000	≤ 2 people	Worthy	Contract workers	Quite a lot of assets	There isn't any	Healthy

2.5. Data Validity and Reliability

Data validity and reliability were assessed in this study to ensure that the data accurately reflected the conditions of potential beneficiaries and resulted in reliable decisions. Validity testing was conducted by verifying data suitability through field observations, interviews with village officials, and reviewing administrative documents of potential PKH recipients. This process ensured that information regarding the 15 alternative beneficiary candidates (A1–A15) and their seven-assessment criteria head of household income, number of dependents, living conditions, employment status, asset ownership, number of school-age children, and health consistently reflected actual conditions. Data reliability was maintained through the use of consistent assessment indicators for each alternative and the application of the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method, complemented by a Consistency Ratio (CR) test on a pairwise comparison matrix (Pramana et al., 2022).

2.6. Research Variables

The research variables in this study consist of decision variables, namely the eligibility level of prospective recipients of the Family Hope Program (PKH), which is determined based on a number of social and economic criteria. The independent variables used include the head of the family's income (C1), the number of dependents (C2), the condition of the residence (C3), the head of the family's employment status (C4), asset ownership (C5), the number of school-age children (C6), and the family's health condition (C7). These seven variables were chosen because they represent the condition of household welfare, which is the basis for determining social assistance recipients. The research data consists of 15 alternative prospective recipients (A1–A15), each of which has different characteristics in each criterion, such as income levels ranging from ≤ Rp1,000,000 to Rp3,000,001–Rp4,000,000, the number of dependents from ≤2 people to ≥6 people, living conditions from decent to very inadequate, employment status, level of asset ownership, number of school-age children and family health conditions (Irwansyah & Mesran, 2022).

2.7. Data Analysis Techniques

The data analysis technique in this study was carried out systematically by applying the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method as an approach in determining the priority of aid recipients. The analysis began by identifying 15 alternative potential recipients (A1–A15) along with seven assessment criteria, namely the income of the head of the family (C1), the number of family dependents (C2), the condition of the residence (C3), the employment status of the head of the family (C4), asset ownership (C5), the number of school-age children (C6) and the family's health condition (C7). Next, a hierarchical decision structure was prepared consisting of objectives, criteria, and alternatives. The next stage was to compile a pairwise comparison matrix based on the level of importance between criteria using a linguistic scale which was then converted into a Triangular Fuzzy Number (TFN). The fuzzy values were used to calculate the priority weight of each criterion through a fuzzy synthesis process, followed by a defuzzification process and weight normalization to obtain a proportional final value. After the weight of each criterion was obtained, all alternatives were evaluated based on the data on each criterion to produce preference values and rankings of potential PKH recipients. To ensure the reliability of the analysis results, a consistency test (Consistency Ratio/CR) was also carried out on the pairwise comparison matrix, with the provision that the CR value ≤ 0.10 is an indicator that the assessment is consistent (Husnaini, 2025).

3. RESULTS AND DISCUSSION

The results and discussion section of this study presents the process of applying the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method in determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village. The stages carried out include identifying criteria and subcriteria, compiling a

pairwise comparison matrix, converting values into fuzzy numbers, calculating the priority weights for each criterion, testing consistency, and determining the final value of potential recipients. All these stages are implemented into a web-based decision support system so that the selection process can be carried out more systematically, objectively, and transparently. The results obtained are then analyzed to assess the eligibility level of each potential recipient based on the priority values generated by the Fuzzy AHP method, while also evaluating the system's ability to assist the village government in making more accurate, fair, and accountable decisions in the PKH social assistance distribution process. (Siregar & Nababan, 2022). The following is the explanation.

3.1. Data Management

Data processing in this study was conducted to obtain objective and structured results for determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village using the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method. The process begins with collecting data on prospective recipients along with established criteria based on the social and economic conditions of the community. Next, a pairwise comparison matrix is compiled which is then converted into fuzzy numbers to accommodate uncertainty in the assessment. The conversion results are used to calculate the priority weight of each criterion through the Fuzzy AHP analysis stages until an importance value is obtained that represents the level of influence of each criterion. The resulting weights are then applied to alternative data to obtain the final value and priority order of prospective PKH recipients. The entire data processing process is implemented in a web-based decision support system so that the calculation process is faster, more accurate, consistent, and transparent.

