JurnalMantik
Volume 4, Number 3, Nov 2020, pp. 2155-2163 E-ISSN 2685-4236
https://iocscience.org/ejournal/index.php/mantik

Collaboration of the Analytical Hierarchy Process (AHP) Method with Simple Additive Weighting (SAW) in Determining the Recipients of Direct Cash Assistance (BLT)

Ferina Gunawan[1], Agung Triayudi[2], Endah Tri Esthi Handayani[3]

Sistem Informasi, Fakultas Teknologi Komunikasi Dan Informatika, Universitas Nasional,

email: feringnwn@gmail.com[1], agungtriayudi@civitas.unas.ac.id[2], endahteh@gmail.com[3]
Correspondence Author: Agung Triayudi

ARTICLEINFO

Article history:
Received: 01/11/2020
Revised: 09/11/2020
Accepted: 29/11/2020

Keywords:
BLT, SPK, Analytical Hierarchy Process (AHP), Simple Additive Weighting (SAW)

ABSTRACT

At this time the government often to provides social assistance such as cash assistance (BLT) one of them in Menteng sub district, But the implementation of the distribution is still problematic because the implementation of the distribution is still subjective. With this the author utilizes a decision support system using Analytical Hierarchy Process (AHP) method to determine the weight and Simple Additive Weighting (SAW) method for ranking. So the results of the design of this system can assist in selecting and determining BLT recipients so that the distribution is right on target. The result of the collaboration between the AHP method and the SAW method get the ranking results with the highest preference value is 0.65 and the lowest is 0.30

1. Introduction

In Jakarta, especially in Menteng sub-district, many residents have been laid off due to the impact of the pandemic. In order to meet the needs of its citizens, the government often distributes social assistance, one of which is direct cash assistance (BLT) so that the community can be helped from an economic perspective to meet their primary and secondary needs, especially for underprivileged families.

Direct Cash Assistance (BLT) is a program that provides cash assistance or a variety of other assistance from the government, whether conditional or unconditional, designated for the poor [1]. In making the decision to determine the prospective recipient of this direct cash assistance, an information system is needed to determine the calculation of the results of the criteria in order to prevent and minimize all forms of fraud committed by certain parties in determining prospective recipients of BLT because the distribution is still subjective. This system can assist in make decisions to determine potential recipients of BLT based on predetermined criteria.

This study uses the collaboration of the AHP method for weighting and SAW for ranking so that the calculation of decision support in this system is more accurate and obtains calculations according to the predetermined criteria, so that the delivery is not wrong target.

2. Literature review

In the development of this decision support system, the writer took several reference journals on social assistance. The first journal in a research that has been done shows that there are differences in floating point, causing a difference between manual calculations and system calculations of 0.01 [2]. The second journal of research conducted using the Hybrid AHP and SAW method with the aim of determining potential recipients of non-cash food assistance which results in an alternative ranking of aid recipients [3]. Journal of the three studies that have been carried out can help the selection committee in data collection based on the criteria that have been determined, from the five alternatives tested there is the lowest alternative, namely alternative 2 with a value of 57.5 which is the chosen alternative as a candidate for RASKIN recipients [4].

The fourth journal deals with implementation DSS using the Analytical Hierarchy Process (AHP) method is less effective and efficient in determining subsidized food acceptance [5]. The fifth journal is research that applies the AHP and SAW methods to determine the ranking according to the weight value of the criteria. The work status of the head of the family is 0.425, the work status of the wife is 0.166, the status of the house is 0.094, the number of dependents is 0.056 and the KTP is 0.259 with a consistency ratio value

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

of 0.09 [6].

The sixth journal is research whose aim is to develop priorities areas in the catchment area for soil conservation measures using A Fuzzy Hierarchy Analyze Process (FAHP) [7]. The seventh journal is the application of the method Fuzzy Simple Additive Weighting (FSAW) results in determining the recipient of agricultural seeds, where the final result will calculate the highest preference value of each alternative [8]. The eighth journal discusses optimization in dealing with problems from the comparison of criteria for the development of public transportation systems using a model approach IAHP [9].

