Decision System for Beneficiaries of the Family Hope Program Using the Rank Order Centroid Method and Weighted Product Method

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Abstract

Poor refers to a state of having little or insufficient material possessions or resources relative to others in a particular society or community. Many factors become the criteria of poverty. These factors identified and measured using the Rank Order Centroid (ROC) method and Weighted Product (WP) method to decide on prospective beneficiaries' social assistance of Program Keluarga Harapan (PKH) or the Family Hope Program. There are 8 criteria used in this research; income of the head of the family, number of dependents, occupation, home ownership, vehicle ownership, condition of the house using Geographical Information system or Global Positioning System (GPS), and having received assistance. The purpose of this study is to facilitate the Samarinda City Social Service in providing appropriate assessments and decisions. The results indicate that the ROC and WP method was successfully applied in decision support systems for the best alternatives with a preference value of 0.000991677.

Keywords: *PKH, Decision Support System, ROC, WP.*

1. INTRODUCTION

Poverty can have significant impacts on a person's quality of life, opportunities, and overall well-being. It can limit access to education and healthcare, lead to inadequate nutrition and housing, and create barriers to economic and social participation. There are varying degrees of poverty, from extreme poverty where individuals struggle to meet even their most basic needs, to relative poverty where individuals have enough to survive but still face limitations in terms of opportunities and resources compared to the broader population.

Efforts to alleviate poverty often involve various social, economic, and political strategies, including social welfare programs, economic development initiatives, education and job training, and advocacy for policies that promote economic equality and opportunity. The problem of poverty is a complex and multidimensional problem so that

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it becomes a development priority.

Indonesian government has had many existing poverty alleviation programs. In poverty alleviation efforts, there are two strategies that must be followed. First, protecting families and groups of poor people by fulfilling their needs from various fields. Second, conduct training for them so that they have the ability to carry out efforts to prevent new poverty [1-6].

The Family Hope Program in Indonesia is an example of a conditional cash transfer (CCT) program designed to alleviate poverty and improve the well-being of vulnerable families. It is part of the government's efforts to address poverty and provide social assistance to those in need. CCT programs like PKH have been implemented successfully in various countries around the world, and they have several key features that make them effective in combating poverty.

Targeted Assistance CCT programs are designed to specifically target the poorest and most vulnerable members of society. These programs often use objective criteria, such as income levels, to identify eligible beneficiaries. Beneficiaries receive regular cash payments from the government, which can be used to meet their basic needs, such as food, education, and healthcare. These cash transfers provide immediate relief from poverty. CCT programs typically have conditions attached to the cash transfers. These conditions are aimed at encouraging behaviors that lead to long-term poverty reduction. For example, families may be required to ensure that their children attend school regularly and receive healthcare check-ups.

PKH has been successful in various countries because it addresses both the immediate needs of impoverished families and the underlying causes of poverty. They provide a safety net while also encouraging beneficiaries to invest in education and healthcare, which can lead to improved prospects for the future. However, the effectiveness of such programs can depend on factors such as proper implementation, adequate funding, and continuous evaluation to ensure they meet their intended goals [7-19].

According to sources from the Coordinating Ministry for Human Development and Culture, the population of Samarinda City in 2022 will be 831,220 people. As many as 8,040 people, residents of Samarinda City fall into the extremely poor category, where people in this category have incomes below Rp. 322,171 per month and this category is the top priority for getting PKH assistance. In the process of selecting thousands of PKH beneficiary data, a Decision Support System is needed that is able to help provide quick and accurate assessments and decisions based on existing criteria.

The selection method for prospective PKH recipients in this study used the Rank Order Centroid (ROC) and Weighted Product (WP) methods. The application was built to help select data on hundreds of thousands of poor people in each region so that they can be selected and decided quickly and transparently. There are several decision support studies that have implemented the ROC and WP methods, where the results of their research also show that the Weighted Product method, complemented by the Rank Order Centroid weighting method, is able to select and make decisions more accurately. The ROC and WP methods make it easy to process the weight of the criteria. ROC gives weight to each criterion according to the ranking which is assessed based on priority level, while the WP method in the decision-making process requires a shorter time calculation, the formula is simpler and easier to apply so that the WP Method is more efficiently applied compared to other methods in Multi-Attribute Decisions Making (MADM) [23-29].

