Determination of The Best Koperasi using Simple Additive Weighting (SAW) in Tanah Laut Regency, South Kalimantan

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A B S T R A C T

Office of Koperasi, UKM, and Trade of Tanah Laut Regency, South Kalimantan conducts the health of Koperasi by manually checking the financial report data of each Koperasi. This study aims to determine the best Koperasi performance using a decision-making system with the Simple Additive Weighting (SAW) method. Performance evaluation is based on the criteria in the Technical Instructions for the Deputy for Koperasi Number 15 of 2021 concerning Guidelines for Working Papers on Cooperative Health Examination. The criteria to determine the best Koperasi performance were based on the attributes of the governance, risk profile, financial performance, and capital of Koperasi. The SAW method was used to select the best Koperasi by adding up each attribute, then multiplying by the weight of the related attributes. Based on the calculations using the SAW method,

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Koperasi 33 was selected, with the highest Vector value (V(i)) of 0.944719. Koperasi 33 can be categorized as the best of 100 Koperasi in Tanah Laut Regency, South Kalimantan.

1. Introduction

Koperasi is a business entity consisting of individuals or legal entities based on their activities with cooperative principles as well as a people's economic movement based on kinship principles [1]. Office of Koperasi, UKM, and Trade has the task to inspect health of Koperasi. The inspection is carried out once a year with the aim to increase the awareness of management in realizing the Koperasi with applicable regulations.

Office of Koperasi, UKM, and Trade of Tanah Laut Regency, South Kalimantan conducts the health of Koperasi manually, that is every information data in the financial reports from each Koperasi is collected by the management of Koperasi [2]. It is based on the criteria in Kertas Kerja Pemeriksaan Kesehatan Koperasi (KKPKK) including the assessment of governance, risk profile, financial performance, and capital. In terms of assessing the health of Koperasi, employees of Office of Koperasi, UKM, and Trade of Tanah Laut Regency, South Kalimantan have difficulties because they manually carry out the health of Koperasi. It takes a long time and requires precision to carry out health checks with manual calculations. Office of Koperasi, UKM, and Trade needs a method that can accomplish the problems related to making the best cooperative health decisions with multi-criteria and requires relatively fast processing time.

One of the solutions with the application of information technology is the use of Decision Support Systems (DSS). DSS has several methods, one of them is Simple Additive Weighting (SAW). According to [3], the Simple Additive Weighting (SAW) method is expected to determine the priority or ranking of each alternative. According to [4], the SAW method is carried out by determining alternatives and criteria, assigning criteria values and weights, and normalizing and ranking so that recommendations for decision-making are produced according to the alternatives, criteria and criteria weights needed.

In their research, [5] stated that the Weighting Product (WP) method has a better level of suitability than Simple Additive Weighting (SAW) in solving lending problems. [6] compared AHP and SAW in assessing employee performance, where AHP was also better than SAW. The merging of the AHP and SAW methods was also carried out by [7] in determining the recipients of cooperative loan funds, where the loan recipients at KOPWALI have equivalent values to the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods.

[8] by applying the Simple Additive Weighting method to determine outstanding cooperatives (Case Study of the West Java Office of Koperasi and UMKM), can solve decision-making problems with multiple criteria in determining outstanding cooperatives. [9] in his research stated that a decision support system using the Electre method can assist in making decisions to determine the best Koperasi at Office of Koperasi, UKM, and Trade of Pekanbaru. It can make the right decision based on predetermined criteria.

This study used the SAW method to weigh the criteria and the ranking. The basic concept of the SAW method is finding the weighted sum of the performance ratings of each alternative on all attributes. The SAW method is appropriate to the needs of the employees at the Office of Koperasi, UKM, and Trade of Tanah Laut Regency, South Kalimantan. It requires a weighted sum to determine the best Koperasi many criteria (multi-criteria) for assessment consisting of governance, risk profile, financial performance, and capital, which is based on the Technical Instructions of the Deputy for Koperasi Number 15 of 2021 on Koperasi Health Examination

Working Paper. The study aims to help the Office of Koperasi, UKM, and Trade of Tanah Laut Regency, South Kalimantan, determine decision-making in assessing the best Koperasi performance.

