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COMPARISON OF SIMPLE ADITIVE WEIGHTING MEHOD WITH MULTI-OBJECTIVE OPTIMIZATION BY RATIO ANALYSIS

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Abstract: One of the advantages of the MOORA method is its high flexibility and good selectivity. This is because MOORA is able to determine the goals of conflicting criteria, where the criteria can be profitable or unfavorable. While the advantage of the SAW method is that it can determine the weight value of each attribute, then proceed with a ranking process that will select the best alternative from a number of alternatives and the assessment will be more precise because it is based on the predetermined criteria and preference weights. Some of the weaknesses of the SAW method include, the data entered must be correct and precise, so as not to cause errors during the weighting and ranking of criteria, while the drawback of this MOORA method is that there must be a weight that is calculated to continue the calculation of the data which is then calculated on each criterion and range of criteria. This is what prompted the researchers to explore the research entitled "Comparison of the Simple Additive Weighting Method (SAW) with Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) in determining the best housing". This research activity plan is carried out in the Medan city area using data that has been published previously through national journals in Indonesia. The final result of the research is expected to be obtained by comparing the results of the two methods according to the decision support system data used, and the results of the research will be published on Sinta 4 accredited national journal articles or better.

Keywords:***Best housing,comparison of SAW method with MOORA,MOORA method, SAW method, SAW and MOORA decision support system.***

INTRODUCTION

Presidential Instruction number 3 of 2006 contains a policy package for improving the investment climate of the President of the Republic of Indonesia. In the manpower section it is stated that the Minister of Manpower and Transmigration must facilitate the application of appropriate technology in the development and expansion of employment and business fields, including in transmigration areas. With this INPRES, it is hoped that the Indonesian people in general, and in particular those who have the economic capacity of the middle class and below will be assisted in choosing and owning housing to sustain their lives and those of their families. According to the website that provides subsidized housing information, the number of subsidized housing continues to grow every year. One of them is the Medan Municipality, where there are dozens of subsidized housing as an alternative for people to own a home. However, the process of determining the best housing in the Medan Municipality is very difficult for people who want to take a house, due to ignorance or lack of information about housing. Therefore, the best method is needed to support decision making in determining the best housing for people who live in

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the municipality of Medan.There are several methods used previously to select housing locations, such as the Simple Additive Weighting (SAW) method, but they have weaknesses in determining the attribute criteria, greatly affecting the error in the final calculation results.Researchers apply the two methods of the Multi-Objective Optimization by Ratio Analysis (MOORA) and SAW methods in determining the best housing, especially the Medan municipality area. The reason researchers use these two methods is because several previous researchers used a lot of decision support systems using the MOORA method in solving problems in decision makers. With this research, the community will gain new knowledge about subsidized housing in the Sei Mencirim area, thereby minimizing existing problems in determining the housing the community wants to live in. The outcome that the researchers promised in this study was an accredited journal sinta 4 or better.

