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Decision Support System to Determine Feasibility of Rice Aid Recipient Group Based on K-Means

Aldy Firdaus [*], Muhammad Ramadhan Adi Putra [*], Kun Nursyaiful Priyo Pamungkas [*†], Isna Wardiah [*], Reza Fauzan [*]

Abstract

Poverty is a crucial social problem in many countries. High economic inequality can lead to social instability. The Indonesian government seeks to alleviate poverty through the Rice for the Poor program. However, aid distribution is often off-target. This study proposes a decision support system based on the K-Means method to determine the group of poor rice recipients. The system was developed by following the user's functional requirements, in this case, the Banjarmasin City Social Service. This study involved 50 respondents as a test sample to evaluate the performance of the proposed system. In addition, this study conducted accuracy tests to assess the accuracy of system processing results. The test results show that the system's accuracy in distinguishing qualified and non-qualified candidates further strengthens its potential use in facilitating the allocation of social assistance to those in need.

Keywords: cluster, decision support system, k-mean, poor, rice.

1 Introduction

The Indonesian government, as well as governments in many countries, pay very high attention to poverty. Article 34, paragraph 1 of the Constitution of the Republic of Indonesia, clearly states that the state is obliged to look after the poor and neglected children. Paying attention to poverty alleviation can help society. In contrast, the adverse effects of high poverty rates include triggering social conflict, exacerbating gender disparities, limited access to education, malnutrition, low health standards, limited job opportunities, and being trapped in a cycle of poverty [1]–[3].

The Indonesian government has enacted numerous policies and prioritized poverty alleviation programs to reduce extreme poverty disparities and attain sustainable development goals (SDG). The Government of Indonesia's poverty alleviation programs includes the Rice Program for Poor Families, abbreviated Raskin. The program launched by the government in 2002 was intended to reduce the financial burden of targeted beneficiary households (RTS-PM) in order to sustain family food security and ensure adequate energy and protein consumption.

Recipients of social assistance, including rice assistance, are households that have been registered in the Integrated Social Welfare Data (DTKS) [4], [5]. Based on the DTKS, a coordinating team formed at the regional level decides the names of Raskin beneficiaries. The study in [6]

[*] Politeknik Negeri Banjarmasin, Banjarmasin, Indonesia
[†] Corresponding Author

shows that the Raskin program helps lighten the economic burden of PM-RTS. However, implementing the Raskin program also needs to be improved regarding the inaccuracy of beneficiaries [7]. Therefore, a decision support system is needed to select families entitled to Raskin assistance based on the applicable parameters.

The Analytical Hierarchy Process (AHP) method is a method that has attracted the attention of researchers and practitioners to be utilized in decision support systems. In [8], Fauzi proposed the AHP approach for a desktop-based decision support system for poor rice beneficiaries. The choice of desktop as a platform certainly limits users to one platform. Budget constraints for the coordinating team at the local government level can also trigger software licensing issues. In addition, the AHP method does not focus on making decisions involving many uncorrelated criteria [9]–[11].

This study proposes a decision support system based on k-means to determine the eligibility of the poor rice assistance beneficiary groups. K-means is a clustering method that is considered effective for grouping data correctly. Thus, the proposed system can avoid the unfair distribution of rice to people experiencing poverty. Furthermore, the web becomes the proposed decision support system's platform so that the local government's coordination team can access it anytime and from anywhere and supports various operating systems.

2 Related Works

Dewi and Yulianto [12] built a decision support system to select rice beneficiaries for people experiencing poverty in Kauman Kidul Village, Salatiga City, using the mobile-based Weighted Product (WP) method. The prototype method was chosen as the application development method. In the testing phase, the results of application calculations using the WP method are compared with those of Excel calculations. The test results show that using the WP method to select beneficiaries of poor rice assistance is valid.

Ramdania et al.[13] proposed implementing the El Choination El Choix Traduisant La Realite (ELECTRE) algorithm as a decision support system to furnish guidelines for workable beneficiaries of uninhabitable housing assistance. The data used in this study came from direct observation of the relevant agencies in the Ciamis Regency. The number of test data is 46 respondents. After the testing data is processed using the ELECTRE method, the processing outcomes contrast with the facts on recipients of uninhabitable housing assistance in the preceding year. The test results show that the accuracy of the ELECTRE method reaches 86.956%. The accuracy achieved by the ELECTRE method is good. However, the ELECTRE method must also improve in systems with large amounts of data and criteria [14].