The ninth journal is about research which can provide redundancies for preference setting criteria, alternatives and mechanisms to validate consistency in maintenance of Electric Power Plants (MEEP) [10].Journal tenth analyzing 2006 financial performance-2019 out of ten Indian pharmacies with Simple Additive Weighting (SAW) and Additive Radio Assessment (ARAS) methods as analysis methods [11].

3. Research methods

This research was conducted to be able to build a system that aims to be able to recommend recipients of Direct Cash Assistance (BLT). Following is the framework of the research conducted by the author to build a decision support system.

Fig 1 Research Framework

3.1 Needs Analysis

Needs analysis is carried out with the aim of analyzing the needed needs which will later be used as research material and finding solutions to the problem.

3.2 Make a Literature Study

The stage of making this literature study, the writer studies the theories from the reference journal, is used as reference material.

3.3 Analysis Method

The method used in this research is the Analytical Hierarchy Process method for weighting and Simple Additive Weighting for ranking.

A. **Analytical Hierarchy Process (AHP) Method**

AHP is used to measure and find ratio scales from discrete and continuous paired comparisons. AHP discusses complex multi-criteria problems into a hierarchy. The first level includes objectives, factors, criteria, sub-criteria, and so on until the last level [3] [5].

AHP steps:

a. Priority comparisons use pairwise comparisons presented in the form of a matrix. Scale to fill the matrix using the Saaty scale.

Intensitas kepentingan	Definisi
1	Sama Penting (*Equal*)
3	Cukup Penting (*Moderate*)
5	Lebih Penting (*Strong*)
7	Sangat Lebih Penting (*Very*)
9	Multlak Lebih Penting (*Extreme*)

Fig 2. Saaty Comparison Table

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

b. Normalization AHP

$$\frac{\text{Nilai kolom kriteria}}{\Sigma \text{ Kolom}} \quad \text{..... (1)}$$

c. Eigen Vector

$$\lambda = \frac{\Sigma \text{ Baris}}{\text{kolom}}$$

d. Eigen Maximum

$$\lambda_{max} = (\lambda_1 x \sum Baris_1) + (\lambda_2 x \sum Baris_2) + \ldots\ldots + (\lambda_n x \sum Baris_n \text{ ..... (3)}$$

e. Consistency Index

$$CI = \frac{\lambda_{Max} - n}{n-1} \quad \text{..... (4)}$$

f. Consistency Ratio

$$CR = \frac{CI}{RI} \quad \text{..... (5)}$$

B. **Simple Additive Weighting (SAW) Method**

SAW is used to find the weighted sum of the performance ratings for each alternative on all attributes and there is a decision matrix normalization process that can be compared with all alternative ratings [3] [4]. SAW steps:

1) Determining the weight of the criteria, the weight of the criteria is the Eigenvector from the AHP Calculation Results.
2) Defining Criteria Values
3) Normalization

$$r_{ij} = \begin{cases} \frac{x_{ij}}{max_{xij}}, & \text{Jika j adalah atribut keuntungan (benefit)} \\ \frac{min_{xij}}{x_{ij}}, & \text{Jika j adalah atribut biaya } (cost) \end{cases} \quad (6)$$

Fig 3.SAW method

4) Decision Seek

$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

5) Ranking

3.4 Data collection

Data collection techniques based on data sources by conducting interviews with related parties. The data needed are the terms and criteria that have been set.

3.5 Method Implementation

This stage is the implementation of the method using the data obtained.

3.6 System planning

The author makes a web-based system using PHP as the programming language and the database uses MySQL.

3.7 System Testing

This stage is done to ensure the system can run and can be used as expected. Testing is done using black box testing where the test is done only by observing the execution of the program.