3.2. Utilization of Fuzzy AHP Method

The use of the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method in this study aims to increase objectivity in the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village. This method is used to process the assessment of each criterion that influences the level of eligibility of potential recipients, so that decisions are not only based on subjective considerations. Through the fuzzy logic approach, uncertainty and differences in perception in providing comparative values between criteria can be better represented compared to the conventional AHP method. The implementation stages start from compiling a decision hierarchy, forming a pairwise comparison matrix, converting values into Triangular Fuzzy Numbers (TFN), calculating priority weights, the defuzzification process, and testing the consistency of the calculation results. The obtained weights are then used to evaluate all alternative recipient candidates to produce a priority order based on their respective levels of eligibility. The implementation of the Fuzzy AHP method in a web-based decision support system allows the selection process to be carried out more quickly, consistently, transparently, and easily accounted for. The following is a description of the use of the profile matching method in this study:

a. The first stage is determining alternatives and criteria. Alternatives represent data on residents who will be prioritized for PKH social assistance. The criteria are based on the head of the family's income, number of dependents, living conditions, employment status, asset ownership, number of school-age children, and family health.

Table 2. Assessment Criteria Data

Criteria Code	Criteria	Types of Criteria
C1	Head of Family Income	Cost
C2	Number of Family Dependents	Benefits
C3	Housing Conditions	Benefits
C4	Head of Family's Employment Status	Benefits
C5	Asset Ownership	Benefits
C6	Number of School-Age Children	Benefits
C7	Family Health Conditions	Benefits

Table 3. Raw Data for Determining PKH Social Assistance Recipients That Has Been Converted

Code	Resident Name	Head of Family Income (C1)	Number of Family Dependents (C2)	Housing Conditions (C3)	Head of Family Employment Status (C4)	Asset Ownership (C5)	Number of School-Age Children (C6)	Family Health Conditions (C7)
A1	Ahmad Fauzi	5	4	4	4	5	3	3
A2	Siti Aminah	4	5	5	5	5	5	4
A3	Budi Hartono	3	3	3	3	3	2	2

A4	Rina Wahyuni	5	4	5	5	4	4	4
A5	Dedi Kurniawan	2	2	2	2	2	1	2
A6	Nurhayati	4	5	4	4	4	5	3
A7	Joko Santoso	3	4	3	4	3	3	3
A8	Lina Marlina	5	5	5	5	5	4	5
A9	Arif Setiawan	2	3	2	2	2	2	2
A10	Dewi Lestari	4	4	4	3	4	3	4
A11	Hendra Saputra	3	2	3	3	2	2	2
A12	Nabila Sari	5	5	4	5	4	5	4
A13	Yudi Pratama	4	3	3	4	3	2	3
A14	Diamond Gems	5	4	5	4	5	4	4
A15	Rudi Haryanto	2	2	2	3	2	1	2

b. The second step is determining alternatives and criteria. Alternatives represent student data to be prioritized, while criteria are determined based on system needs, such as the head of household's income, number of dependents, living conditions, employment status of the head of household, asset ownership, number of school-age children, and family health.

$$W_1 = \frac{20}{20+15+20+10+10+15+10} = \frac{20}{100} = 0.20$$
$$W_2 = \frac{15}{20+15+20+10+10+15+10} = \frac{15}{100} = 0.15$$
$$W_3 = \frac{20}{20+15+20+10+10+15+10} = \frac{20}{100} = 0.20$$
$$W_4 = \frac{10}{20+15+20+10+10+15+10} = \frac{10}{100} = 0.10$$
$$W_5 = \frac{10}{20+15+20+10+10+15+10} = \frac{10}{100} = 0.10$$
$$W_6 = \frac{15}{20+15+20+10+10+15+10} = \frac{15}{100} = 0.15$$
$$W_7 = \frac{10}{20+15+20+10+10+15+10} = \frac{10}{100} = 0.10$$

Table 4. Converted Weight Value Data

Criteria Name	Type	Weight Value
Head of Family Income	Cost	0.20
Number of Family Dependents	Benefits	0.15
Housing Conditions	Benefits	0.20
Head of Family's Employment Status	Benefits	0.10
Asset Ownership	Benefits	0.10
Number of School-Age Children	Benefits	0.15
Family Health Conditions	Benefits	0.10

c. The third step is to add up each column, where in this step all the values in each criteria column will be added up.