LITERATURE REVIEW

The Program Indonesia Pintar (PIP) is an educational scholarship from the government for students who lack funds to continue their education, one of which is at the junior high school level. It is still done manually when selecting students who are eligible to receive the PIP scholarship at the junior high school level. This is less efficient because the selection process will take a long to analyze, and the reporting process is not yet computerized. To overcome these problems, a decision support system is needed to assist schools in selecting students who receive PIP assistance. The method used for the development of a decision support system is Simple Additive Weighting (SAW). The choice of this method is because the decisionmaking process is carried out by searching for the highest alternative from all alternatives so that the assessment is more accurate based on the provisions of the criteria values and preference weights. With the construction of this system, it is expected to be able to provide a solution so that the student selection decisionmaking process can be carried out quickly and accurately. Keywords: Decision Support System(Septiana et al., 2022), Penerimaan siswa baru merupakan salah satu proses yang ada di instansi Pendidikan untuk menyaring calon siswa yang terpilih sesusai kriteria yang ditentukan. Pada umumnya proses penerimaan siswa baru dilakukan melalui tahap pendaftaran, seleksi berkas dan penerimaan siswa. Akan tetapi proses seleksi penerimaan siswa di SMAN 1 Cikakak Palabuhanratu Jl. Padurenan Km. 1 Cikakak Kab. Sukabumi masih menggunakan cara manual sehingga menimbulkan masalah yang masih sering terjadi yaitu sulitnya menyeleksi satu persatu calon siswa yang akan diterima, hal tersebut dapat diatasi dengan menggunakan metode SAW(Abdillah, 2021). MCDM didefinisikan sebagai gabungan metode kualtatif dan kuantitatif yang berkaitan dengan beberapa kriteria. Model ini diklasifikasikan dalam kategori MADM dan MODM. Penelitian ini menggunakan metode AHP, TOPSIS, dan MOORA dengan pengukuran tingkat keakuratan ranking menggunakan uji sensitivitas. Dari hasil percobaan yang dilakukan peringkat pertama pada metode AHP yaitu alternatif AU dengan nilai preferensi sebesar 0,1335. Disisi lain peringkat pertama pada metode TOPSIS dan MOORA adalah alternatif DA dengan nilai preferensi 0,7392 dan 0,0581. pada kasus ini TOPSIS merupakan metode yang memiliki nilai preferensi paling tinggi, sedangkan MOORA memiliki nilai preferensi paling rendah yaitu 0,0581. berdasarkan uji sensitivitas, metode MOORA merupakan metode paling baik dengan menghasilkan 2 nilai terendah dari 3 uji sensitivitas yang dilakukan yaitu nilai uji sensitivitas 1 sebesar 0,0058 dan sensitivitas 3 sebesar 0,0029 (Nurhaliza et al., 2022). The difference between the research that will be carried out and the previous research is that this research will focus on obtaining differences in the analysis of the calculations of the SAW and MOORA methods, in accordance with the concept of a decision support system, so that the best method will be obtained at this time, especially in determining housing for urban communities. middle of Medan (Budihartanti&Nasution, 2020).

METHOD

The method used by SAW and MOORA is to analyze the results of calculations in determining the best subsidized housing in the Medan municipality, while the data used are data that has been published so far

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in the Medan municipality (Indra Borman, 2018). The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings (Budiman et al., n.d.; Efendi, 2019).

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \text{ if j is the attribute benefit} \qquad (1)$$

$$r_{ij} = \frac{Min(x_{ij})}{x_{ij}} \text{ if j is the attribute cost} \qquad (2)$$

Description:
x = decision matrix, r = performance rating of the alternatives, max = the highest score
min = the lowest value, The alternative preference value is (V_i) given as:

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \qquad (3)$$

Description:
V_i = ranking for each alternative, w = weight value of each criterion, rij = normalized performance rating value