Based on this background, a decision support system for PKH beneficiaries using the ROC-WP method was carried out in order to assist the Samarinda City Social Service in carrying out the selection process for PKH beneficiary candidates. This aims to facilitate the selection of thousands of data on the population of Samarinda City so that the election results are more precise based on existing criteria.

2. LITERATURE REVIEW

2.1 Decision Support System

Decision Support System (DSS) is a system that can help deal with problems in identifying decisions accurately and on target. Decisions made can increase the efficiency of decision-making, and decision-making can be more objective. It provides analytical and data-driven tools to support the decision-making process [23-29].

2.2   Family Hope Program (PKH)

PKH is a social protection program that provides cash assistance to disadvantaged families and communities or very poor families. The community must fulfill the terms and conditions set by laws and local government regulations. This program is a short-term assistance aimed at reducing the burden. The long-term program aims to break the inter-generational poverty chain through health and education services so that their children have sufficient provisions to get out of the poverty trap. The implementation of PKH also supports efforts to achieve the Millennium Development Goals [7-19]. The target beneficiaries of the Family Hope Program are poor families who meet one of the criteria consisting of children aged 0 to 21 years, pregnant/postpartum women, seniors over 60 years, and severe disabilities. PKH beneficiaries are mothers or women who take care of children in the household concerned [7-19].

2.3   Rank Order Centroid

The Rank Order Centroid method is a method that assigns a weight value to each criterion based on its level of importance. The advantage of weighting using the ROC method is that it can determine the order of priority levels of criteria starting from the priority order of the 1st criterion to the last priority order of criteria so that it can show which criteria are more prioritized. In this case, criterion 1 is the highest priority compared to criterion 2, as well as criterion 2 is the highest priority when compared to criterion 3, then the same steps are carried out until the priority of the lowest criterion is [20-23]. Weighting with the ROC method can be formulated as Equation (1).

$$W_j = \frac{1}{n} \sum_{k=j}^{n} \frac{1}{k} \text{ with } j = 1,2, \dots, n \tag{1}$$

W_j : Criteria weight to j

n   : Number of Criteria

2.4   Weighted Product

The WP method is a decision-making method in the form of multiplication that connects attribute ratings, where the results are obtained from each rating raised to the power of the attribute concerned. This concept has been widely used to solve a decision practically. This is because the WP method is a relatively simple method. In general, the settlement process uses the WP method [20], [23-26], as follows;

i. Perform weight repair $\sum w_j = 1$ on each criterion using Equation   (2).

$$W_j \frac{w_j}{\sum w_j} \tag{2}$$

ii. Calculate the score for each alternative using Equation (3)

$$S_i = \prod_{j=1}^{n} X_{ij}^{w_i} \quad \text{where } i = 1,2, \dots, n \tag{3}$$

$\prod$: Product

S_i : Score/value of each alternative

n   : The number of criteria

X_{ij} : The value of the -i alternative to the -j attribute

W_i : The weight of each criterion

iii. Calculating the preference value or vector V for each alternative To find the preference value of each alternative using Equation (4).

$$V_i = \frac{\prod_{j=1}^{n} x_{ij}^{w_i}}{\prod_{j=1}^{n} \left(x_{ij}^{*}\right)^{w_j}} \tag{4}$$

V_i : Alternative preference values

n : The number of criteria

X : Alternative criteria value

W : Criteria weight

i : Alternative

j : Criteria

* : The number of criteria on the value of the vector S

iv. Ranking by sorting preference values from highest to lowest. The best alternative is the alternative that has the highest value and is the result recommended in decision making.

