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Comparison of Moora and Waspas Methods for Recommendations of Cayenne Pepper Seeds

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ABSTRACT

Multiple Criteria Decision Making (MCDM) encompasses several methodologies, including MOORA and WASPAS. These strategies demonstrate unique approaches and produce varying results. The main aim of this work is to provide a comparative analysis of the MOORA and WASPAS procedures. To achieve this objective, we conduct a detailed analysis that specifically examines five parameters related to cayenne pepper seeds: prospective crop yields, optimal harvesting time, recommended conditions for highland cultivation, weight of 1000 seeds, and plant height. The study utilizes the sensitivity test approach in a comparative analysis framework to ascertain the superior method. The computations using both the MOORA and WASPAS methods determine that the Bisi HP 35 (A3) alternative is the best choice. This alternative has a MOORA preference value of 0.1463, while the WASPAS approach gives it a preference value of 0.8374. Next, we perform a sensitivity test by increasing the weight criteria for each criterion by 0.5 and 1. The sensitivity analysis indicates that the MOORA approach has a level of 380, whereas the WASPAS method has a level of 376. The data suggest that the MOORA method is more effective than the WASPAS method when it comes to making recommendations for cayenne pepper seeds.

1. Introduction

The decision-making process is always attempted objectively, quickly and accurately. In building a decision support system, of course, it involves various decision support system methods [1]. Decision support systems have various methods, techniques and approaches used to analyze data and provide recommendations in decision making. The existence of this method offers a variety of different approaches, providing an opportunity for researchers and practitioners to choose the method that best suits the needs and characteristics of the problem being faced [2].

Two methods commonly used in decision support systems are the MOORA and WASPAS methods. The MOORA method focuses on comparing ratios between alternatives, while the WASPAS method combines weight calculations with multiplication and addition of values against the criteria [3]. Comparison between the two methods is important, because choosing the right method greatly influences the quality and success of the decision support system created [4], [5].

Comparative analysis of the MOORA and WASPAS methods applied to the case of recommendations for cayenne pepper seeds. Because the need for chilies continues to increase from year to year, this is in line with the increasing population and the growing uptake of the industrial sector which uses chilies as raw materials [6].

Cayenne pepper is an important vegetable crop that has high economic value and is widely cultivated in various regions. Selection of superior varieties of cayenne pepper seeds is one aspect that farmers need to pay attention to when making decisions before purchasing seeds so that farmers do not experience losses due to errors in purchasing cayenne pepper seeds [7], [8].

A case study regarding the comparison of the MOORA and WASPAS methods is the focus of research on selecting cayenne pepper seeds to find the best method considering the complexity of selecting ideal seeds which is influenced by various factors [9]. Comparing the results of the MOORA and WASPAS methods, a sensitivity test will be carried out to determine which method is the best for determining recommendations for cayenne pepper seeds [10]. Research conducted by Khasanah (2019) regarding Sensitivity Test of Simple Additive Weighting and Weighted Product Methods in Determining Laptops, proves that the sensitivity test method can be carried out to determine the relevant method in a case, and produces the Simple Additive Weighting method which is considered relevant in solving problems in determining a laptop for this problem, if a method has a high sensitivity value to changes in ranking, that method is increasingly chosen [11].

Based on these problems, this research research aims to compare the ranking result of the two MOORA and WASPAS methods in determining cayenne pepper seeds. Then the ranking result from the MOORA dan WASPAS methods will be tested to determine the best methos using the sensitivity test method.

2. Method

2.1 Research Stages

The research implementation stages are the stages carried out in carrying out research [12]. In this research, the understanding stages, data processing and analysis stages, data collection, design and implementation were carried out. The complete stages of research implementation can be seen in Figure 1.