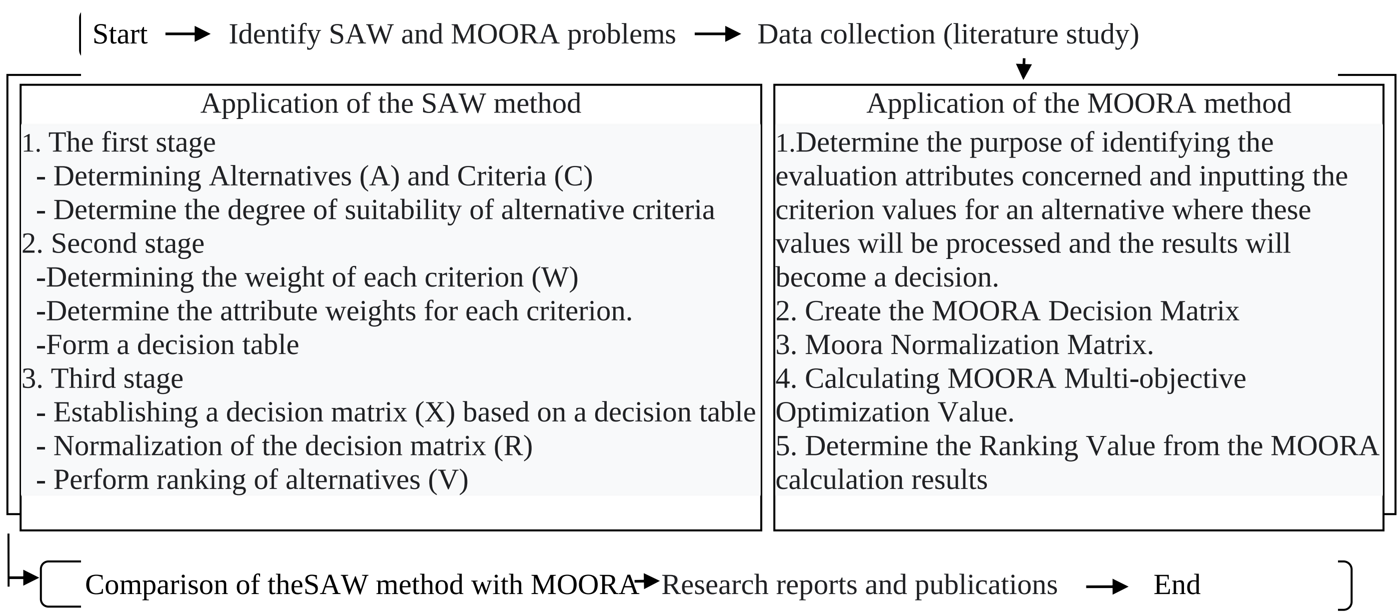

Figure 1. Flow chart of the SAW and MOORA solution methods

The steps taken to solve the problem in the decision using the MOORA method are as follows:

Step 1: Determine the objective of identifying the relevant evaluation attributes and inputting the criterion values for an alternative where these values will be processed and the results will become a decision.

Step 2: Create the MOORA Decision Matrix

Represents all available information for each attribute in the form of a decision matrix. Equation (1) represents an X m x n matrix. Where xij is the performance measurement of the ith alternative on the jth attribute, m is the number of alternatives and n is the number of attributes/criteria. Then a ratio system is

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developed in which each performance of an alternative on an attribute is compared with a denominator which is representative for all alternatives on that attribute.

$$X = \begin{bmatrix} X_{11} & . & X_{1i} & . & . & X_{1n} \\ . & . & . & . & . & . \\ X_{j1} & . & X_{ij} & . & . & X_{jn} \\ . & . & . & . & . & . \\ X_{m1} & . & X_{mi} & . & . & X_{mn} \end{bmatrix} \quad \text{.......................................(4)}$$

Description:

Xij = alternative response j on criterion i, i = 1,2,3,4…….. n is the attribute or criteria sequence number, j = 1,2,3,4…….. m is the alternate sequence number, X= Decision matrix

Step 3. Moora Normalization Matrix

This ratio can be expressed as follows:

$$X^*ij = \frac{S_{ij}}{J\left[\sum_{J=1}^{M} Sij^2\right]} \quad \text{.......................................(5)}$$

Description:

$\mathbf{x_{ij}}$ **:** Alternative matrix j on criterion i, **i** : 1,2,3, ..., n is the attribute or criterion sequence number

j : 1,2,3, ..., m is the alternate sequence number, $\mathbf{X^*_{ij}}$: Alternative normalization matrix j on criterion i

Step 4: Calculating MOORA's Multi-Objective Optimization Value

a. If the attributes or criteria for each alternative are not given a weight value. The normalized size is added in the maximization case (for favorable attributes) and reduced in minimization (for unfavorable attributes) or in other words it reduces the maximum and minimum values for each row to get the ranking for each row, if it is formulated then:

$$\mathbf{y^*_j} = \sum_{i=1}^{i=g} x^*ij - \sum_{i=g+1}^{i=n} x^*ij \quad \text{.......................................(6)}$$

Description:

i : 1,2,3, ..., g is an attribute or criterion with maximized status

j : g+1, g+2, g+3, ..., n is an attribute or criterion with minimized status

$\mathbf{y^*_j}$: Alternative max-min Normalization Matrix j

b. If the attributes or criteria for each alternative are assigned a weighted value of importance. Giving a weight value to the criteria, provided that the maximum criteria type weight value is greater than the minimum criteria type weight value. To indicate that an attribute is more important it can be multiplied by the appropriate weight (signification coefficient). The following is the formula for calculating the MOORA Multi-Objective Optimization value,

$$y_i = \sum_{j=1}^{g} w_j x^*_{ij} - \sum_{j=g+1}^{n} w_j x^*_{ij} \quad \text{.......................................(7)}$$

Description:

i : 1,2,3, ..., g are attributes or criteria with maximized status, j : g+1, g+2, g+3, ..., n are attributes or criteria with minimized status, wj : weight to alternative j, y*j : Normalized value of alternative j to all attributes, x*ij : Normalized matrix of alternative j to criterion i.

