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Implementation of a Mamdani Fuzzy-Based Decision Support System for Determining Social Assistance Priorities

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ABSTRACT
Determining the priority of social assistance recipients is a semi-structured problem commonly faced by village governments and social institutions. The manual and subjective selection process often leads to mistargeting and inequitable distribution of aid. This study aims to implement a Decision Support System (DSS) based on the Mamdani Fuzzy method to determine the priority of social assistance recipients. The research object is data on prospective social assistance recipients in Sidowayah Village, Beji District, Pasuruan Regency. The criteria used include income, number of dependents, housing conditions, and employment status. The Mamdani Fuzzy method was selected because it effectively handles uncertainty and linguistic data in the decision-making process. The results demonstrate that the developed system can produce objective, consistent, and adaptive priority rankings for social assistance recipients compared to manual methods and the SAW method. Expert validation through interviews with village officials indicates that the system is deemed feasible for implementation, rated as valid to highly valid.

***Keywords**: Decision Support System; Mamdani Fuzzy; Social Assistance.*

INTRODUCTION
Social assistance serves as one of the government's strategic instruments to improve community welfare and reduce poverty rates. However, a common issue in its implementation is the mistargeting of aid recipients. The determination of recipients, which is still conducted manually and based on deliberation, has the potential to introduce subjectivity and lead to social conflicts.

Case studies at the village level indicate that the lack of decision-support tools results in a selection process for aid recipients that is less transparent and difficult to account for systematically. Therefore, there is a need for a system capable of assisting decision-makers in objectively and measurably determining the priorities of social assistance recipients.

A **Decision Support System (DSS)** is a computer-based system designed to assist in solving semi-structured problems by utilizing data and decision models. One of the methods widely used in DSS is fuzzy logic, particularly the **Mamdani Fuzzy** method. This method can accommodate linguistic values and data uncertainty that frequently arise in assessing the eligibility of social assistance recipients.

Based on this background, this study aims to implement a **Mamdani Fuzzy-based Decision Support System** for determining the priority of social assistance recipients, with a case study in Sidowayah Village, Beji Subdistrict, Pasuruan Regency.

METHOD
- **Research Object and Case Study** The object of this research is the data on prospective social assistance recipients in Sidowayah Village, Beji Subdistrict, Pasuruan Regency. The data used are secondary data obtained from village officials, including information on income, number of family dependents, housing conditions, and employment status.
- **Decision Support System** A Decision Support System (DSS) is a computer-based system designed to assist decision-makers in solving semi-structured problems by utilizing data, models, and specific rules.
- **Mamdani Fuzzy Method** The Mamdani Fuzzy method employs IF-THEN rules and a fuzzy

inference process to generate decision values. The stages of this method include fuzzification, formation of fuzzy rules, inference, and defuzzification using the centroid method.

- **Research Stages** The research stages include problem identification, data collection and analysis, determination of criteria and fuzzy sets, formation of fuzzy rules, system implementation, as well as testing and evaluation of results.
- **Evaluation Criteria** The criteria used in this research consist of income, number of dependents, housing conditions, and employment status.
- **Example of Mamdani Fuzzy Calculation** As an example, a prospective recipient has an income of Rp1,200,000, 4 dependents, fairly decent housing conditions, and irregular employment status. These values are fuzzified into their respective fuzzy sets, then processed using IF-THEN rules. The inference process is performed with the MIN-MAX operator, and the final stage of defuzzification uses the centroid method to produce a priority value.