4. Results and Discussion

4.1 Calculations using AHP

Table 1.
Initial Data Table

Kode	C1	C2	C3	C4
A1	Rp 2,500,000.00	3	1	45
A2	Rp 800,000.00	1	1	77
A3	Rp 3,000,000.00	4	2	50
A4	Rp 4,000,000.00	2	2	37
A5	Rp 4,000,000.00	2	1	40
A6	Rp 3,000,000.00	5	1	50
A7	Rp 2,000,000.00	1	1	32
A8	Rp 3,500,000.00	2	2	58
A9	Rp 3,200,000.00	3	2	40
A10	Rp 3,000,000.00	2	1	50
A11	Rp 2,000,000.00	2	2	58
A12	Rp 4,500,000.00	2	2	58
A13	Rp 3,000,000.00	2	2	30
A14	Rp 3,500,000.00	2	1	65
A15	Rp 3,300,000.00	2	1	65
A16	Rp 3,200,000.00	4	1	47
A17	Rp 2,400,000.00	2	1	30
A18	Rp 2,000,000.00	2	2	49
A19	Rp 3,000,000.00	4	1	38
A20	Rp 3,200,000.00	4	2	36

In Table 1, there are real data that has not been processed, where there are 4 criteria, namely the criteria for income (C1), number of dependents (C2), home ownership status (C3) and age (C4).

After the data has been arranged, the first step that must be taken is determining the pairwise comparison of the criteria based on the current scale concept. The results of the pairwise comparison can be seen in Table 2.

Table 2.
Pairwise Comparison Table

Code	C1	C2	C3	C4
A1	1	5	5	5
A2	0.2	1	0.25	4
A3	0.2	4	1	0.125
A4	0.2	0.25	8	1
Total	1.6	10.25	14.25	10,125

Based on the pairwise comparison table, the next step is to normalize each criterion. Can be seen in table 3.

Table 3.
Table of Normalization Results

kode	C1	C2	C3	C4	Jumlah
A1	0.63	0.49	0.35	0.49	1.96
A2	0.13	0.10	0.02	0.40	0.64
A3	0.13	0.39	0.07	0.01	0.60
A4	0.13	0.02	0.56	0.10	0.81
Jumlah	1	1	1	1	4.00

After normalizing each criterion,

Next is to calculate the Eigenvectors value based on equation (2). The results of the Eigenvectors can be

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

seen in Table 4.

Table 4.
Eigenvector Table

Eigen Vektor Penghasilan/bln	0.49
Eigen Vektor Banyak Tanggungan	0.16
Eigen Vektor Status Kepemilikan Rumah	0.15
Eigen Vektor Usia	0.20

Based on the results of the Vector Eigen contained in Table 4, the next step is to determine the Maximum Eigen which is done according to equation (3). Can be seen in Table 5.

Table 5.
Maximum Eigen Table

Eigen Vector	Maximum eigen	Maximum Eigen / Eigenvector
0.49	3,042	6.21707
0.16	1,104	6,94990
0.15	0.908	6.07451
0.20	1,535	7.58681

Based on Table 5, the maximum eigenvalues are equal to 6.5893526. Next, look for the Consistency Index in equation (4) where the result is 0.09470. And then the calculation is done to find the consistency ratio of equation (5) and the result is 0.7972, and it is stated as consistent because the value is less than 0.01. The results can be seen in table 6.

Table 6.
Table of Consistency Index Results and Consistency Ratio.

Lambda	CI	RI	CR	Keterangan
5.37881	0.09470	1.188	0.07972	**KONSISTEN**

4.2 Calculation Using SAW

The author uses the results from the Eigen Vector from the AHP calculation as the weight of the criteria in the SAW method calculation. Table 7 is a table from giving the value of each criterion which is the next step.