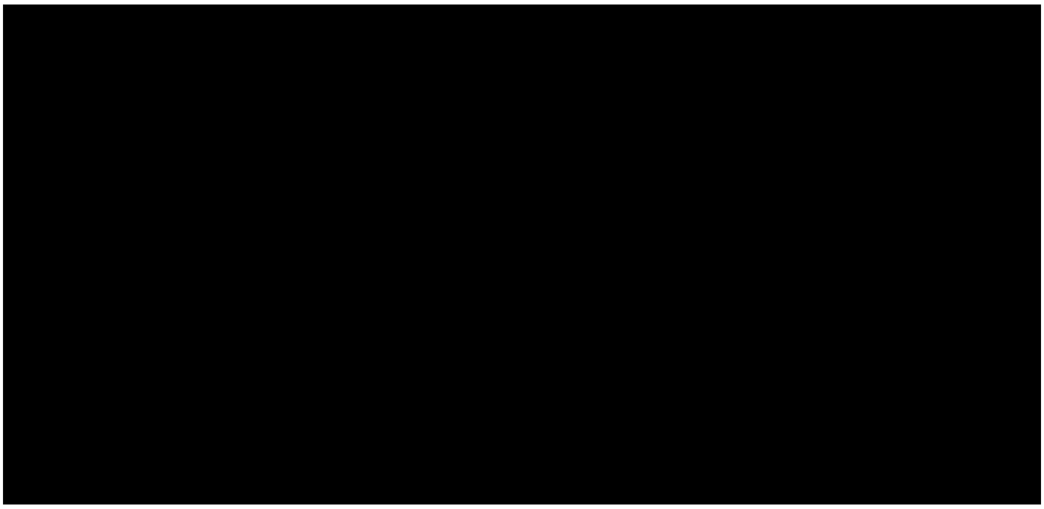

Figure 1. Research Stages

The research stages consist of four stages, namely:

a. Stages of Understanding
   The understanding stage is the stage that will identify the problem. At this stage, we begin to understand and analyze existing problems.
b. Data Collection Stages
   At the data collection stage, three things were carried out, namely literature study, observation and interviews to obtain information regarding criteria and data about cayenne pepper seeds from agricultural experts.
c. Data Processing and Analysis Stages
   This stage is the stage of processing and analyzing data, starting from determining criteria, sub-criteria, criteria weights, determining the type of criteria, processing alternative data, and carrying out calculations using the MOORA and WASPAS methods.

d. Design Stages
   This stage is the stage that contains process design and system design in creating the system.
e. Implementation Stages
   This stage is the stage of creating a decision support system and comparing the MOORA and WASPAS methods using a sensitivity test.

2.2 Decision Support System

Decision Support System (DSS) is an interactive system and is able to support problem solving in the decision making process either in structured or semi-structured conditions [13]. Decision Support Systems (DSS) or decision support systems (DSS) are components of computer-based information systems (including knowledge-based) that are used to assist decision making in businesses or organizations [14]. DSS can also be referred to as a computer system that converts data into information for the purposes of making decisions regarding certain semi-structured problems [15], [13].

2.3 Data Collection Techniques

Conducting interviews is data collection carried out by means of question and answer or direct dialogue with parties related to the research being conducted [14]. Research data was obtained from the Agricultural Technology Assessment Agency Service and an expert, Mrs. Margaretha S.Sos., M.Sc. as a researcher in the field of horticulture. in the form of cayenne pepper seed data which is used as alternative data and five criteria, namely potential production yield, harvest time, recommended terrain, weight of 1000 seeds, and plant height.

2.4 *Multi-Objective Optimization on the basis of Ratio Analysis*

The MOORA method focuses on comparing ratios between alternatives [15]. The MOORA method has a good level of selectivity because it can determine objectives from unrelated criteria where the criteria can be beneficial (benefit) and unprofitable (cost) [16]. The steps for completing the MOORA method are shown in Eq (1)-(3) [15]:

a. Make a Decision Matrix

$$x = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{1}$$

b. Normalization Matrix

$$X *_{ij} = \frac{x_{ij}}{\sqrt{\left[\sum_{i=1}^{m} X_{ij}^{2}\right]}} \tag{2}$$

c. Weighted Matrix Normalization
   After normalizing the matrix, then carry out weighted normalization by multiplying the matrix by the weight.