3. METHODS

3.1   Stages of Research Implementation

The stages of conducting research are the stages carried out in carrying out research. In this research will be carried out are the stages of understanding, data collection, design, and implementation. The complete stages of the research implementation can be seen in Figure 1.
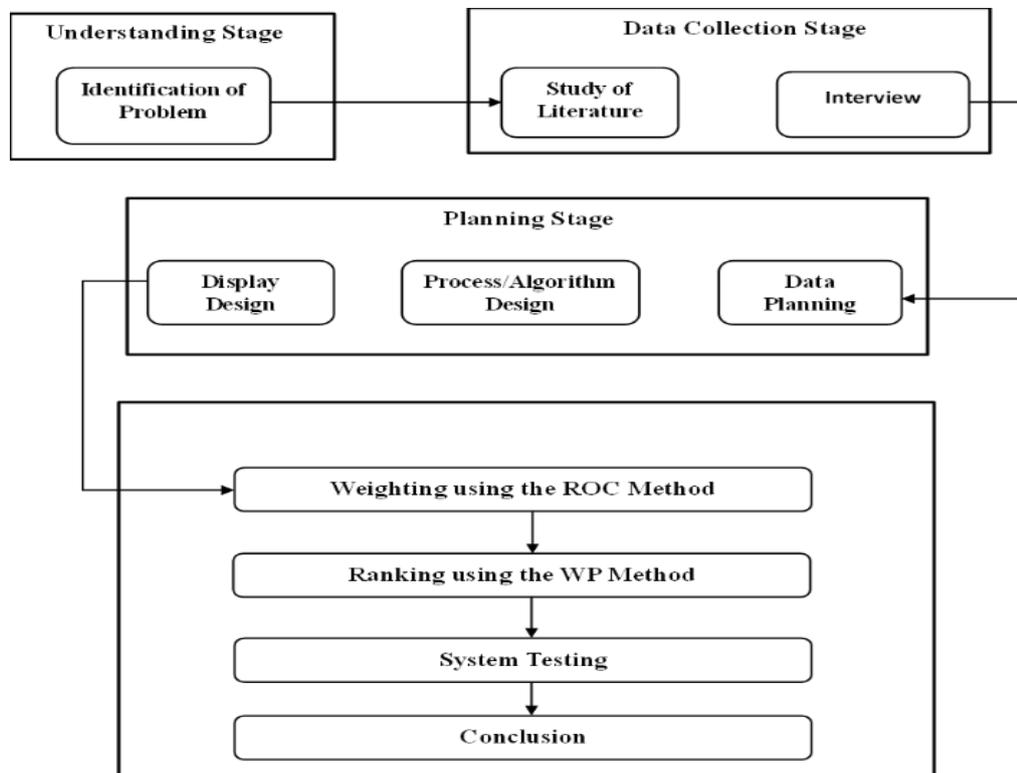

Figure 1. Research implementation stages

3.2   Data Design

Data design is done to process the raw data obtained during data collection. Ready data can be used for system calculations. The data used are criteria, sub-criteria, and alternative data.

3.2.1 Criteria

The criteria used in this study totaled 8 criteria which had been determined based on the results of interviews from the Samarinda City Social Service. The criteria along with their types and order of importance can be seen in Table 1.

Table 1. Criteria for PKH Beneficiary Candidates

No	Code	Criteria	Type
1	C1	PKH category	Benefit
2	C2	Income of the Head of the Family	Cost
3	C3	The number of dependents	Benefit
4	C4	Profession	Cost
5	C5	Homeownership	Cost
6	C6	Vehicle Ownership	Cost
7	C7	Home Conditions	Cost
8	C8	Got Help	Cost

3.2.2 Sub-criteria

The sub-criteria were obtained based on interviews with the Samarinda City Social Service regarding assistance from the Hopeful Family program. Sub-criteria data can be seen in Table 2.