Table 7.
Criteria Value Table

No.	Criteria	Score
	Income	
	<1JT S / D 2JT	1
	> 2JT S / D 2.5JT	2
	> 3JT / 4JT	3
	> 4	
1	million	4
	The number of dependents	
	> 4	5
	4	4
	3	3
	2	2
2	1	1
	Home Status	
	Personal	1
3	Contract	2
	age	
	30 to 40	1
	> 40/45	2
	> 45/55	3
4	> 55	4

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

Each criterion is determined by its value based on the initial data in Table 1. Then converted to value form, the result will be as in Table 8.

Table 8.
Criteria Value Conversion Table

Code	C1	C2	C3	C4
A1	2	3	1	2
A2	1	1	1	4
A3	3	4	2	4
A4	3	2	2	1
A5	3	2	1	1
A6	3	5	1	3
A7	1	1	1	1
A8	3	2	2	4
A9	3	3	2	2
A10	3	2	1	3
A11	2	2	2	4
A12	4	2	2	4
A13	3	2	2	1
A14	3	2	1	4
A15	3	2	1	4
A16	3	4	1	3
A17	2	2	1	1
A18	2	2	2	3
A19	3	4	1	1
A20	3	4	2	1

Then carry out the normalization process based on equation (6). Then the results are like Table 9.

Table 9.
SAW Normalization Table

C1	C2	C3	C4
1.00	0.20	0.50	0.25
0.25	0.80	1.00	1.00
0.25	0.60	1.00	1.00
0.27	0.40	1.00	1.00
0.27	0.80	0.50	1.00
0.27	1.00	0.50	0.75
0.20	0.40	1.00	1.00
0.40	0.40	1.00	0.50
0.27	0.80	1.00	0.50
0.40	0.20	0.50	1.00
0.33	0.40	0.50	1.00
0.32	0.60	0.50	0.75
0.40	0.40	1.00	0.25
0.20	0.40	0.50	1.00
0.25	0.80	0.50	0.50
0.23	0.40	1.00	0.25
0.27	0.40	0.50	0.50
0.18	0.40	1.00	0.25
0.24	0.40	0.50	0.25
0.23	0.40	0.50	0.25

After normalizing, the next step is to find a decision using equation (7). The results of the search for decisions are shown in Table 10.

Table 10.
Decision Seek Table

C1	C2	C3	C4	Preference
1.00	0.20	0.50	0.25	0.65
0.25	0.80	1.00	1.00	0.60
0.25	0.60	1.00	1.00	0.57
0.27	0.40	1.00	1.00	0.54
0.27	0.80	0.50	1.00	0.53
0.27	1.00	0.50	0.75	0.52
0.20	0.40	1.00	1.00	0.51

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

C1	C2	C3	C4	Preference
0.40	0.40	1.00	0.50	0.51
0.27	0.80	1.00	0.50	0.51
0.40	0.20	0.50	1.00	0.50
0.33	0.40	0.50	1.00	0.50
0.32	0.60	0.50	0.75	0.48
0.40	0.40	1.00	0.25	0.46
0.20	0.40	0.50	1.00	0.44
0.25	0.80	0.50	0.50	0.43
0.23	0.40	1.00	0.25	0.38
0.27	0.40	0.50	0.50	0.48
0.18	0.40	1.00	0.25	0.35
0.24	0.40	0.50	0.25	0.31
0.23	0.40	0.50	0.25	0.30

Next carry out the ranking process. In Table 11, the ranking process is obtained from the largest to the smallest Preference value.