d. Reduce the max and min values

$$y_j^* = \sum_{i=I}^{i=g} x_{ij}^* - \sum_{i=g+1}^{i=n} x_{ij}^* \tag{3}$$

2.5 *Weighted Aggregated Sum Product Assessment*

The WASPAS method is a method that combines the well-known Multi Criteria Decision Making (MCDM) approach, namely the weighted sum model. The steps for completing the WASPAS method are shown in equations (4)-(7) [17].

a. Make a decision matrix

$$x = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (4)$$

b. Normalization Matrix

$$R_{ij} = \frac{x_{ij}}{max_i x_{ij}} \quad (5)$$

$$R_{ij} = \frac{min_i x_{ij}}{x_{ij}} \quad (6)$$

c. Calculating Qi Value

$$Q_i = 0.5 \sum_{j=1}^{n} R_{ij} w_j + 0.5 \prod_{j=1}^{n} R_{ij} w_j \quad (7)$$

3. Results and Discussion

In chapter III the author will describe the result of the research and discussion based on the analytical method in chaper II in order to get the best method int he case of selecting cayenne pepper seeds.

3.1 Data Processing

Based on the data collection that has been explained, there are 23 data on cayenne pepper seeds which are alternative data and 5 criteria obtained from interviews. Criteria and alternatives can be seen in Table 1 and Table 2.

Table 1. Criteria

Code	Criteria Name	Type	Weighted	SubCriteria	Weighted
C1	Potential Production Output	*Benefit*	0,3	>17 tons	5
				15-16 tons	4
				13- 14 tons	3
				11 – 12 tons	2
				<10 tons	1
C2	Harvest Time	*Cost*	0,3	<70 day	1
				71 - 80 day	2
				81 - 90 day	3
				91 - 100 day	4
				>101 day	5
C3	Plains recommendations	*Benefit*	0,15	Low	3
				Middle	2
				High	1
C4	Seed Weight	*Benefit*	015	8 grams	5
				6-7 grams	4
				4-5 grams	3
				2-3 grams	2
				1 grams	1
C5	Plant Height	*Benefit*	0,1	>140 cm	5
				131 – 140 cm	4
				121 – 130 cm	3
				101 – 120 cm	2
				<100 cm	1

Table 1 shows the criteria data used by the author obtained from direct observations and interviews with experts. The criteria consist of 5, namely potential production results, harvest time, recommended terrain, seed weight and plant height. There are also types, weights of criteria and sub-criteria.

Table 2. Alternative

No	*Name*	*C1*	*C2*	*C3*	*C4*	*C5*
1	CRV 212	26	93	Low	5.27	157
2	Bisi HP 34	16	66	Medium	4.97	94
3	Bisi HP 35	17	67	Medium	5.00	105
4	CR 8873	12	111	High	1.02	119
5	CR Hiyung	6	107	Low	3.08	71
6	CR 3255	12	76	Low	4.65	80
7	Batari	12	66	Low	3.29	63
8	Carlica	13	96	Low	4.15	150
9	Kancane	15	91	Medium	4.03	132
10	Red Thunder	13	85	Medium	1.17	69
11	Enno 1433	17	87	Low	5.03	125
12	Enno 1434	17	87	Low	5.05	122
13	Gatra Putih	15	100	Low	5.65	52
14	Mhanu	12	58	Medium	6.07	135
15	CF 1999	7	99	Low	4.84	133
16	CF 3253	9	62	Low	4.29	73
17	CF 857	23	101	Low	4.07	107
18	CBR 001	13	76	Low	4.31	130
19	Prima Agrihorti	14	132	High	4.05	117
20	Rabani Agrihorti	8	144	High	3.07	91
21	Patra	13	96	Low	4.49	165
22	Ritan	11	72	Low	4.58	120
23	HPTr 102	15	67	Low	3.75	93

Table 2 shows alternative data used by the author in this research. There are 23 types of cayenne pepper seeds along with criteria obtained from the East Kalimantan Agricultural Technology Assessment Center.

3.2 Process Implementation

The application of the calculation process to obtain recommendations for cayyene pepper seeds carried out using the MOORA and WASPAS methods, while to obtein the best method a sensitivity test.