KOPERASI HEALTH CRITERIA

Koperasi intends to improve the economic welfare of its members and create a just and prosperous society. Koperasi health assessment criteria based on Petunjuk Teknis Deputi Bidang Perkoperasian No.15 of 2021 in KKPKK are Governance, Risk Profile, Financial Performance, and Capital [10].

Governance

The governance aspect is an assessment of the questionnaire consisting of 3 variables, namely principles, institutions, and management of Koperasi:

- **Principles**, including the voluntary and open membership, democratic management, fair distribution of the remaining business results in proportion to the number of business services each member provides, limited remuneration for capital, independence, cooperative education, and cooperation between cooperatives
- **Institutions**, including the legality of legal entities, savings and loan business licenses and or financing, articles of association, membership, and organizational completeness of Koperasi.
- **Management**, including general management, institutional management, capital management, asset management, and liquidity management.

Governance aspect consists of 3 variables with 17 indicators and 77 questions. The calculation of each indicator and the total number of governance aspects are:

$$Per\ indicator = \frac{Number\ of\ Questions\ Score}{Number\ of\ Questions\ per\ Indicator} \times 100 \quad (1)$$

$$Governance = \frac{Total\ Score\ 17\ indicators}{Number\ of\ Governance\ Indicators\ (17)\times 4} \times 100 \quad (2)$$

Risk Profile

The risk profile aspect is a questionnaire assessment of financial data consists of 2 (two) components, namely the Inherent Quality and the Quality of Risk Management Implementation. The risk profile aspect consists of 2 components, 12 variables, 31 indicators, 4 sub-indicators or financial data assessments, and 106 questions. Calculation of the risk profile aspect score for the assessment of questionnaires or questions and the total number of risk profile aspects are:[11]

$$Governance = \frac{Total\ Score\ 31\ indicators}{Number\ of\ risk\ profile\ Indicators\ (31)\times 4} \times 100 \quad (3)$$

Financial Performance

The financial performance aspect is a questionnaire assessment of financial data consists of 3 (three) components, namely the Financial Performance Evaluation, Financial Management, and Financial Sustainability. Each component consists of several variables, each variable consists of several indicators, and each indicator consists of several sub-indicators or questions. The financial performance aspect consists of 3 components, 6 variables, 29 indicators, and 29 sub indicators or financial data assessments. Every sub-indicators has its calculation, and the sum score of each sub-indicator will be the total score of 29 indicators. Calculation of the total number of financial performance aspects is:[5]

$$Financial\ Performance = \frac{Total\ Score\ 29\ indicators}{Number\ of\ Financial\ Performance\ Indicators\ (29)\times 4} \times 100 \quad (4)$$

Capital

The capital aspect is an assessment of financial data consisting of 2 (two) variables, namely capital adequacy and capital management adequacy. The capital aspect consists of 2 variables, 5 indicators. Every indicators has its calculation, and the sum score of each indicator will be the total score 5 indicators. Calculation of the total number capital aspect, namely:[11]

$$Capital = \frac{Total\ Score\ 5\ indicators}{Number\ of\ Capital\ Indicators\ (5)\times 4} \times 100 \quad (5)$$

SIMPLE ADDITIVE WEIGHTING

The Simple Additivie Weighting (SAW) method is a weighted addition method used in simple and classic

multi-criteria decision-making systems. The basic concept of the SAW method is finding the weighted sum of the performance ratings on each attribute of each alternative on all attributes [12] .The stages of the SAW method as follows:[8]

1. Determine the criteria as a reference in making decisions.
   The determination of the number of criteria (C1, C2, C3 and C4) has been determined by the Technical Instructions of the Deputy for Koperasi Number 15 of 2021 concerning Guidelines for Working Papers on Koperasi Health Checks, which consist of Governance, Risk Profile, Financial Performance and Capital.