Table 11.
Ranking Result Table

Code	Name	Preference	Ranking
A1	Suratman	0.65	1
A2	Herman Marjoko	0.60	2
A3	Candra Mimol	0.57	3
A4	Ronny Achbar	0.54	4
A5	Rachmtat Hidayat	0.53	5
A6	Warsiyah	0.52	6
A7	Dicky Darmawan	0.51	7
A8	Word of Piyatna	0.51	8
A9	Indra Julfitri	0.51	9
A10	Darto	0.50	10
A11	Dita Purwnti	0.50	11
A12	Japareng	0.48	12
A13	Idup Achmad	0.46	13
A14	Tri Agung Rustanto	0.44	14
A15	Zulfardi	0.43	15
A16	Siti Syahroni	0.38	16
A17	Evoke Wasu Praba	0.48	17
A18	Mohamad Irfan	0.35	18
A19	Ismail	0.31	19
A20	Iwan Setiawan	0.30	20

4.3 Design Results

Fig 4. Main page

Figure 4 is a picture of the Main Hamalam display, where there are 6 main displays, namely the Criteria dropdown menu which contains the Criteria display menu itself, the value of each criterion, the Criteria Comparison and the Weighting of the criteria using the AHP calculation method.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

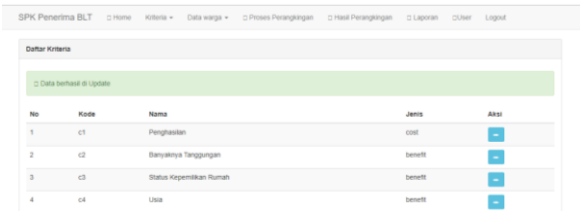

Fig 5. Criteria Form page

On the page to determine the Criteria Type of each criterion. Is it the Maximum (Benefi) or Minimum (Cost) type.

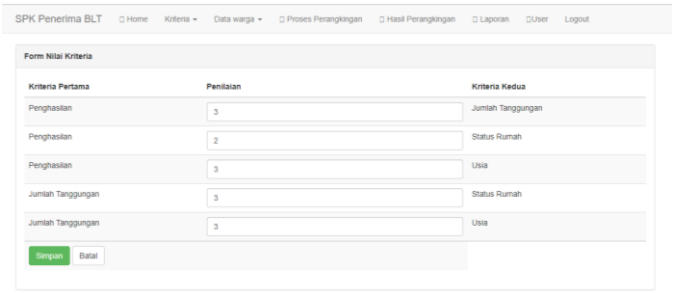

Fig 6. Display Criteria Value Form

In Figure 6, there is a display of the scoring form for each criterion whose value is on a scale of 2 to 9.

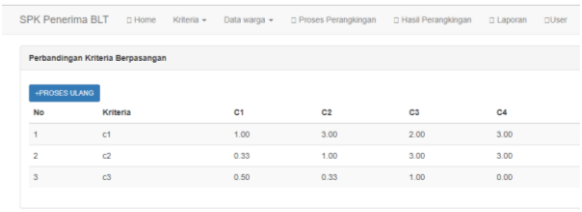

Fig 7. Pairwise Criteria Comparison View

In Figure 7, there is a paired criteria comparison display that is processed based on the criteria values shown in Figure 6.

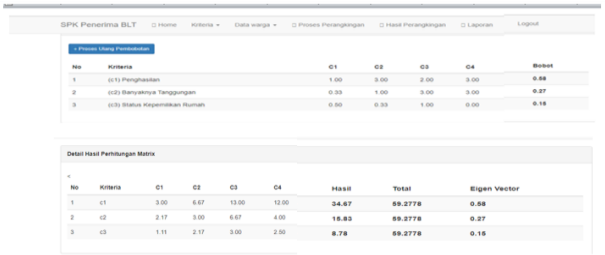

Fig 8. Criteria Weighted View

Figure 8 is a picture of the final view of weighting criteria using the AHP method.