3.2.1 Application Multi-Objective Optimization Ratio Analysis (MOORA)

The application of the MOORA method consists of 4 stages, the first is creating a decision matrix, normalizing the matrix, then carrying out weighted normalization, and finally calculating the preference value Yi. This is table 3-6, showing the calculation steps using the MOORA method.

Table 3. Matrix Decision

Code	**Alternative**	**C1**	**C2**	**C3**	**C4**	**C5**
A1	CRV 212	5	4	3	3	5
A2	Bisi HP 34	4	1	2	3	1
A3	Bisi Hp 35	5	1	2	3	2
A4	CR 8873	2	5	1	1	2

Code	Alternative	C1	C2	C3	C4	C5
A5	CR Hiyung	1	5	3	2	1
A6	CR 3255	2	2	3	3	1
...	...	...	...	...	...	...
A23	HPTr 102	4	1	3	2	1

Table 3 shows the decision matrix created based on criteria and sub-criteria data along with scales values that correspond to alternative data.

Table 4. Normalization Matrix

Code	Alternative	C1	C2	C3	C4	C5
A1	CRV 212	0.3089	0.2453	0.2387	0.2206	0.3758
A2	Bisi HP 34	0.2471	0.0613	0.1591	0.2206	0.0752
A3	Bisi Hp 35	0.3089	0.0613	0.1591	0.2206	0.1503
A4	CR 8873	0.1236	0.3066	0.0796	0.0735	0.1503
A5	CR Hiyung	0.0618	0.3066	0.2387	0.1470	0.0752
A6	CR 3255	0.1236	0.1226	0.2387	0.2206	0.0752
...	...	...	...	...	...	...
A23	HPTr 102	0.2471	0.0613	0.2387	0.1470	0.0752

Table 4 displays the results of the decision matrix normalization process carried out by applying equation (2).

Table 5. Matrix Weighted

Code	Alternative	C1	C2	C3	C4	C5
A1	CRV 212	0.0927	0.0736	0.0358	0.0331	0.0376
A2	Bisi HP 34	0.0741	0.0184	0.0239	0.0331	0.0075
A3	Bisi HP 35	0.0927	0.0184	0.0239	0.0331	0.0150
A4	CR 8873	0.0371	0.0920	0.0119	0.0110	0.0150
A5	CR Hiyung	0.0185	0.0920	0.0358	0.0221	0.0075
A6	CR 3255	0.0371	0.0368	0.0358	0.0331	0.0075
...	...	...	...	...	...	...
A23	HPTr 102	0.0741	0.0184	0.0358	0.0221	0.0075

Table 5 displays the results of the weighted decision matrix normalization process by multiplying the decision matrix by the available weights.

Table 6. Value Yi

Code	Alternative	MAX (C1 +C3+C4+C5)	MIN(C2)	Value Yi (MAX-MIN)
A1	CRV 212	0.1992	0.0736	0.1256
A2	Bisi HP 34	0.1386	0.0184	0.1202
A3	Bisi HP 35	0.1647	0.0184	0.1463
A4	CR 8873	0.0750	0.0920	-0.017
A5	CR Hiyung	0.0839	0.0920	-0.0081
A6	CR 3255	0.1135	0.0368	0.0767
...	...	...	...	...
A23	HPTr 102	0.1395	0.0184	0.1211

Based on Table 6 of the ranking results using the MOORA method where the highest Yi preference value is the best alternative, the recommended cayenne pepper seed is the Bisi Hp 35 alternative with a Yi preference value of 0.1463.

3.2.2 Application Weighted Aggregated Sum Product Assessment (WASPAS)

The application of the WASPAS method consists of 3 stages, the first is creating a decision matrix, normalizing the matrix, and finally calculating the Qi preference value. The following is table 7-9 which shows the calculation steps using the WASPAS method.

Table 7. Decision Matrix

Code	*Alternative*	*C1*	*C2*	*C3*	*C4*	*C5*
A1	CRV 212	5	4	3	3	5
A2	Bisi HP 34	4	1	2	3	1
A3	Bisi Hp 35	5	1	2	3	2
A4	CR 8873	2	5	1	1	2
A5	CR Hiyung	1	5	3	2	1
A6	CR 3255	2	2	3	3	1
...	...	...	...	...	...	...
A23	HPTr 102	4	1	3	2	1

Table 7 shows the decision matrix created based on criteria and sub-criteria data along with scales values that correspond to alternative data.