Maulachela et al.[15] introduced the exertion of the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) method to assess who is entitled to receive rice assistance for people experiencing poverty. The accuracy of PROMETHEE was tested using test data from 40 respondents. The results of processing test data with PROMETHEE showed that 34 respondents were eligible to receive assistance, and six were not entitled. These results were then compared with the evaluation by the coordination team, which stated that all respondents were eligible to receive assistance. Based on this test, PROMETHEE has an accuracy rate of 85%.

3 Research Method

In the research method, researchers carried out several stages. The stage begins with identifying the system that is running. Then the researcher formulates a proposed system flow that is built. The next stage is the identification of the data to be used. The next stage is the design of the system to be built, in this context, the author explains the k-means flow that will be implemented. Then the design is implemented.

3.1 System Overview

Based on the system that is already running, a survey process is carried out to make decisions on the grouping of potential beneficiaries. However, the survey used did not refer to predetermined criteria, resulting in a tendency toward subjectivity. In addition, the survey media used is still using conventional methods, namely through paper media.

In general, the system built is a decision support system to assign the eligibility of poor rice recipients by considering indicators of rice recipients in accordance with guidelines set by the government employing the K-Means Clustering algorithm method. As initial input is a list of heads of households that have been recommended by the sub-district and approved by the Office of Social Affairs. Data on the population of family and data on values can be input by the admin manually via the website or in the Excel format provided and the clustering results can be downloaded in a report format in the form of a digital document. Then, the surveyor filled in the assessment of each family head based on predetermined criteria. After all the data has been assessed by the surveyor, the data cluster system uses k-means. The output provided can assist rice distributors in determining who is more entitled to receive the rice assistance. Details of the proposed system overview can be seen in Figure 1. There are three sequential main processes. First, the admin inputs the population to the data collection. Second, the surveyor fills in the data based on field observation. Third, the admin clusters the data collection using k-means.

3.2 Data Identification

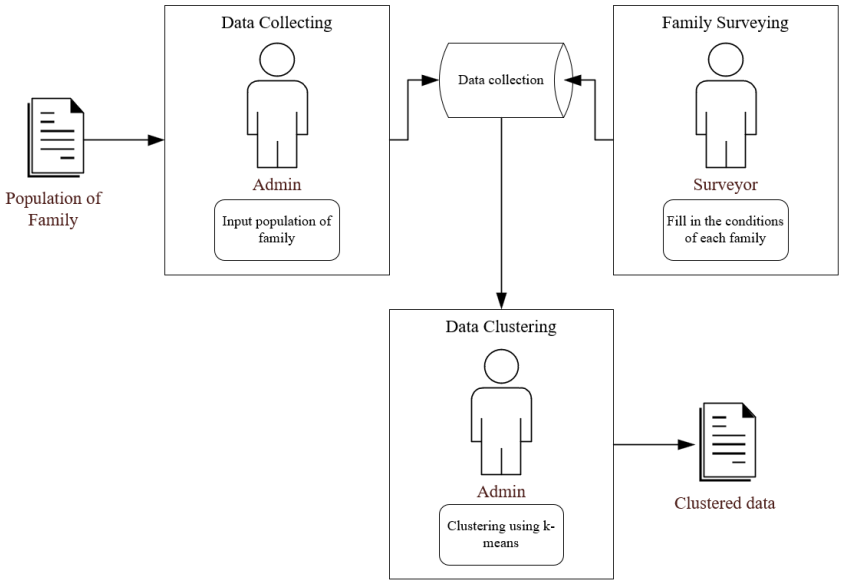

Figure 1: System Overflow

Data collection was carried out using 3 methods, namely observation, interviews, and literature study. Observations are carried out by directly observing what is happening in the field. Interviews were carried out by collecting data directly by dealing with research subjects and technical implementers of research sources. The parties interviewed were the Provincial Social Services Office and the City of Banjarmasin, the Central Bureau of Statistics for the Province of South Kalimantan, representatives of distributors, and recipients of rice food assistance. A literature study is carried out by searching for and collecting materials related to the problem under study to obtain secondary data.

There are two groups of data used in this study. The first is data from each family. Families registered are families that have been recommended from the sub-district to the Social Service as families receiving rice assistance. The second is the criteria data accompanied by weights. The criteria come from the National Team for the Acceleration of Poverty Reduction. There are 14 criteria used in this system, namely the floor area of the house, the type of floor of the house, the type of house walls, defecation facilities, sources of house lighting, sources of drinking water, cooking fuel, dependents of the children of the head of the family, expenses, frequency of meals per day, ability to pay for medical expenses, the income of the head of household, education of the head of the family, and age of the head of the family [16]. Each criterion has a weight. Weight is the result of assessing data on family heads based on existing criteria data. Detailed criteria and weights that serve as a reference can be seen in Table 1.