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Step 5: Determine the Rank Value from the MOORA calculation results

The yi value can be positive or negative depending on the maximum total (favorable attribute) in the decision matrix. A ranking order of yi indicates the final choice. Thus the best alternative has the highest yi value while the worst alternative has the lowest yi value.

Table 1 The best housing criteria

Code	Criteria	Descripsion
C1	The price of the diversity of site selection	Cost/MIN
C2	Buyer-choice PCA (Principal Component Analysis) feature vector	Benefit/MAX
C3	The age of the respondent to the house request	Benefit/ MAX
C4	The price of each variable is the developer's choice	Cost/MIN
C5	The value of the weight of the work that wants to own a house	Benefit/ MAX

Based on the description of the data that has been collected, the researchers and objects that are used as part of the research conduct data analysis so that sub-criteria are found as the needs of the calculation process, the following are the results of the sub-criteria analysis:

Table 2 Sub-criteria for the best housing

Criteria	Description	Sub Criteria Value
C1	The price of the diversity of site selection	Very Good, Good, Fair, Bad
C2	PCA (Principal Component Analysis) feature vector chosen by the developer	Very Good, Good, Fair, Bad
C3	The age of the respondent to the house request	Cheap, Standard, Expensive, Very Expensive
C4	The weight of each developer's choice variable	Very Good, Good, Fair, Bad
C5	The value of the work weight that chooses	Very Good, Good, Fair, Bad

Alternative Data

Where is the alternative data needed to be determined to be the best subsidized house after going through the MOORA Method calculation process as follows:

Table 3. Alternative data

Alternative	Residential Name
A1	Tamora Residence
A2	Green View Sunggal
A3	Perumahan Subsidi Delitua
A4	Cluster Cengkeh Turi
A5	Wonosari Asri Residence

RESULT

Simple Additive Weighting (SAW) Method

In selecting the best subsidized housing using the SAW method, criteria and weights are needed to carry out the calculations so that the best alternative will be obtained.

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In the SAW method, there are criteria needed to determine which location will be selected or selected as the best subsidized housing as a place for the people of Medan municipality to live. The criteria are in table 4:

Table 4 Criteria for the Best Housing Locations

Criteria	Description	Values
C1	The price of the diversity of site selection	20%
C2	PCA (Principal Component Analysis) feature vector chosen by the developer	10%
C3	The age of the respondent to the house request	20%
C4	The weight of each developer's choice variable	30%
C5	The value of the work weight that chooses the house	20%

Calculation of the determination of the best housing

Each criterion has a value and weight. The following is a table describing the criteria for the weight of the best subsidized housing assessment:

Table 5. Price of diversity in location selection (C1)

Work Weight Values That Choose Houses	Weight	Values
< 2,75	0	0%
2,76-3,00	0,2	10%
3,01-3,25	0,4	20%
3,26-3,50	0,6	20%
3,51-3,75	0,8	20%
3,76-4,00	1	30%

Table 6 PCA (Principal Component Analysis) feature vector of developer choice (C2)

Vector PCA	Weight	Values
<155	0	0%
156-160	0,25	10%
161-165	0,5	20%
166-170	0,75	30%
171-177	1	40%

Table 7 Age of respondents to a house request (C3)

Respondent Age	Weight	Values
< 15	0	0
45-64	0,25	10%
35-44	0,5	20%
25-34	0,75	30%
15-24	1	40%

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Table 8. Weight of each payment/purchase period variable (year)developer choice (C4)

Developer Choice Variable Weights	Weight	Values
0	0	0%
1 year	0,25	10%
2 years	0,5	20%
3 years	0,75	30%
> 4 years	1	40%

Table 9. The value of the weight of work that chooses a house (C5)

Work Weight Value	Weight	Values
Doesn't work	0	10%
C	0,3	20%
B	0,6	30%
A	1	40%

1. Calculations based on research data, three housing candidates with the following criteria and weights:

Table 10 Data on prospective housing to be selected

No	Residential Name	**C1**	**C2**	**C3**	**C4**	**C5**
1	Tamora Residence	3,20	165	25	1	B
2	Tamora Residence	3,50	170	30	3	B
3	Perumahan Subsidi Delitua	4,00	170	30	4	A

Match Rating of Each Alternative on Each Criterion

Based on the location data above, a decision matrix X can be formed that has been converted to fuzzy numbers, as follows:

$$X = \begin{bmatrix} 0,4 & 0,5 & 0,75 & 0,25 & 0,6 \\ 0,6 & 0,75 & 0,75 & 0,75 & 0,6 \\ 1 & 0,75 & 0,75 & 1 & 1 \end{bmatrix}$$

2. Provide a weight value (W)

The decision maker gives a weight based on the level of importance of each required criterion, where the weight value (W) is obtained with the data:

W = [0.01 0,25 0,5 0,75 1], Normalize the X matrix to become the R matrix.