1). C1 Calculation
5+4+3+5+2+4+3+5+2+4+3+5+4+5+2 =56
2). C2 Calculation
4+5+3+4+2+5+4+5+3+4+2+5+3+4+2 =55

3). C3 Calculation
4+5+3+5+2+4+3+5+2+4+3+4+3+5+2 =54
4). C4 Calculation
4+5+3+5+2+4+4+5+2+3+3+5+4+4+3 =56
5). C5 Calculation
5+5+3+4+2+4+3+5+2+4+2+4+3+5+2 =53
6). C6 Calculation
3+5+2+4+1+5+3+4+2+3+2+5+2+4+1 =46
7). C7 Calculation
3+4+2+4+2+3+3+5+2+4+2+4+3+4+2 =47

Table 5. Comparison Matrix Values

Criteria	Total
C1	56
C2	55
C3	54
C4	56
C5	53
C6	46
C7	47

d. The fourth step is matrix normalization, where at this stage each matrix element is divided by the total of its columns.

Table 6. Matrix Normalization Values

C1	C2	C3	C4	C5	C6	C7
0.0893	0.0727	0.0741	0.0714	0.0943	0.0652	0.0638
0.0714	0.0909	0.0926	0.0893	0.0943	0.1087	0.0851
0.0536	0.0545	0.0556	0.0536	0.0566	0.0435	0.0426
0.0893	0.0727	0.0926	0.0893	0.0755	0.0870	0.0851
0.0357	0.0364	0.0370	0.0357	0.0377	0.0217	0.0426
0.0714	0.0909	0.0741	0.0714	0.0755	0.1087	0.0638
0.0536	0.0727	0.0556	0.0714	0.0566	0.0652	0.0638
0.0893	0.0909	0.0926	0.0893	0.0943	0.0870	0.1064
0.0357	0.0545	0.0370	0.0357	0.0377	0.0435	0.0426
0.0714	0.0727	0.0741	0.0536	0.0755	0.0652	0.0851
0.0536	0.0364	0.0556	0.0536	0.0377	0.0435	0.0426
0.0893	0.0909	0.0741	0.0893	0.0755	0.1087	0.0851
0.0714	0.0545	0.0556	0.0714	0.0566	0.0435	0.0638
0.0893	0.0727	0.0926	0.0714	0.0943	0.0870	0.0851
0.0357	0.0364	0.0370	0.0536	0.0377	0.0217	0.0426

e. The fifth step is to calculate the priority weight (eigenvector), where after normalization is carried out, the average of each row is calculated to obtain the priority weight and calculate the maximum eigenvalue (λmax), where the λmax value is used to measure the consistency of the assessment.

1). A1 – Ahmad Fauzi
VA1=(0.0893×0.20)+(0.0727×0.15)+(0.0741×0.20)+(0.0714×0.10)+
(0.043×0.10)+(0.0652×0.15)+(0.0638×0.10)
=0.0179+0.0109+0.0148+0.0071+0.0094+0.0098+0.0064
VA1=0.0763
2). A2 – Siti Aminah
VA2=(0.0714×0.20)+(0.0909×0.15)+(0.0926×0.20)+(0.0893×0.10)+
(0.0943×0.10)+(0.1087×0.15)+(0.0851×0.10)
=0.0143+0.0136+0.0185+0.0089+0.0094+0.0163+0.0085
VA2=0.0895

Table 7. Maximum Eigenvalues

Code	Eigenvector
A1	0.0763
A2	0.0895
A3	0.0519
A4	0.0854

A5	0.0349
A6	0.0801
A7	0.0617
A8	0.0920
A9	0.0409
A10	0.0713
A11	0.0473
A12	0.0876
A13	0.0593
A14	0.0854
A15	0.0368

f. The sixth step is to calculate the consistency index (ci), where the consistency index is used to determine the level of assessment consistency.