Table 8. Normalized Matrix

Code	**Alternative**	**C1**	**C2**	**C3**	**C4**	**C5**
A1	CRV 212	1	0.25	1	0.75	1
A2	Bisi HP 34	0.8	1	0.6666	0.75	0.2
A3	Bisi Hp 35	1	1	0.6666	0.75	0.4
A4	CR 8873	0.4	0.2	0.3333	0.25	0.4
A5	CR Hiyung	0.2	0.2	1	0.5	0.2
A6	CR 3255	0.4	05	1	0.75	0.2
...	...	...	...	...	...	...
A23	HPTr 102	0.8	1	1	0.5	0.2

Table 8 shows the results of the normalization matrix adjusted for the type of each criterion, namely the type of benefit and cost. if it is a benefit type then use equation (5) if it is a cost type then use equation (6)

Table. 9 Preference Value Qi

Code	**Alternative**	**Nilai Preferensi Qi**
A1	CRV 212	0.6847
A2	Bisi Hp 34	0.7450
A3	Bisi HP 35	0.8374
A4	CR 8873	0.3011
A5	CR Hiyung	0.3286
A6	CR 3255	0.5278
...	...	...
A23	HPTr 102	0.7513

Table 9 shows the preference value obtained using equation (7), the Bisi HP 35 alternative obtained the highest preference value, namely 0.8374.

3.2.3 Sensitivity Test

Sensitivity testing is the process of knowing and getting results from a comparison of the MOORA and WASPAS methods. The greater the change in the ranking of a method, the more sensitive the method is [6]. Changes in ranking are obtained after adding criteria weight values. The weight values are added by 0.5 and 1. This helps identify whether the DSS method is sensitive to changes in one criterion, after that the MOORA and WASPAS method calculations are carried out and then the alternative ranking changes are saved [20]. In this process, 10 repetitions occurred. The results of changes in the ranking of the MOORA and WASPAS methods are presented in Table 10.

Table 10. Sensitivity Test Result

Criteria		***Number of Rating Changes***	
Criteria	***Addition Criteria***	***MOORA***	***WASPAS***
C1	Criteria C1+0.5	14	20
	Criteria C1+1	18	21
C2	Criteria C2+0.5	18	15
	Criteria C2+1	17	15
C3	Criteria C3+0.5	19	20
	Criteria C3+1	21	21
C4	Criteria C4+0.5	19	15
	Criteria C4+1	22	18
C5	Criteria C5+0.5	22	20
	Criteria C5+1	21	21
Total	**10**	**190**	**186**

In sensitivity testing, the higher the number of change values produced by a method, the more relevant its use is in that case. Calculating ranking changes can use the following formula:

$$S = \frac{T}{I * A} * 100 \quad (8)$$

Where T= Final total of ranking changes
I= Total Addition Criteria
A= Number of Criteria used

So the results of the MOORA method sensitivity test are obtained as follows:

$$S = \frac{T}{I * A} * 100 = \frac{190}{10 * 5} * 100 = 380$$

Meanwhile, the WASPAS method is as follows:

$$S = \frac{T}{I * A} * 100 = \frac{186}{10 * 5} * 100 = 372$$

Based on comparative calculations using the sensitivity test, the MOORA method is the best method in the case study of recommendations for cayenne pepper seeds because it has a greater level of sensitivity.

3.3 Discussion

Based on calculations using the MOORA and WASPAS methods The resulting preference value is used to determine the ranking of alternatives from largest to smallest preference value. The ranking produces the same best alternative, namely Bisi HP 35 (A3) with different preference values, namely the Yi value for the MOORA method is 0.1463 and the Qi value for the WASPAS method is 0.8374. In the method sensitivity test, it was carried out to compare the MOORA and WASPAS methods based on changes in ranking that occurred when the weight was added by 0.5 and 1. The results of the sensitivity level for the 23 alternatives in the MOORA method were 380. while the WASPAS method is 372. So it can be said that the MOORA method is considered better because it has a high sensitivity value.