Table 2 Sub-criteria for PKH assistance

Code	Criteria	Sub-Criteria	Value
C1	PKH category	Pregnant women, toddlers, school children, the elderly, severe disabilities	5
		Not included in the category	1
C2	Income of the Head of the Family	< Rp.322.170	1
		Rp.322.170 – Rp. 699.000	2
		Rp.700.000 – Rp.1.000.000	3
		> Rp.1.000.000	4
C3	The number of dependents	< 1 Person (none)	1
		1-2 Person	2
		3-4 Person	3
		5-6 Person	4
		7-8 Person	5
		> 9 Person	6
C4	Profession	Not Yet/Not Working	1
		Housewife	2

| Code	Criteria	Sub-Criteria	Value
		Past Daily Laborers	3
		Household assistant	4
		Trader	5
		Farmers / Gardeners	6
		Driver/Ojek/Transportation	7
		Honorary	8
		Self-employed	9
		Private sector employee	10
		Civil Servant / ASN	11
		Do not have a house/ride / join the family	1
C5	Homeownership	Rent / Rented House	2
		Parent/In-law's house	3
		My own house	4
		Don't have Don't have Vehicle	1
		Bicycle	2
C6	Vehicle Ownership	Vehicle rent	3
		Motorcycle	4
		Car	5
		Wooden Shack	1
		Ground floor, wood/plywood walls	2
		Ground Floor, Stone Wall without Plaster	3
C7	Home Conditions	Wooden house	4
		Semi Permanent	5
		Permanent	6
		Never Yet	1
		Only once	2
C8	Got Help	Been Some	3
		Often	4
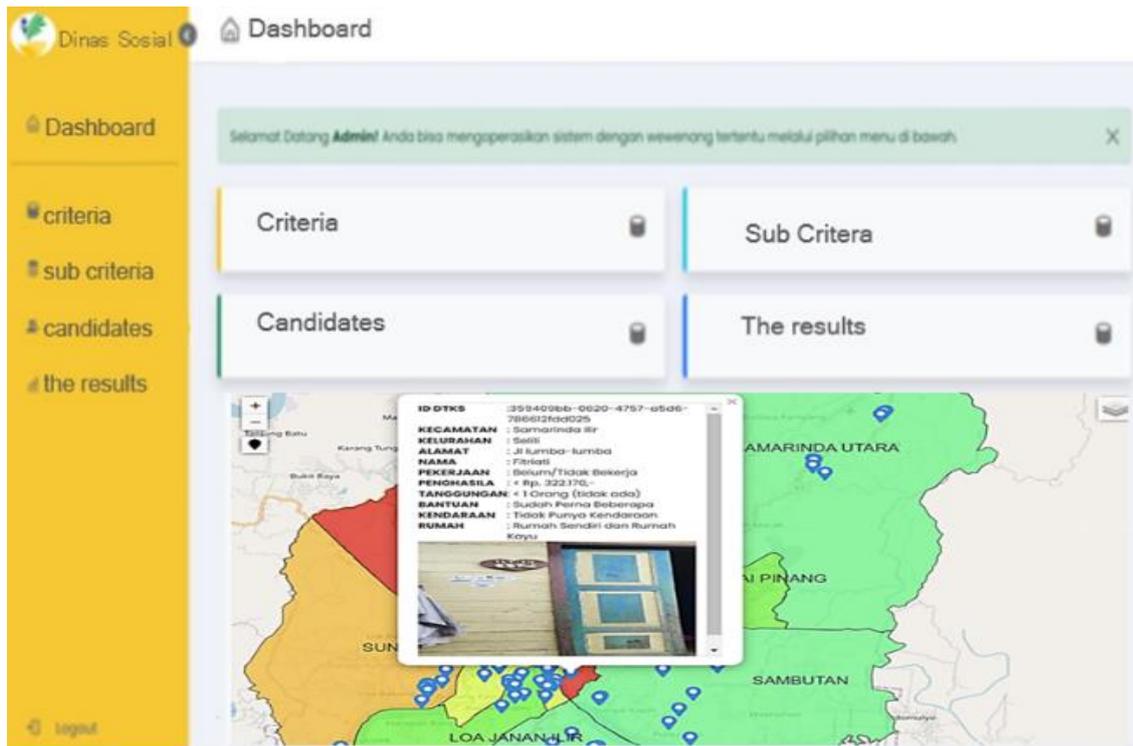
Figure 2. Dashbord Page

