MOORA and SAW Methods for Selecting Optimal Oil Palm Fertiliser

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ABSTRACT

Oil palm (Elaeis guineensis) is an important commodity for Indonesia's economy; therefore, fertilizer selection during the nursery stage plays a crucial role in determining the quality and productivity of the plants. This study aims to develop a web-based Decision Support System (DSS) by applying the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) and Simple Additive Weighting (SAW) methods to determine the best fertilizer for the optimal growth of oil palm seedlings. The evaluation was conducted on ten fertilizer alternatives using five criteria, namely price, availability, ease of application, growth effectiveness, and solubility. The results of the study show that Urea Pupuk Kujang ranked first in both methods, with a MOORA score of 0.2084 and a SAW score of 0.8333. These findings indicate that the application of MOORA and SAW can support more objective, efficient, and reliable decision-making in selecting the best fertilizer for oil palm seedlings.

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1. INTRODUCTION

Oil palm (Elaeis guineensis) is a strategic commodity for the Indonesian economy because it plays an important role in exports, state revenue, and employment, especially in the regions of Sumatra and Kalimantan [1]. The nursery stage is a crucial factor in producing high-quality oil palm plants, where fertilizer selection plays an important role in providing nutrients for optimal growth.

Various types of fertilizers, both organic and inorganic, have their own advantages and disadvantages. Fertilizer selection should not only consider nutrient content, but also price, availability, ease of use, and environmental impact. Therefore, an objective and measurable approach is needed to determine the best fertilizer.

A Decision Support System (DSS) can be used to assist in this process. A DSS based on the Multi-Criteria Decision Making (MCDM) method allows the selection of the best alternative based on a number of criteria. Two widely used MCDM methods are MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) and SAW (Simple Additive Weighting). MOORA uses normalized data ratio comparisons, while SAW sums the values of alternatives based on criteria weights [2].

Previous studies have shown the effectiveness of MOORA and SAW in fertilizer selection. Based on this, this study aims to develop and apply both methods to determine the best fertilizer alternative for optimal oil palm seedling growth[3].

2. METHOD

2.1 The Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA)

The Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method is a decision-making technique introduced by Brauers and Zavadskas. It was developed as an approach for solving multi-criteria problems. MOORA is known for its flexibility, simplicity, and its ability to separate subjective judgment into weighted criteria across multiple decision attributes [4].

The MOORA procedure generally consists of five steps. First, each alternative is assigned criterion values that will be processed to produce a final decision. Second, these values are transformed into a decision matrix, which represents the performance of alternative i on attribute j. Each attribute value is later compared using a ratio-based system [5].

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Figure 1. MOORA method formula

2.2 Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) method, also known as the weighted sum model, is one of the simplest and most widely used techniques in decision support systems [6]. SAW is commonly applied in Multiple Attribute Decision Making (MADM) problems [7]. The fundamental concept of SAW is to calculate the weighted sum of performance ratings for each alternative across all criteria [8].

$$R_{ij} = \frac{X_{ij}}{\max X_{ij}} \text{ for benefit criteria}$$
$$R_{ij} = \frac{\min X_{ij}}{X_{ij}} \text{ for cost criteria}$$

Figure 2. SAW benefit & cost decision formula

Where R_{ij} is the normalized value, X_{ij} is the original criterion value, and $\max X_{ij}$ and $\min X_{ij}$ are the highest and lowest values of each criterion, respectively. Finally, the overall score of each alternative is obtained by multiplying the normalized values with their corresponding weights and summing the results, expressed as:

$$V_i = \sum_{j=1}^{n} W_j R_{ij}$$

Figure 3. SAW method formula

2.3 Alternatives

This study evaluates ten fertilizer alternatives commonly used for oil palm seedlings. The alternatives included in this research are:

1. NPK Phonska Plus
2. NPK Mutiara
3. Growmore
4. Dekastar Plus
5. Yara Mila
6. Grower Mix
7. ZK Meroke
8. Urea Pupuk Kujang
9. SP-36
10. KCI Jordan

These fertilizers were selected based on their availability in the Indonesian agricultural market and their relevance to early oil palm seedling development.