4. Conclusion

The reported research results suggest that the computation outcomes from the MOORA and WASPAS methodologies are initially comparable. The Bisi HP 35 (A3) obtained the highest ranking in both the alternative MOORA technique, with a Yi preference value of 0.1643, and the alternative WASPAS approach, with a Qi preference value of 0.8374. In 10 sensitivity test trials, with additional weights of 0.5 and 1 assigned to each criterion, the MOORA approach demonstrated a higher sensitivity value than the WASPAS technique. During the sensitivity test, the MOORA method demonstrated a sensitivity value of 380, whereas the WASPAS approach exhibited a sensitivity value of 372. Consequently, considering the outcomes of this trial, the MOORA approach proved to be a superior option.

References

[1] A. D. Berdie, M. Osaci, I. Muscalagiu, and C. Barz, "A combined approach of AHP and TOPSIS methods applied in the field of integrated software systems," IOP Conference Series: Materials Science and Engineering, vol. 200. IOP Publishing, p. 012041, 2017. doi: 10.1088/1757-899x/200/1/012041.

[2] A. Irfanda, I. D. Maysanjaya, and I. M. E. Listartha, "Pengembangan Sistem Pendukung Keputusan Penentuan Promo Menu Pada Kafe Kumpulin Coffee Menggunakan Metode Multi-Objective Optimization on the Basis of Ratio Analysis (Moora)," *Inser. Inf. Syst. Emerg. Technol. J.*, vol. 4, no. 1, pp. 37–50, 2023. doi: 10.23887/insert.v4i1.59054.

[3] R. D. Sianturi, "Penerapan Metode Waspas untuk Pengambilan Keputusan Penerimaan Siswa/i Baru," *Teknol. Inf. Komput. dan Sains 2019*, vol. 2, no. 1, pp. 66–71, 2019.

[4] N. Lestari, J. Karman, and B. Santoso, "Komparasi Metode Weighted Aggregated Sum Product Assessment (WASPAS) dan Multi-Objective Optimization on The Basis of Ratio (MOORA) Dalam Penerimaan Dosen," *J. Inf. Sist. Res.*, vol. 2, no. 2, pp. 138–147, 2021.

[5] R. Ramadiani *et al.*, "Decision System for Beneficiaries of the Family Hope Program Using the Rank Order Centroid Method and Weighted Product Method," *Migr. Lett.*, vol. 20, no. 5, pp. 1170–1182, 2023, doi: 10.59670/ml.v20i5.4763.

[6] C. L. Salaki and J. Pelealu, "Pemanfaatan Baringtonia Asiatica dan Annona Muricata Terhadap Serangga Vektor Penyakit Pada Tanaman Cabai," *Eugenia*, vol. 18, no. 1, 2012, doi: 10.35791/eug.18.1.2012.4144.

[7] C. Fadlan, A. P. Windarto, and I. S. Damanik, "Penerapan Metode MOORA pada Sistem Pemilihan Bibit Cabai (Kasus: Desa Bandar Siantar Kecamatan Gunung Malela)," *J. Appl. Informatics Comput.*, vol. 3, no. 2, pp. 42–46, 2019, doi: 10.30871/jaic.v3i2.1324.

[8] R. Rina, F. Agus, and U. Hairah, "Sistem Pendukung Keputusan Penentuan Dosen Pembimbing Magang Fasilkom Unsika Menggunakan Metode Analytical Hierarchy Process," *Jurti*, vol. 5, no. 1, pp. 17–24, 2021.

[9] A. Anriani, I. F. Astuti, and F. Agus, "Model Penentuan Kualitas Getah Karet Menggunakan Metode Multi Attributive Border Approximation Area Comparison (Mabac)," *IKRA-ITH Inform. J. Komput. dan Inform.*, vol. 8, no. 2, pp. 34–43, 2024, doi: 10.37817/ikraith-informatika.v8i2.2954.