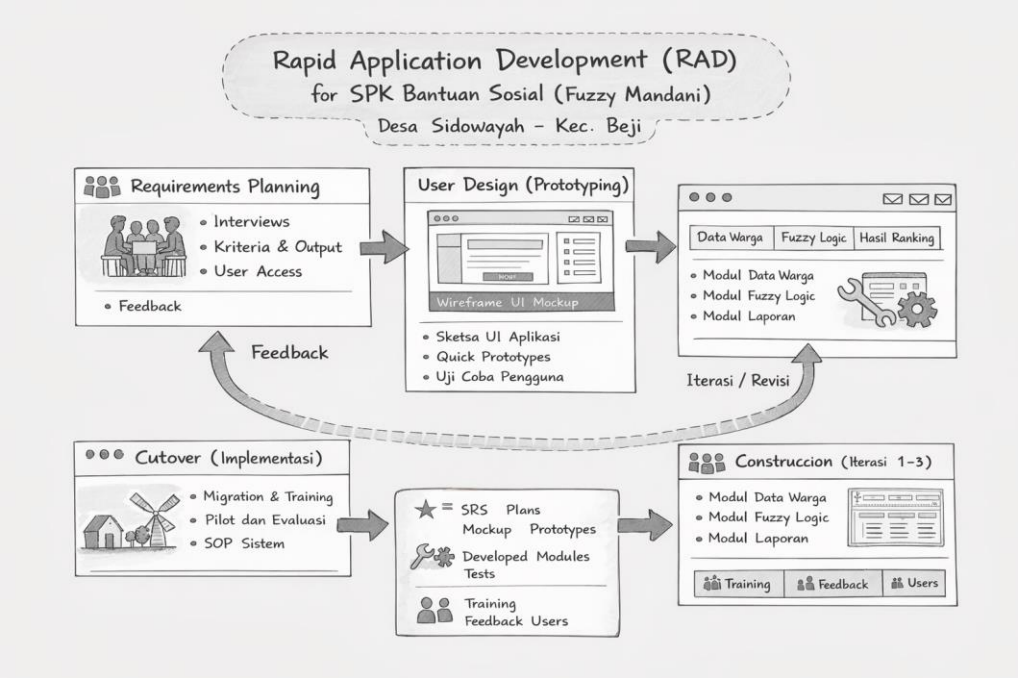

Figure 1. Stage of the Method

RESULT AND DISCUSSION

- **Evaluation Aspects**
  The evaluation aspects used in the system include income, number of dependents, housing conditions, and employment status. These four aspects reflect the socio-economic conditions of the community in Sidowayah Village and serve as the basis for determining social assistance priorities.
- **Conceptual Framework**
  The conceptual framework of the research begins with the collection of data on prospective social assistance recipients, followed by the determination of evaluation aspects, fuzzification process, application of fuzzy rules, inference, defuzzification, and finally obtaining the priority value and decision regarding aid recipients.
- **Calculation Results and Priority Table**
  The calculations using the Mamdani Fuzzy method produce priority values and rankings for prospective social assistance recipients. The result table shows differences in ranking compared to the manual method, indicating a reduction in subjectivity in the decision-making process.

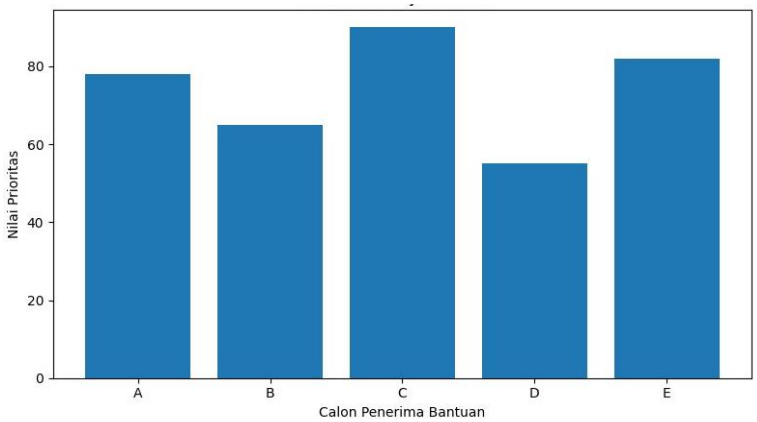

Figure 2. Results of determining the priority of social assistance recipients using the Fuzzy Mamdani Method

- **Comparison with Manual and SAW Methods**
  Comparison with the manual method reveals shifts in ranking (ranking shift). Spearman correlation analysis yields a value of 0.994, indicating a very strong relationship between the two methods; however, the Mamdani Fuzzy approach is more adaptive in handling uncertainty. Comparison with the SAW method demonstrates that Mamdani Fuzzy is more suitable for social problems involving linguistic data. The Spearman correlation value of 0.994 indicates a very strong relationship between the rankings produced by the Mamdani Fuzzy method and the manual method. This suggests that the developed system is consistent with the manual assessments that have long been used by village officials. However, the ranking shifts observed for several candidates demonstrate that the Mamdani Fuzzy method is more adaptive in handling uncertainty and variations in socio-economic data compared to both the manual method and the SAW method.