The dashboard page display is the first page after the admin logs in. This page contains all the menus available for the admin to input criteria data, sub criteria data, alternative data, and reports. The dashboard page display can be seen in Figure 2.

3.2.3 Alternative

The alternative is data on prospective recipients of PKH assistance. The alternatives used in this study amounted to 4000 alternatives. Data on prospective beneficiaries was obtained from interviews with the Samarinda City Social Service.

3.2.4. Home Location

Google Maps is a widely used web-based mapping service provided by Google. It offers a variety of features and functionalities, making it a valuable tool for navigation, location-based services, and geographical information. GPS stands for "Global Positioning System," and it is a satellite-based navigation system that provides location and time information to users anywhere on or near the Earth's surface. Google Maps and GPS are available as a web application for desktop and as mobile apps for iOS and Android devices (Figure 3) [21-22].

Figure 3. Home Location

4. RESULTS AND DISCUSSION

4.1 Process Implementation

Application of the calculation process to get PKH beneficiary candidates for the ROC-WP method. Several steps were carried out, namely calculating the weight of the criteria using the ROC method, making a decision matrix, calculating the vector S value, calculating the preference value, and determining the ranking from the results of the WP calculation [23-24].

Following are the steps for calculating the selection of PKH beneficiaries using the ROC-WP method:

Criteria weight is calculated based on the Rank Order Centroid formula by first determining the priority ranking order of each criterion used using equation (1). The criteria and weights of the established ROC criteria can be seen in Table III below:

Table 3. Criteria Weight

Criteria	Priorities	ROC Criteria Weight
PKH category	1	$\dfrac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8}$ $= 0.33973214285714$
Income of the Head of the Family	2	$\dfrac{\frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8} = 0.21473214285714$
The number of dependents	3	$\dfrac{\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8} = 0.15223214285714$

1. Develop a decision matrix

Criteria	Priorities	ROC Criteria Weight
Profession	4	$\dfrac{\frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8} = 0.11056547619048$
Home ownership	5	$\dfrac{\frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8} = 0.079315476190476$
Vehicle Ownership	6	$\dfrac{\frac{1}{6} + \frac{1}{7} + \frac{1}{8}}{8} = 0.054315476190476$
Home Conditions	7	$\dfrac{\frac{1}{7} + \frac{1}{8}}{8} = 0.033482141857143$
Got Help	9	$\dfrac{\frac{1}{8}}{8} = 0.015625$

The decision matrix is compiled based on the criteria and sub-criteria data along with the value scale that can be seen in Tables II and III. The resulting decision matrix can be seen in the form of a match rating table in Table IV.

Table 4 Decision Matrix

No	Alternative	C1	C2	C3	C4	C5	C6	C7	C8
1	A1	5	1	5	1	2	1	4	3
2	A2	5	1	5	1	2	1	4	3
3	A3	5	1	5	1	2	1	4	3
4	A4	5	1	5	1	2	1	4	3
5	A5	5	1	5	1	2	1	4	3
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
3999	A3999	1	4	1	10	4	5	6	2
4000	A4000	1	4	1	10	4	5	6	3

2. Calculate the value of the vector S

Calculate the score value or vector value S using the WP method for each alternative using Equation (3) where the variable W uses rank which has a positive value when the attribute is included in the benefit category and uses a rank with a negative value when the attribute is included in the cost category.