Table 8. Consistency Index Values

Code	Resident Name	Priority Values
A1	Ahmad Fauzi	0.0763
A2	Siti Aminah	0.0895
A3	Budi Hartono	0.0519
A4	Rina Wahyuni	0.0854
A5	Dedi Kurniawan	0.0349
A6	Nurhayati	0.0801
A7	Joko Santoso	0.0617
A8	Lina Marlina	0.0920
A9	Arif Setiawan	0.0409
A10	Dewi Lestari	0.0713
A11	Hendra Saputra	0.0473
A12	Nabila Sari	0.0876
A13	Yudi Pratama	0.0593
A14	Diamond Gems	0.0854
A15	Rudi Haryanto	0.0368

g. The seventh step is the consistency test, where a consistent comparison matrix will be created and can be used for each criterion.

Table 9. Consistency Test Values

Component	Mark
Number of Criteria (n)	7
Maximum Eigenvalue (λmax)	7
Consistency Index (CI)	0
Random Index (RI)	1.32
Consistency Ratio (CR)	0
Test Results	Consistent

h. The eighth step is to determine the ranking of alternatives, where the final value of each alternative is ordered from largest to smallest.

Table 10. Ranking Results

No	Alternative Code	Resident Name	Priority Values	Ranking
1	Alternative 8	Lina Marlina	0.0920	Rank 1
2	Alternative 2	Siti Aminah	0.0895	Rank 2
3	Alternative 12	Nabila Sari	0.0876	Rank 3
4	Alternative 4	Rina Wahyuni	0.0854	Rank 4
5	Alternative 14	Diamond Gems	0.0854	Rank 5
6	Alternative 6	Nurhayati	0.0801	Rank 6
7	Alternative 1	Ahmad Fauzi	0.0763	Rank 7
8	Alternative 10	Dewi Lestari	0.0713	Rank 8
9	Alternative 7	Joko Santoso	0.0617	Rank 9
10	Alternative 13	Yudi Pratama	0.0593	Rank 10
11	Alternative 3	Budi Hartono	0.0519	Rank 11
12	Alternative 11	Hendra Saputra	0.0473	Rank 12
13	Alternative 9	Arif Setiawan	0.0409	Rank 13

14	Alternative 15	Rudi Haryanto	0.0368	Rank 14
15	Alternative 5	Dedi Kurniawan	0.0349	Rank 15

3.3. Comparison of This Research with Previous Research

The results of the study indicate that the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method is able to produce an objective ranking of prospective recipients of the Family Hope Program (PKH) based on seven criteria, namely the head of the family's income, number of dependents, living conditions, employment status, asset ownership, number of school-age children and health conditions. Based on the calculation results, Lina Marlina (Alternative 8) obtained the highest priority value of 0.0920, followed by Siti Aminah (0.0895) and Nabila Sari (0.0876). Conversely, Dedi Kurniawan (Alternative 5) obtained the lowest value of 0.0349 because he had a relatively better economic condition compared to the other alternatives. These results indicate that the Fuzzy AHP method is able to distinguish the level of eligibility of prospective recipients fairly and systematically based on all the criteria used. When compared with previous studies, the results of this study are in line with the finding that Fuzzy AHP is effective for use in multi-criteria decision making. The difference is, this study uses seven more comprehensive socio-economic criteria and is adjusted to the characteristics of determining PKH recipients in Sumber Harapan Village. In addition, the application of fuzzy numbers can reduce subjectivity in weighting criteria, resulting in recommendations for aid recipients that are more objective, consistent, transparent, and on target.

3.4. System Implementation

The system implementation in this study is the stage of implementing a web-based Decision Support System (DSS) designed to assist the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village using the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method. The system is built with an easy-to-use interface that makes it easier for officers to manage criteria, sub-criteria, and prospective recipient data in an integrated manner. In addition, the system automates all stages of the Fuzzy AHP method calculation, starting from the preparation of the pairwise comparison matrix, converting values into Triangular Fuzzy Numbers (TFN), calculating priority weights, the defuzzification process, and determining the final value of each alternative. The results of the data processing are then displayed in the form of a ranking that provides information on the level of eligibility of each prospective PKH recipient. This implementation not only speeds up the selection process but also improves consistency, transparency, and accuracy in decision-making.

3.4.1. User Login Page View

The user login page display is the website page display that will be accessed by the user to enter the main page of the website, where the user will carry out the account verification process to log in to the main page display of the website.