$$C_j \ with \ j = 1,2,...,n \qquad (6)$$

2. Determine the weight for each criterion
$$W_j = \frac{Total \ Weight \ of \ Each \ Criterion}{Total \ Weight},$$

$$W_j \ with \ j = 1,2,...,n \qquad (7)$$

3. Normalize the decision matrix by performing a comparison process on all alternative values in the following equation:
$$If \ j \ is \ benefit \ attribute \ , then \ r_{ij} = \frac{x_{ij}}{\max_i x_{ij}}$$

$$(8)$$

$$If \ j \ is \ cost \ attribute \ , then \ r_{ij} = \frac{\min_i x_{ij}}{x_{ij}}$$

$$(9)$$

with:

r_{ij} : Normalized performance rating value

x_{ij} : Attribute value of each criterion

x_{ij} : Maximum value of each criterion

x_{ij} : Minimum value of each criterion

4. Calculate the preference value for each alternative (Vi) with the following equation:
$$V_i = \sum_{j=1}^{n} W_j \times r_{ij}$$

$$(10)$$

with:

V_i : Rank for each alternative, $i = 1,2,....m$

W_j : Weight value of each criteria,$j = 1,2,....n$

5. Alternative selection, where the chosen alternative is the alternative with the largest V_i value

2. Method

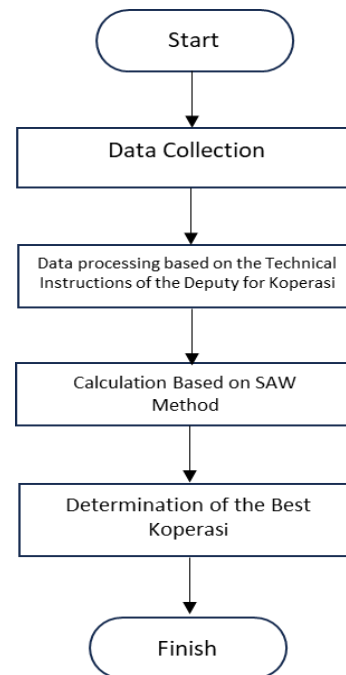The research method used in this study is presented in Figure 2.

Figure 2. Research Method

3. Result and Discussion

The application of the Simple Additive Weighting (SAW) method for evaluating Koperasi with achievements in Koperasi and UMKM Service of West Java is carried out by providing an assessment of each criterion but is subjective and not based on the applicable technical guidelines so that the results obtained are not optimal [8]. In comparison, the evaluation of the best Koperasi in the Office of Koperasi, UMKM, and Trade of Tanah Laut uses the Simple Additive Weighting (SAW) method, which is based on criteria based on the Technical Instructions

of the Deputy for Cooperatives Number 15 of 2021 concerning Guidelines for Working Papers for Cooperative Health Examination.

The stages of the decision-making system using SAW in determining the best cooperative are as follows.

1) Determine the criteria as a reference in making decisions. Based on the results of interviews using Technical Instructions of the Deputy for Cooperatives Number 15 of 2021 in KKPKK there are 4 criteria in each alternative value which are presented in Table 1

TABLE 1. The Criteria of Koperasi Health

Alternative	Governance	Risk Profile	Financial Performance	Capital
Kop.1	84,6096	61,7803	61,8067	66,5657
Kop.2	69,9149	62,3945	67,0688	64,2247
Kop.3	62,8029	97,2342	63,0441	69,9935
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
Kop.98	91,9688	85,9751	96,996	81,05
Kop.99	63,1994	63,0013	73,0456	90,3729
Kop.100	73,3999	61,9542	89,9183	93,8724

2) Determine the weight for each criterion. The equation to obtain the repair weight as follows:
$$W_j = \frac{Total\ Weight\ of\ Each\ Criterion}{Total\ Weight},$$

$$j = 1, 2, \ldots, n$$

The total weight for each criterion has been determined in the Technical Instructions of the Deputy for Cooperatives Number 15 of 2021 concerning Guidelines for Cooperative Health Examination Working Papers.

$$W_1 = \frac{30}{100} = 0{,}3$$

$$W_2 = \frac{15}{100} = 0{,}15$$

$$W_3 = \frac{40}{100} = 0{,}4$$

$$W_4 = \frac{15}{100} = 0{,}15$$

The normalization results are obtained from the determination of the type of benefit criteria, so it is positive (+).