First, the X matrix is normalized to calculate the value of each criterion based on the criteria assumed as profit criteria as follows:

First, the X matrix is normalized to calculate the value of each criterion

A1) R_{11} = 0,4 :1 = 0,4
R_{12} = 0,5 : 0,75 = 0,6
R_{13} = 0,75 : 0,75 = 1
R_{14} = 0 : 1 = 0
R_{15} = 0,6 : 1 = 0,6

A2) R_{21} = 0,6 : 1 = 0,6
R_{22} = 0,75 : 0,75 = 0,3

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R_{23} = 0,75 : 0,75 = 1
R_{24} = 0,75 : 1 = 0,75
R_{25} = 0,6 : 1 = 0,6
A3) R_{31} = 1 : 1 = 1
R_{32} = 0,75 : 0,75 = 1
R_{33} = 0,75 : 0,75 = 1
R_{34} = 1 : 1 = 1
R_{35}= 1 : 1 = 1

Second, normalizing the R matrix obtained from the results of normalizing the X matrix as follows:

$$R = \begin{bmatrix} 0,4 & 0,6 & 1 & 0 & 0,6 \\ 1 & 1 & 1 & 0,75 & 0,6 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

The Next, the W * R matrix will be multiplied and the sum of the multiplication results will be made to obtain the best alternative by ranking the largest value as follows:

V1=(0)(0,4)+(0,25)(0,6)+(0.5)(1)+(0.75)(0)+ (1)(0.6)
= 0 + 0,15 + 0,5+ 0 + 0,6
= 1,25
V2=(0)(0,1)+(0,25)(1)+(0,5)(1)+(0,75)(0,75) +(1)(0,6)
= 0 + 0,25 + 0,5 + 0,5625 + 0,6
= 1,9125
V3= (0)(1)+(0,25)(1)+(0,5)(1)+ (0,75)(1)+(1)(1)
= 0 + 0,25 + 0,5 + 0,75 + 1
= 2,5

The biggest value is in V3, so V3 in this case is Delitua subsidized housing, which is the housing that was selected as the best housing.

Multi-Objective Optimization by Ratio Analysis (MOORA) Method Analysis

Based on the X decision matrix above, the next step in completing the MOORA method is to normalize the X matrix using the 5th equation, where for the magnitude of the diversity of location selection (C1).

$$X^*_{1,1} = \frac{0.4}{\sqrt{0.4^2 + 0.6^2 + 1^2}} = 0.32,$$ in the same way it can be tabled as:

$$X^*ij = \begin{bmatrix} 0.3244428 & 0.426401 & 0.57735 & 0.196116 & 0.457496 \\ 0.4866643 & 0.639602 & 0.57735 & 0.588348 & 0.457496 \\ 0.8111071 & 0.639602 & 0.57735 & 0.784465 & 0.762493 \end{bmatrix}$$

And the attribute optimization attribute matrix is:

Attribute Optimization =

C1	C2	C3	C4	C5
0.003244	0.003244	0.003244428	0.003244428	0.003244428
0.003244	0.003244	0.003244428	0.003244428	0.003244428
0.003244	0.003244	0.003244428	0.003244428	0.003244428

Calculating the Optimization Value

Calculating the optimization value is obtained by multiplying the weight value with the Xij normalization matrix, so that the results are as follows:

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No	Alternative	Maximum	Minimum	Yi(Max-Min)	Ranking
1	A1	0.009733285	0.006488857	0.003244428	3
2	A2	1.165698675	1.075012669	0.090686006	2
3	A3	1.36181481	1.595571646	0.233375684	1

Determining the best best housing value

From the calculation results of the MOORA method, it is obtained that the largest value is in A3, so that A3 is Delitua Subsidized Housing which was selected as the best subsidized housing.