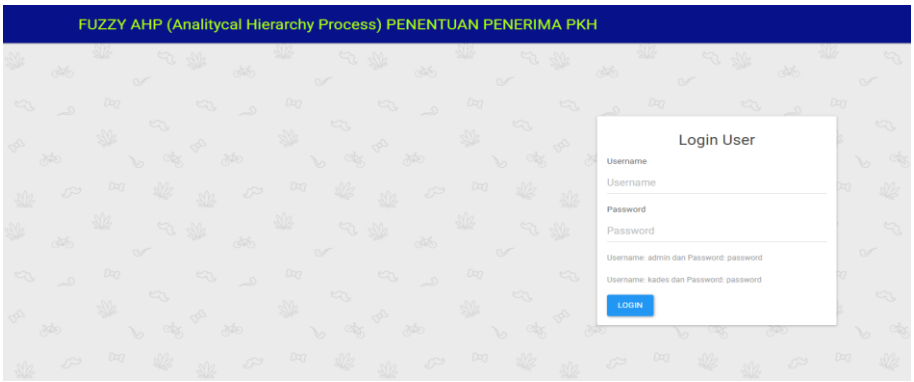

Figure 1. User Login Page Display

3.4.2. Website Main Menu Page Display

The Main Menu Page Display of the Website is the display of the website page that can be accessed by the user when they have completed the login verification process on the website.

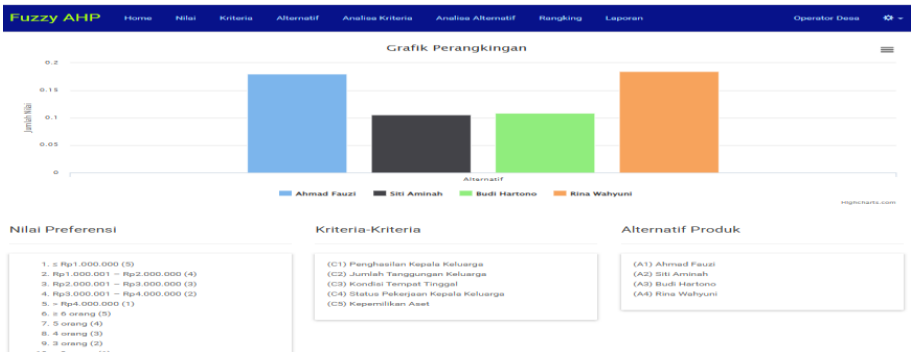

Figure 2. Main Menu Page Display of the Website

3.4.3. Data Page View Print Ranking Results Report

The Print Data Page Display of the Ranking Results Report is a website page display that can be accessed by users to view the results of determining the final value data from the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) Method that has been run on the system based on the assessment that has been carried out.

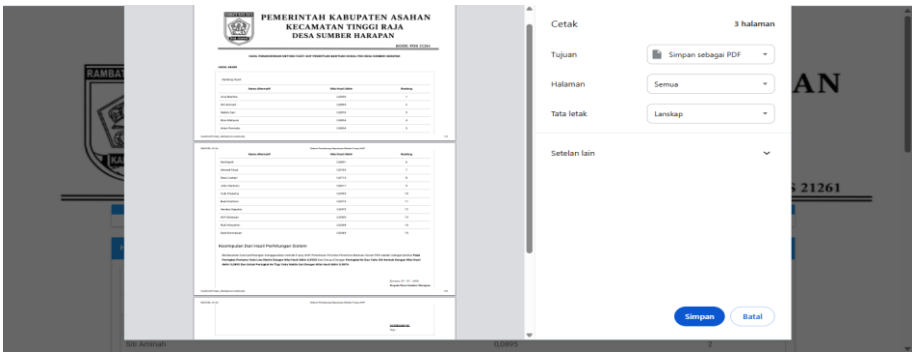

Figure 3. Display of the Ranking Results Data Page of the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) Method