Table 1: Details of the criteria and weights used to assess the eligibility of beneficiaries.

Criteria	Option	Weight
House floor area	Size > 12 m^2	1
	Size < 12 m^2	0.75
	Size < 10 m^2	0.5
	Size > 8 m^2	0.25
	Size < 6 m^2	0
Types of House Floors	Ceramics	1
	Cement	0.75
	Good Quality Wooden Board	0.5
	Poor Quality Wooden Planks	0.25
	Sand	0
Types of House Walls	Wall with Plaster	1
	Walls without Plaster	0.75
	Wooden board	0.5
	Plywood	0.25
	Asbestos	0
Defecation Facility	Own in the house	1
	Own outside the house	0.75
	Government built public toilets	0.5
	Residents built public toilets	0.25
	Hitching a neighbor's	0
Home Lighting Source	One's own	1
	A mix of residents	0.75
	Hitchhiking belonging to a neighbor pays per day	0.5
	Free hitchiking	0.25
	Wall Lamp	0
Source of Drinking Water	Self billing	1
	Joint Bill of Several Residents	0.75
	Buy per litre	0.5
	River water	0.25
	The well itself is not protected	0

Criteria	Option	Weight
Dependents of the Head of the Family	have no children	1
	Have 1 child	0.75
	Have 2 children	0.5
	Have 3 children	0.25
	Have > 4 children	0
Expenses per 3 months	Rp. 0 s/d Rp. 500.000	1
	Rp. 500.000 s/d Rp. 800.000	0.75
	Rp. 800.000 s/d Rp. 1.200.000	0.5
	Rp. 1.200.000 s/d Rp. 1.500.000	0.25
	Rp. 1.500.000	0
Meal Frequency in a Day	More than 3 times a day	1
	3 times in a day	0.75
	2 times in a day	0.5
	1 time in a day	0.25
	2 days one meal	0
Willingness to Cost of Treatment	> Rp. 1.000.000	1
	Rp. 700.000 s/d Rp. 1.000.000	0.75
	Rp. 500.000 s/d Rp. 700.000	0.5
	Rp. 200.000 s/d Rp. 500.000	0.25
	Rp. 0 s/d Rp. 200.000	0
Income of Head of Household	> Rp. 2.000.000	1
	Rp. 700.000 s/d Rp. 1.000.000	0.75
	Rp. 500.000 s/d Rp. 700.000	0.5
	Rp. 200.000 s/d Rp. 500.000	0.25
	Rp. 0 s/d Rp. 200.000	0
Highest education of the head of the family	High school graduate	1
	Middle school graduate	0.75
	Elementary school graduate	0.5
	Didn't graduate from elementary school	0.25
	Never went to school	0

Criteria	Option	Weight
Cooking Fuel	LPG Gas 12 Kg	1
	LPG Gas 3 Kg	0.75
	Charcoal	0.5
	Oil	0.25
	Firewood	0

Criteria	Option	Weight
Children aged 5 to 15 years not attending school	0	1
	1	0.75
	2	0.5
	3	0.25
	>4	0

3.3 K-Means Classifier

The k-means algorithm is an iterative clustering algorithm that divides statistical units into a predetermined quantity of K clusters. The k-means algorithm is effortless to enforce and execute, reasonably quick, flexible, and widely used in practice. K-Means has historically been one of the most considerable data mining algorithms [17]. K-Means is a non-hierarchical approach to statistics clustering that attempts to divide current data into one or more clusters or organizations [18]. This approach partitions facts into clusters or organizations such that statistics with similar traits (high intra-class similarity) are grouped into identical clusters. In contrast, facts with unique characteristics (low inter-class similarity) are grouped into different groups.

A flowchart is the first step in making a program, which contains pictures or charts showing the order and relationship between processes and their instructions. Relationships between processes are depicted by connecting lines. Then programming translates into a program with a programming language. The flowchart is the stages in the process of clustering the eligibility data for poor rice recipients and clustering. The k-means flow used can be seen in Figure 2.

3.4 System Implementation

System implementation is the stage where the previously designed system can run and be operated. The application is built using PHP and MySQL.