DISCUSSIONS

The SAW method can determine the weight value of each attribute, then proceed with a ranking process which will select the best alternative from a number of alternatives, and the assessment will be more precise because it is based on predetermined criteria values and preference weights. This is what makes the SAW method more flexible, able to solve problems. complex problems and learning based on human knowledge and experience in solving a problem. but the data entered must be correct and precise, so as not to cause errors when weighing and ranking criteria. High flexibility and a good level of selectivity allow MOORA to be able to determine goals from conflicting criteria, where criteria can be beneficial or unprofitable (cost). The MOORA method is a method that optimizes many objectives based on ratio analysis. The way this method works is to give weight to each specified criterion. From this weight assessment, the highest ranking results will be taken to determine the best subsidized housing.

CONCLUSION

From the results of calculations and implementation during the research, it can be concluded that the two methods have the same goal, namely choosing the best subsidized housing, namely subsidized housing delitua, but has a difference in the magnitude of the value of 0.25 - 0.23 = 0.02. This happens because the MOORA method is used to rank subsidized housing data which has the potential to become the best subsidized housing with non-benefit criteria. The comparison of the SAW method with MOORA is that the MOORA method is used to rank subsidized housing that has the potential to become the best housing with non-benefit criteria. The SAW method is used to determine the best subsidized housing with predetermined benefit criteria.

REFERENCES

Abdillah, A. (2021). SistemPendukung Keputusan PenerimaanSiswaBaruDenganMetode Simple Additive Weigthing(Saw) Di Sman 1 CikakakKab . Sukabumi. *SISMATIK (Seminar Nasional SistemInformasi Dan ManajemenInformatika)*, 124–131.

Budihartanti, C., &Nasution, A. (2020). *KOMPARASI METODE SAW DAN MOORA PADA SMAN 15 JAKARTA DALAM PEMILIHAN SISWA BERPRESTASI*. *7*(2).

Budiman, A., Lestari, Y. D., Fitri, Y., &Lubis, A. (n.d.). *SistemPendukung Keputusan DalamPemilihanPergururan Tinggi TerbaikDenganMenggunakanMetode SAW (Simple Additive Weighting)*.

Efendi, Z. (2019). SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN LOKASI PERUMAHAN MENGGUNAKAN METODE PROFILE MATCHING. *JURTEKSI (JurnalTeknologi Dan SistemInformasi)*, *6*(1), 79–86. https://doi.org/10.33330/jurteksi.v6i1.408

Indra Borman, R. (2018). SistemPendukung Keputusan Menentukan Lokasi PerumahanDiPringsewu Selatan Menggunakan Fuzzy Multiple Attribute Decision Making. In *JTKSI* (Vol. 01, Issue 01).

Nurhaliza, N., Adha, R., &Mustakim. (2022). *PerbandinganMetodeAhp, Topsis, Dan MooraUntukRekomendasiPenerimaBeasiswa Kurang Mampu*. *8*(1), 23–30.

* Corresponding author

Panggabean, E. (2015). SISTEM PENDUKUNG KEPUTUSAN PENENTUAN LOKASI PERUMAHAN IDEAL MENGGUNAKAN METODE FUZZY SIMPLE ADDITIVE WEIGHTING. In *Jurnal TIMES: Vol. IV*.

Rosita, I., &Apriani, D. (n.d.). *55 METIK VOLUME. 4 NOMOR. 2*, 2020.

Septiana, Y., Nuraeni, F., & Anisa, K. (2022). *Decision Support System for The Program Indonesia Pintar Scholarship using Simple Additive Weighting method*. *7*(4), 2311–2316.

Wardani, S., Parlina, I., Revi, A., SistemInformasi, M., Tunas BangsaPematangsiantar, S., AMIK Tunas BangsaPematangsiantar, D., & Sudirman Blok No, J. A. (n.d.). *ANALISIS PERHITUNGAN METODE MOORA DALAM PEMILIHAN SUPPLIER BAHAN BANGUNAN DI TOKO MEGAH GRACINDO JAYA*.

Yandi Saputra, A., Eluis Bali Mawartika, Y., Bina Nusantara Jaya Lubuklinggau, S., YosSudarso No, J., & Kota Lubuklinggau Sumatera Selatan, A. (n.d.). SistemPendukung Keputusan DalamMemilih Lokasi PerumahanDenganMetode Simple Multi Attribute Rating Technique Decision Support System In Choosing Housing Locations With The Simple Multi Attribute Rating Technique Method. *Cogito Smart Journal |*, *5*(1).

* Corresponding author