3.5. Sensitivity Analysis

A sensitivity analysis was conducted to assess the stability of the ranking results generated by the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method against changes in criteria weights. This study used seven criteria with weights of the head of the family's income (20%), number of dependents (15%), living conditions (20%), employment status (10%), asset ownership (10%), number of school-age children (15%), and health conditions (10%). The calculation results showed that Lina Marlina (A8) obtained the highest priority value of 0.0920, followed by Siti Aminah (A2) with 0.0895 and Nabila Sari (A12) with 0.0876, while Dedi Kurniawan (A5) obtained the lowest value of 0.0349. The difference in values indicates that alternatives with more vulnerable socioeconomic conditions receive higher priority than alternatives with better conditions. The results of this analysis also show that small changes in the criteria weights do not cause significant changes in ranking because all criteria contribute proportionally in the assessment process. This is reinforced by the consistency test results, which obtained a Consistency Ratio (CR) of 0, confirming the weighting is consistent and can be used as a basis for decision-making. Furthermore, the web-based system implementation produced the same ranking as the manual calculation using the Fuzzy AHP method, proving that the system operates accurately, stably, and is capable of providing objective, transparent, and targeted recommendations for PKH recipients.

3.6. Sensitivity Analysis

A sensitivity analysis was conducted to assess the stability of the ranking results generated by the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method against changes in criteria weights. This study used seven criteria with weights of the head of the family's income (20%), number of dependents (15%), living conditions (20%), employment status (10%), asset ownership (10%), number of school-age children (15%), and health conditions (10%). The calculation results showed that Lina Marlina (A8) obtained the highest priority value of 0.0920, followed by Siti Aminah (A2) with 0.0895 and Nabila Sari (A12) with 0.0876, while Dedi Kurniawan (A5) obtained the lowest value of 0.0349. The difference in values indicates that alternatives with more vulnerable socioeconomic conditions receive higher priority than alternatives with better conditions. The results of this analysis also show that small changes in the criteria weights do not cause significant changes in ranking because all criteria contribute proportionally in the assessment process. This is reinforced by the consistency test results, which obtained a Consistency Ratio (CR) of 0, confirming the weighting is consistent

and can be used as a basis for decision-making. Furthermore, the web-based system implementation produced the same ranking as the manual calculation using the Fuzzy AHP method, proving that the system operates accurately, stably, and is capable of providing objective, transparent, and targeted recommendations for PKH recipients.

3.7. Advantages and Limitations of the System

The developed Fuzzy Analytical Hierarchy Process (Fuzzy AHP)-based decision support system is capable of assisting the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village in a more objective, fast, and structured manner. The system provides alternative data management features, criteria data, value data, analysis, and ranking reports in a single web-based application, making it easier for users to process data and generate recommendations for aid recipients automatically. Furthermore, the system is able to reduce manual calculation errors, increase weighting consistency, and support transparency in the decision-making process. On the other hand, the system still has several limitations. The recommendation results are highly dependent on the accuracy of the data input by the user. The system also only applies the Fuzzy AHP method without providing comparisons with other decision-making methods and is not yet integrated with population databases or government social assistance data.

3.8. System Implementation Challenges

The implementation of a Fuzzy Analytical Hierarchy Process (Fuzzy AHP)-based decision support system for determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village has improved the objectivity, efficiency, and transparency of the selection process. However, its implementation still faces several challenges, such as ensuring that prospective recipient data is always accurate and updated according to community conditions and maintaining consistency in assigning criteria weights to ensure the ranking results remain valid. Furthermore, the Fuzzy AHP method has quite complex calculation stages, requiring users to have a good understanding of how to operate the system. Based on test results, the system has supported the entire decision-making process through login features, management of alternative data, criteria and values, analysis of criteria and alternatives, and automatic printing of ranking results reports. The integration of these features can accelerate data processing, reduce manual calculation errors, and produce more consistent recommendations.

3.9. Implications of Research Results

The results of the study indicate that the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method is able to produce an objective ranking of prospective recipients of the Family Hope Program (PKH) based on seven assessment criteria. Based on the calculation results, Lina Marlina (Alternative 8) obtained the highest priority value of 0.0920, followed by Siti Aminah (0.0895) and Nabila Sari (0.0876), while Dedi Kurniawan (Alternative 5) obtained the lowest value of 0.0349. These results indicate that prospective recipients with more vulnerable socioeconomic conditions receive higher priority than candidates with relatively better conditions. The application of the Fuzzy AHP method has positive implications for the PKH recipient selection process because it is able to reduce subjectivity, increase assessment consistency, and produce more transparent and targeted decisions.