2.4 Criteria

The decision-making process in this study uses five evaluation criteria representing both agronomic performance and practical usability. The criteria used are:

1. C1 – Price (Cost) The cost required to purchase the fertilizer. Lower prices indicate better preference.

2. C2 – Availability (Benefit) Measures how easy the fertilizer can be found in agricultural stores or distributors.
3. C3 – Ease of Application (Benefit) Indicates how simple the fertilizer is to apply during seedling management.
4. C4 – Growth Effectiveness (Benefit) Represents the fertilizer's effectiveness in supporting oil palm seedling growth
5. C5 – Solubility (Benefit) Indicates how easily the fertilizer dissolves and how quickly nutrients can be absorbed.

These criteria were selected based on agronomic expert recommendations and practical considerations in oil palm nursery management.

3. RESULT AND DISCUSSION

The results of this study present the evaluation of ten fertilizer alternatives for oil palm seedlings using the MOORA and SAW methods. Both methods were applied to the same decision matrix containing five criteria: price (cost), availability, ease of application, growth effectiveness, and solubility. The preference values generated by each method were then compared to determine consistency in ranking.

3.1 MOORA Flowchart and Result

The MOORA method begins with normalization, followed by applying weights and calculating the overall preference value. Based on the final MOORA computation, **Urea Pupuk Kujang** achieved the highest score of **0.2084**, positioning it as the best fertilizer alternative among all evaluated options. This result indicates that Urea Pupuk Kujang performs consistently well across benefit criteria and maintains a competitive value on the cost criterion. Meanwhile, fertilizers such as SP-36 and KCI Jordan obtained lower scores, demonstrating weaker performance across multiple criteria.

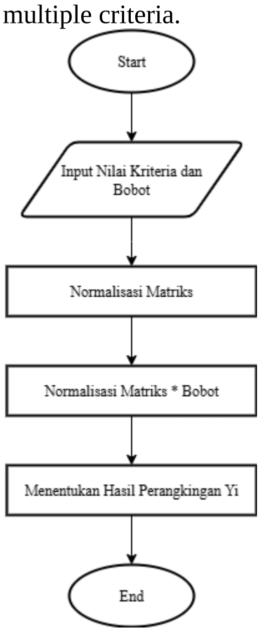


Figure 4. Moora Flowchart

3.2 SAW Flowchart and Result

The SAW method produced comparable findings. After normalizing each criterion according to benefit or cost rules and applying the designated weights, the final SAW ranking again placed **Urea Pupuk Kujang** as the top alternative with a score of **0.8333**. This reinforces the strength of this fertilizer in terms of growth response, ease of use, and solubility. Similar to the MOORA results, alternatives with lower scores in SAW showed consistent weaknesses in the same criteria, confirming that the data pattern is stable across methods.

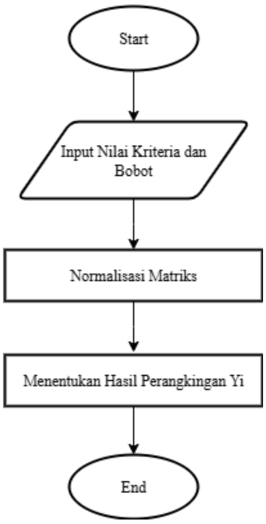


Figure 5. SAW Flowchart

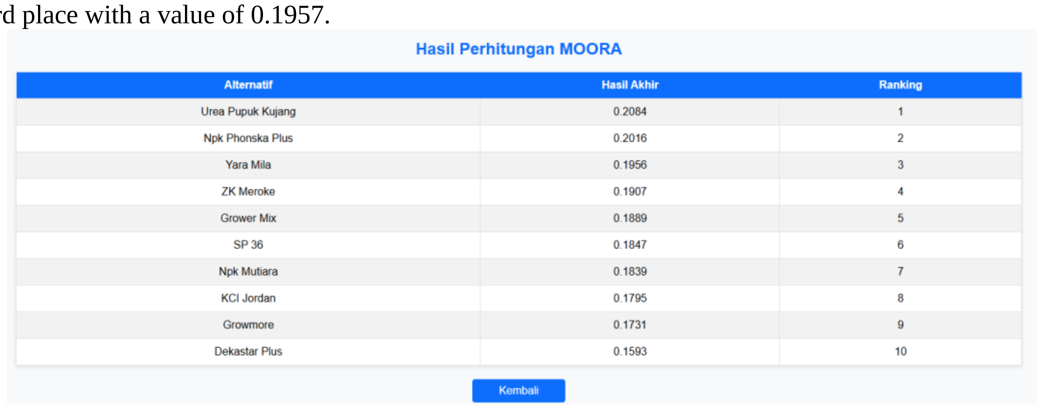
3.3 System Implementation Result

This section presents the implementation results of the MOORA and SAW calculations within the web-based decision support system developed in this study. Both methods were previously explained in detail through manual calculations in Chapter III, whereas this section displays the outputs generated automatically by the system.