[10] N. Nurhaliza, R. Adha, and M. Mustakim, "Perbandingan Metode Ahp, Topsis, Dan Moora Untuk Rekomendasi Penerima Beasiswa Kurang Mampu," *J. Ilm. Rekayasa dan Manaj. Sist. Inf.*, vol. 8, no. 1, p. 23, 2022, doi: 10.24014/rmsi.v8i1.15298.

[11] F. N. Khasanah and D. Setiyadi, "Uji Sensitivitas Metode Simple Additive Weighting Dan Weighted Product Dalam Menentukan Laptop," *Bina Insa. Ict J.*, vol. 6, no. 2, pp. 165–174, 2019.

[12] G. Phylosta and H. Sulistiani, "Sistem Penunjang Keputusan Untuk Persetujuan Pemberian Pinjaman Menggunakan Metode Profile Matching Berbasis Web (Studi Kasus Koperasi Simpan Pinjam Smpn 1

Hulu Sungkai)," *J. Teknol. dan Sist. Inf.*, vol. 3, no. 3, pp. 49–55, 2022. doi: 10.33365/jtsi.v3i3.2000.

[13] G. Lestari and A. Savitri Puspaningrum, "Sistem Pendukung Keputusan Pemberian Tunjangan Karyawan Menggunakan Metode Analytical Hierarchy Process (Ahp) Studi Kasus: Pt Mutiara Ferindo Internusa," *J. Teknol. dan Sist. Inf.*, vol. 2, no. 3, pp. 38–48, 2021. doi: 10.33365/jtsi.v2i3.860.

[14] M. E. Jumaddin, D. Agus, F., and A. H. Kridalaksana, "Perbandingan Metode Simple Additive Weigthing Dan Weighted Product Untuk Pemilihan Atlet Terbaik Pada Ukm Mulawarman University Chess Club," *Semin. Nas. Ilmu Komput. dan Teknol. Inf.*, vol. 3, no. 2, pp. 50–58, 2018.

[15] D. M. Ariska, I. F. Astuti, and F. Agus, "Rancangan dan Implementasi Sistem Pendukung Keputusan Pemilihan Bibit Tanaman Karet," *IKRA-ITH Inform. J. Komput. dan Inform.*, vol. 8, no. 2, pp. 82–91, 2024, doi: 10.37817/ikraith-informatika.v8i2.2961.

[16] Ekastini, "Sistem Pendukung Keputusan, Keputusan Pemilihan Pemasok Kayu Terbaik," *Jinteks (Jurnal Inform. Teknol. dan Sains)*, vol. 5, no. 3, pp. 346–350, 2023. doi: 10.51401/jinteks.v5i3.3235 .

[17] A. Muharsyah, S. R. Hayati, M. I. Setiawan, H. Nurdiyanto, and Yuhandri, "Sistem Pendukung Keputusan Multi Obective Optimization On the Basis Of Ratio Analysis (MOORA)," *JURIKOM (Jurnal Ris. Komputer)*, vol. 5, no. 2, pp. 19–23, 2018. doi: 10.26623/transformatika.v17i1.1311.

[18] A. Ulva, D. Iqbal, N. Nuraini, and M. Mesran, "Sistem Pendukung Keputusan Pemilihan Bibit Lele Terbaik Menggunakan Metode MOORA (Multi-Objective Optimization On The Basis Of Ratio Analysis) dan WASPAS (Weight Aggregated Sum Product Assesment)," *Junal Inform.*, vol. 2, no. 12, pp. 177–185, 2018, [Online].

[19] A. P. Nanda, S. Sucipto, and S. Hartati, "Analisis Menentukan Jasa Pengirim Terbaik Menggunakan Metode Weight Aggregated Sum Product Assesment (WASPAS)," *Expert J. Manaj. Sist. Inf. dan Teknol.*, vol. 10, no. 2, p. 42, 2020, doi: 10.36448/jmsit.v10i2.1594.

[20] W. R. K. Jayawardani and M. Maryam, "Sistem Pendukung Keputusan Seleksi Penerima Program Keluarga Harapan dengan Implementasi Metode SAW dan Pembobotan ROC," *Emit. J. Tek. Elektro*, vol. 22, no. 2, pp. 99–109, 2022, doi: 10.23917/emitor.v22i2.18411.