- $S_1 = 1^{-0,3704081632} \times 5^{0,22755102} \times 1^{-0,156122449} \times 2^{-0,108503401} \times 1^{-0,0727891157} \times 4^{-0,0442176871} \times 3^{-0,0204081633} = 1,23035288$

- $S_2 = 1^{-0,3704081632} \times 5^{0,22755102} \times 1^{-0,156122449} \times 2^{-0,108503401} \times 1^{-0,0727891157} \times 4^{-0,0442176871} \times 3^{-0,0204081633} = 1,23035288$

- $S_3 = 1^{-0,3704081632} \times 5^{0,22755102} \times 1^{-0,156122449} \times 2^{-0,108503401} \times 1^{-0,0727891157} \times 4^{-0,0442176871} \times 3^{-0,0204081633} = 1,23035288$

- $S_4 = 1^{-0,3704081632} \times 5^{0,22755102} \times 1^{-0,156122449} \times 2^{-0,108503401} \times 1^{-0,0727891157} \times 4^{-0,0442176871} \times 3^{-0,0204081633} = 1,23035288$

- $S_5 = 1^{-0,3704081632} \times 5^{0,22755102} \times 1^{-0,156122449} \times 2^{-0,108503401} \times 1^{-0,0727891157} \times 4^{-0,0442176871} \times 3^{-0,0204081633} = 1,23035288$

- $S_{3999} = 4^{-0,3704081632} \times 1^{0,22755102} \times 10^{-0,156122449} \times 4^{-0,108503401} \times 5^{-0,0727891157} \times 6^{-0,0442176871} \times 2^{-0,0204081633} = 0,291148886$

- $S_{4000} = 4^{-0,3704081632} \times 1^{0,22755102} \times 10^{-0,156122449} \times 4^{-0,108503401} \times 5^{-0,0727891157} \times 6^{-0,0442176871} \times 3^{-0,0204081633} = 0,288749628$

3.   Calculating preference values

Calculating the preference value or vector V using the WP method for each alternative using Equation (4).

- $V_1 = \frac{1,23035288}{1240,67888821932} = 0,000991677$

- $V_2 = \frac{1,23035288}{1240,67888821932} = 0,000991677$

- $V_3 = \frac{1,23035288}{1240,67888821932} = 0,000991677$

- $V_4 = \frac{1,23035288}{1240,67888821932} = 0,000991677$

- $V_5 = \frac{1,23035288}{1240,67888821932} = 0,000991677$

- $V_{3999} = \frac{0,291148886}{1240,67888821932} = 0,000234669$

- $V_{4000} = \frac{0,288749628}{1240,67888821932} = 0,000232735$

4.   Determine the ranking from the calculation results of the WP method

Perform ranking by sorting preference values from highest to lowest. The best alternative is the alternative that has the highest value. The results of ranking using the WP method can be seen in Table V.

Table 5. Ranking Results

No	Alternative	Preference Value	Ranking
1	C1	0,000991677	1
2	C2	0,000991677	2
3	C3	0,000991677	3
4	C4	0,000991677	4
5	C5	0,000991677	5
⋮	⋮	⋮	⋮
3999	C3999	0,000234669	3999
4000	C4000	0,000232735	4000

Figure 4 The Results Page

System testing used the black box testing method with 30 respondents trying the PKH beneficiary, then filling out a survey to provide responses from the experiment on each feature on the website whether the feature was functioning properly or not. The form used is the Google form so that the respondent's answers can be directly seen in the percentage of respondents' answers. After observing the respondents' answers, it can be seen that the feature functionality in each system functions well as expected (Figure 4) [25-28].

5. CONCLUSIONS AND SUGGESTIONS

Based on the results of research in making a decision support system for PKH beneficiaries using the ROC-WP method, the following conclusions are obtained: The system that has been built using the ROC-WP method can provide a decision in the form of a ranking sequence of PKH beneficiary data starting from the highest to the lowest. The results of applying the ROC-WP method to the Decision Support System for PKH beneficiaries obtained the 5 best alternatives with a preference value of 0.000991677.

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