Table 1. Comparison of Fuzzy Mamdani Vs SAW

Candidate Code	Fuzzy Mamdani Score	Status Rating	
1 R7/06	85	1	1
2 R8/10	79	2	2
3 R5/11	71	3	3
4 R6/02	66	4	5
5 R1/01	58	4	5
6 R3/03	54	6	-3

- **Expert Validation**
  Validation was conducted through interviews with officials from Sidowayah Village. The validation results show an average score on table 2 below (on a 1-5 scale) in the valid to highly valid category, confirming that the system is deemed feasible for implementation. Scale: 1 = Not Valid, 2 = Less Valid, 3 = Quite Valid, 4 = Valid, 5 = Very Valid

Table 2. Sidowayah village interview - expert validation

No.	Validation Aspect	Scale 1-5			Average Category
		Kasi	Kesra	Kades	
1	Criteria Conformity	5	5	5	Very Valid
2	Assessment Rules	4	5	5	Very Valid
3	Field Results and Conditions	5	4	4	4,7
4	User Ease	5	4	4	4,3
5	Implementation Feasibility	5	5	4	Very Valid

- **Research Limitations**
  This study has several limitations that need to be considered. First, the amount of data on prospective social assistance recipients used is still limited and is based on a case study in

Sidowayah Village, so the research findings cannot yet be widely generalized. Second, the evaluation criteria employed are restricted to the aspects of income, number of dependents, housing conditions, and employment status, leaving room for the addition of other, more complex criteria in the future. Third, the developed system has not yet been integrated with real-time population data or village information systems. Nevertheless, this research has successfully demonstrated the effectiveness of the Mamdani Fuzzy method as a decision-support tool at the village level.

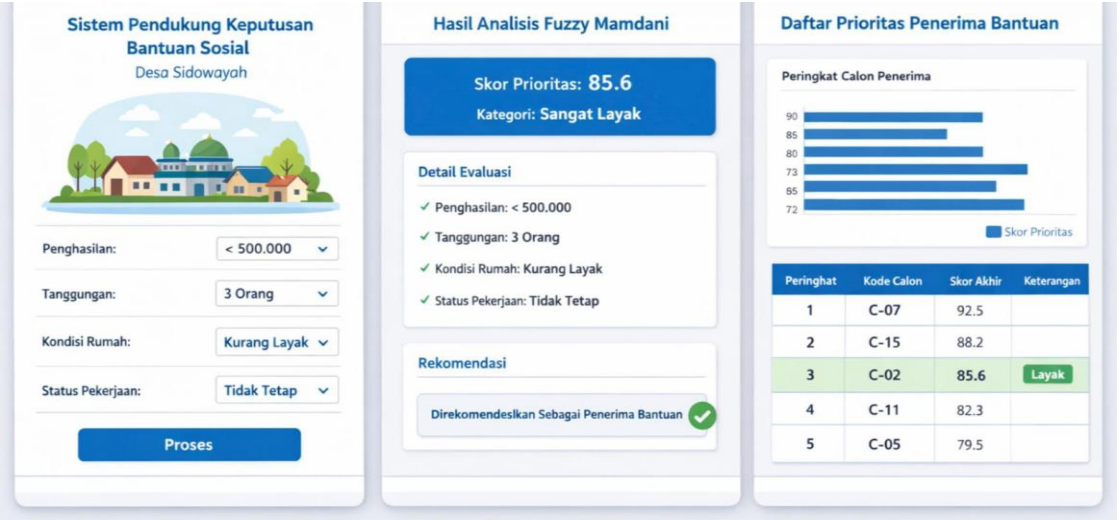

Figure 3. The Study Limitations

CONCLUSIONS

Based on the research findings, it can be concluded that the Decision Support System based on the Mamdani Fuzzy method is capable of determining the priority of social assistance recipients in an objective, systematic, and adaptive manner. Through the case study in Sidowayah Village, Beji Subdistrict, the system has proven to reduce subjectivity in the selection process compared to the manual method and offers greater flexibility than the SAW method.

The main contributions of this research include the application of the Mamdani Fuzzy method supported by expert validation from village officials, multi-method comparative analysis, and visualization of results in the form of tables and graphs that enhance the transparency of decision-making. This study is expected to serve as a reference for village governments in implementing technology-based decision support systems to ensure more accurate and targeted distribution of social assistance.

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