TABLE 2. The Initial Weight for Each Criterion

Criteria	Type	Normalization
C1	*Benefit*	0,3
C2	*Benefit*	0,15
C3	*Benefit*	0,4
C4	*Benefit*	0,15
Normalization of W_j		1

The determination of the number of criteria (C1, C2, C3 and C4) has been determined by the Technical Instructions of the Deputy for Cooperatives Number 15 of 2021 concerning Guidelines for Working Papers on Cooperative Health Checks, which consist of Governance, Risk Profile, Financial Performance and Capital.Normalize the decision matrix. The maximum and minimum value each citeria as follows:

TABLE 3. Max and Min value for Each Criterion

Alternative	Governance	Risk Profile	Financial Performance	Capital
Kop.1	84,6096	61,7803	61,8067	66,5657
Kop.2	69,9149	62,3945	67,0688	64,2247
Koperasi 3	62,8029	97,2342	63,0441	69,9935
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
Koperasi 98	91,9688	85,9751	96,996	81,05
Koperasi 99	63,1994	63,0013	73,0456	90,3729
Koperasi 100	73,3999	61,9542	89,9183	93,8724
MAX	98,6298	98,0429	98,4657	98,3934
MIN	60,2538	60,2318	60,0243	60,5388

Calculation of the normalized value of r_{ij} for Koperasi 1 :

$$r_{i1} = \frac{84,6096}{98,6298} = 0,8579$$

$$r_{i2} = \frac{61,7803}{98,0429} = 0,6301$$

$$r_{i3} = \frac{61,8067}{98,4657} = 0,637209$$

$$r_{i4} = \frac{66,5657}{98,3934} = 0,6765$$

TABLE 4. Normalization value for Each Criterion

Alternative	Governance	Risk Profile	Financial Performance	Capital
Koperasi 1	0,8579	0,6301	0,6277	0,6765
Koperasi 2	0,7089	0,6364	0,6811	0,6527
Koperasi 3	0,6368	0,9918	0,6403	0,7114
Koperasi 4	0,6133	0,7407	0,7022	1,0000
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
Koperasi 97	0,7903	0,9599	0,7050	0,6314
Koperasi 98	0,9325	0,8769	0,9851	0,8237
Koperasi 99	0,6408	0,6426	0,7418	0,9185
Koperasi 100	0,7442	0,6319	0,9132	0,9541

3) Calculate the preference value. Calculation of preference value for each alternative is as follows:
$V_1 = (0,3000 \times 0,8579) + (0,1500 \times 0,6301) + (0,4000 \times 0,6277) + (0,1500 \times 0,6765) = 0,7044$

$V_2 = (0,3000 \times 0,7089) + (0,1500 \times 0,6364) + (0,4000 \times 0,6811) + (0,1500 \times 0,6527) = 0,6784$

$V_3 = (0,3000 \times 0,6368) + (0,1500 \times 0,9918) + (0,4000 \times 0,6403) + (0,1500 \times 0,7114) = 0,7025$

TABLE 5. The calculation results of preference values

No.	Alternatif	Vektor (V_i)
1	Koperasi 33	0,944719
2	Koperasi 98	0,928866
3	Koperasi 69	0,916069
4	Koperasi 60	0,915385
5	Koperasi 76	0,909292
:	:	:
:	:	:
:	:	:
97	Koperasi 57	0,702238
98	Koperasi 78	0,701737
99	Koperasi 2	0,678484
100	Koperasi 62	0,6413

4) Chosen alternative
The result of preference value of Table 5 give the order of the highest preference value to the lowest preference value. Based on the preference value, it is indicated that Koperasi 33 has the highest value with $V_i = 0,944719$. It means that Koperasi 33 can be categorized as the best Koperasi among others.

4. Conclusion

Based on the calculation using Simple Additive Weighting (SAW) method with reference to the assessment based on the criteria used, namely governance, risk profile, financial performance, and capital, Koperasi 33 was selected which had the highest vector value $V_i = 0.944719$. This means that Koperasi 33 can be categorized as the best Koperasi among others based on the Petunjuk Teknis Deputi Bidang Perkoperasian Nomor 15 Tahun 2021 concerning guidelines for Pedoman Kertas Kerja Pemeriksaan Kesehatan Koperasi. It means that Koperasi 33 can be categorized as the best Koperasi out of 100 Koperasi in Tanah Laut Regency, South Kalimantan Province. Suggestions for the future are to

use other Decision Support Systems methods, combine or compare Decision Support Systems methods in determining the best Koperasi.

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