3.10. Comparison of Research Results

Before the implementation of the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method, the process of determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village was carried out manually based on the results of observations and considerations of officers regarding the economic conditions of the community. This mechanism did not use structured weighting, so the assessment of each potential recipient tended to be influenced by subjectivity, took longer and potentially resulted in less consistent decisions when the number of potential recipients increased. In addition, all criteria, such as the income of the head of the family, number of dependents, living conditions, employment status, asset ownership, number of school-age children and health conditions, had not been analyzed proportionally, so the selection process did not fully reflect the level of need of each resident. After the Fuzzy AHP method was implemented, the selection process was carried out through the stages of criteria weighting, priority value calculation, and systematic ranking. The results of the study show that Lina Marlina (Alternative 8) obtained the highest priority value of 0.0920, followed by Siti Aminah at 0.0895, Nabila Sari at 0.0876, Rina Wahyuni at 0.0854, and Intan Permata at 0.0854. On the other hand, Dedi Kurniawan (Alternative 5) obtained the lowest value of 0.0349, which indicates that his socio-economic condition is relatively better than other alternatives. The following is a percentage image of the Comparison before and after the application of the Fuzzy AHP Method in the process of determining PKH social assistance in Sumber Harapan Village.

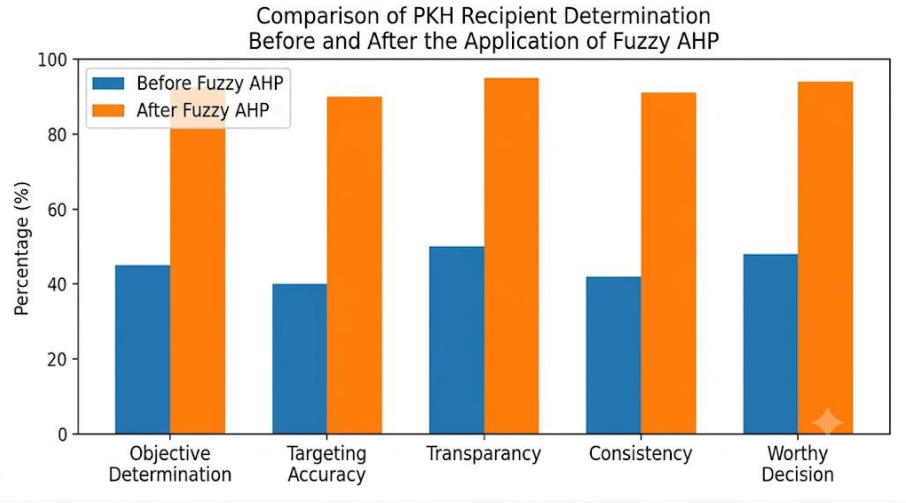

Figure 4. Percentage Comparison Graph of the Performance of the PKH Social Assistance Determination Process Before and After the Fuzzy AHP Method Was Applied

4. CONCLUSION

Based on the research results, it can be concluded that the Fuzzy Analytical Hierarchy Process (Fuzzy AHP) method is effective for determining recipients of the Family Hope Program (PKH) in Sumber Harapan Village because it is able to process various social and economic criteria objectively, systematically, and measurably. The calculation results for 15 alternatives show that Lina Marlina (Alternative 8) obtained the highest priority value of 0.0920, followed by Siti Aminah (Alternative 2) with a value of 0.0895 and Nabila Sari (Alternative 12) with a value of 0.0876, while Dedi Kurniawan (Alternative 5) obtained the lowest value of 0.0349. These results prove that the Fuzzy AHP method is able to produce a ranking of prospective recipients based on seven assessment criteria that is fairer and more targeted. This research also succeeded in developing a web-based decision support system using PHP and MySQL that is able to automate the process of data management, Fuzzy AHP calculations, and presenting selection results quickly and accurately. Testing using the Black Box and White Box methods showed that all system functions ran well according to user needs. As a suggestion for further research, the system can be equipped with real-time integration of population data and social welfare data, so that the validation process for prospective recipients becomes faster and more accurate. In addition, future research can compare the Fuzzy AHP method with other multicriteria decision-making methods, such as Fuzzy TOPSIS, Fuzzy VIKOR, or Fuzzy MOORA, to evaluate the level of accuracy and consistency of the results obtained.

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