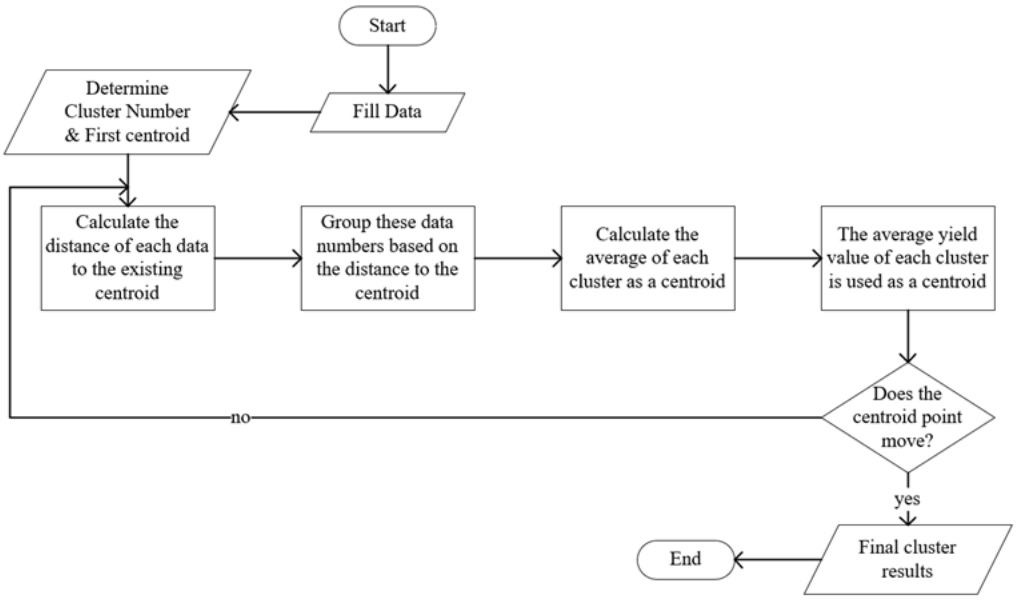

Figure 2: Flowchart of K-Means

4 Result and Discussion

This study aims to develop a decision support system that uses the K-Mean method in determining the group of poor rice recipients. This study involved 50 respondents as a test sample to evaluate the performance of the proposed decision support system. Respondents used in this test are spread across five sub-districts of Banjarmasin. The respondents' economic capacity profile is divided into three groups: people experiencing poverty, the vulnerable, and the non-poor. Therefore, the proposed decision support system will recommend beneficiary candidates into three clusters, namely C1, C2, and C3. C1 is a candidate beneficiary who is in the poor group. Communities included in C1 are those who are eligible to receive rice assistance. C2 is a prospective beneficiary who is in a poor vulnerable group. Furthermore, C3 is a candidate beneficiary who is in the non-poor group. Communities included in clusters C2 and C3 are not entitled to receive assistance.

This study uses two types of testing: black box and accuracy. Black box testing aims to assess whether the decision support system built in the web environment follows functional requirements. The proposed decision support system is built by following the user's functional requirements, in this case, the Banjarmasin City Social Service. Table II displays the functional requirements and black box test results.

In addition, this study performed accuracy testing to evaluate the accuracy of the processing results of the proposed decision support system using the K-Mean method. The same data was processed manually with the Microsoft Excel application. Then the results of manual processing were reviewed by the coordination team. Furthermore, we compared manual processing results with decision support systems' computational results. The test results show that processing using the K-Mean method in this decision support system consistently achieves the same results as manual processing using Microsoft Excel. The results of manual processing and computational decision support systems recommend 17 beneficiary candidates in cluster C1. In other words, 17 heads of households have the right to receive Raskin assistance.

Meanwhile, 33 family heads are not entitled to assistance, consisting of 21 family heads in cluster C2 and 12 family heads in cluster C1. These results show that the K-Mean method implemented in a decision support system has good accuracy and is reliable in determining groups of poor rice recipients. Table III indicates detailed comparisons.

5 Conclusion

Experiment results highlight the effectiveness and reliability of the K-Mean method implemented in the decision support system for determining the groups of poor rice recipients. The system's accuracy in distinguishing eligible and ineligible candidates further reinforces its potential utility in facilitating the allocation of social assistance to those in need.

It is important to note that in developing and utilizing this decision support system, due consideration should be given to the validity and reliability of input data, as well as potential changes in social conditions that may impact the system's outcomes. Future research and improvements could enhance the system's adaptability to evolving socio-economic dynamics and expand its applicability to other contexts.

In conclusion, the study's results demonstrate the successful development and evaluation of a decision support system based on the K-Mean method for determining the group of poor rice recipients. The system exhibits good accuracy and can serve as a valuable tool in the decision-making process related to allocating rice assistance to eligible individuals and households.

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