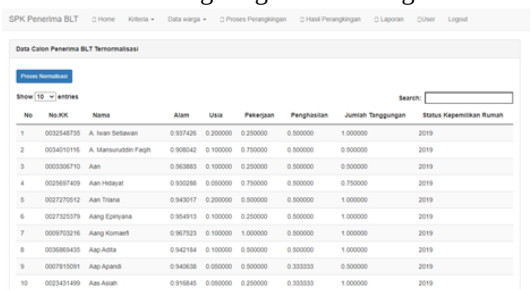

Fig 9. Normalization View

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

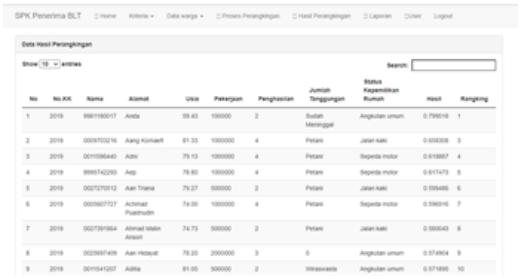

Fig 10. Display of SAW Ranking Results

Figure 10 is a display of the ranking results using SAW calculations based on the results of normalization that have been obtained in Figure 9.

5. Conclusion

a. The results of manual calculations on the AHP method are consistent. So that the criteria data can be used.
b. By collaborating between the AHP method for weighting and the SAW method as a ranking, the ranking result with the highest preference value is 0.65 and the lowest preference value is 0.30.
c. It is hoped that later this collaboration method can be developed to select BOT recipients in Menteng sub-district.

6. References

[1] Direct Cash Assistance. Wikipedia. Available:https://id.m.wikipedia.org/wiki/Bantup-L Direct-Tunai/ (accessed on October 1, 2020)
[2] W.Wiwin "Decision Support System for Determining Direct Cash Aid Recipients at the Head of Ngiro Village Using the Simple Additive Weighting Algorithm," Jurnal TIKomSiN ,. 2019.
[3] Satria Rizki Arianto, Sri Siswanti and Wawan Laksito Yuly Saptomo "Decision Support System for Non-Cash Food Aid Recipients Using the AHP-SAW Hybrid Method," TRANSFORMATIKA Journal. Vol. 17, No.2, pp. 200-208, January 2020.
[4] Guna Yanti Kumala Sari Siregar Pahu, Lili Rizkia Putri, Nungsiyati and Riki Renaldo, "Decision Support System for Determining Prospective Raskin Recipients Using the Simple Additive Weighting Method," TEKNOINFO Journal ,. Vol. 12, No.2, 2018.
[5] R. Mahdalena Simanjorang, Harvei Desmon Hutahean and Hengki Tamando Sihotang, "Decision Support System for Determining Recipient of Subsidized Food Material Recipients for Poor Families Using the AHP Method at Mangga Village Offices," Journal Of Informatic Pelita Nusantara ,. Vol. 2, No.1, October 2017.
[6] Nidya Kusumawardhany, "Application of Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) Methods to Determine Recipients of Covid-19 Pandemic Social Assistance," Journal of IDEALIS, Vol. 3, No.2, July 2020.
[7] C, D, Mirsha, RKJaiswal, AKNema, VK Chandola, C. Arpit "Priority Assessment of Sub-watershed Based on Optimum Number of Parameters Using Fuzzy-AHP Decision Support System in the Environment of RS and GIS," Journal of the Indian Society of Remote Sensing ,. April 2019.
[8] Andino Maseleno, "Fuzzy Simple Additive Weighting For Determination Of Recipients Breeding,",. February 2018.
[9] G. Omid, M.Sarbast, B. Thomas, and D.Szabolcs "Sustainable Urban Transport Planning Considering Different Stakeholfer Groups by an Interval-AHP Decision Support Model," MDPI Sustainability ,. December 2018.
[10] Sattar.A.Mutlag, HKDawood "A Maintenance Management-based Decision Support System for Multicriteria using AHP Methodology for Power Plants," TEST Engineering Management ,. Vol. 82, January-February 2020.
[11] DR.A.Vijayakhumar "Comparison of Multhi Criteria Decision Making Methods SAW and ARAS: An Application to Performance of Indian Pharmaceutical Companies," Journal of Economics and Technology Research ,. Vol. 1, No.2, 2020.