The purpose of this implementation is to ensure that the algorithms embedded in the system produce results that are fully consistent with the manual calculations. Thus, the system not only displays the ranking of the best fertilizer alternatives but also provides validation that the calculation process is performed correctly in accordance with the theoretical formulas. The system outputs include normalized values, MOORA preference scores, SAW final scores, and the overall ranking of each alternativ

3.4 MOORA Ranking Results Generated by the System

The MOORA method in the developed system operates automatically after the user inputs the alternatives, criteria, and their corresponding values. The system immediately generates the final preference score (Yi) and the ranking of fertilizer alternatives. The results show that Urea Pupuk Kujang ranked first with a Yi value of 0.2084, followed by NPK Phonska Plus in second place with a value of 0.2017, and Yara Mila in third place with a value of 0.1957.



Hasil Perhitungan MOORA

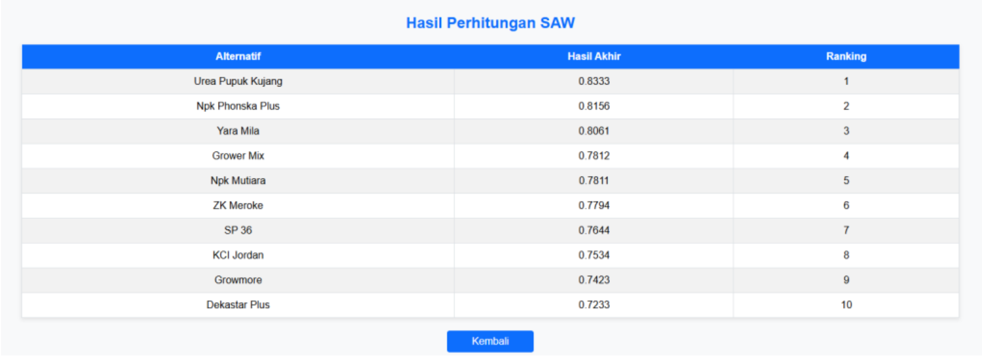
Alternatif	Hasil Akhir	Ranking
Urea Pupuk Kujang	0.2084	1
Npk Phonska Plus	0.2016	2
Yara Mila	0.1956	3
ZK Meroke	0.1907	4
Grower Mix	0.1889	5
SP 36	0.1847	6
Npk Mutiara	0.1839	7
KCl Jordan	0.1795	8
Growmore	0.1731	9
Dekastar Plus	0.1593	10

Kembali

Figure 6. Moora Result by the system

3.5 SAW Ranking Results Generated by the System

The SAW method in the developed system also operates automatically. After the user inputs the criteria, alternatives, and corresponding values, the system immediately generates the final preference scores and the ranking of the fertilizer alternatives. The results show that Urea Pupuk Kujang ranks first with a final score of 0.8330, followed by NPK Phonska Plus in second place with a score of 0.8156, and Yara Mila in third place with a score of 0.8061.



Hasil Perhitungan SAW

Alternatif	Hasil Akhir	Ranking
Urea Pupuk Kujang	0.8333	1
Npk Phonska Plus	0.8156	2
Yara Mila	0.8061	3
Grower Mix	0.7812	4
Npk Mutiara	0.7811	5
ZK Meroke	0.7794	6
SP 36	0.7644	7
KCl Jordan	0.7534	8
Growmore	0.7423	9
Dekastar Plus	0.7233	10

Kembali

Figure 7. SAW Result by the system

3.6 Comparison of the results of the Moora and Saw methods

Based on the results obtained, several points can be evaluated:

1. The MOORA method provides a more detailed calculation process, starting from normalization to the optimization value (Yi), making the process more transparent and easier to trace. The most prominent and influential part of this method is the Yi optimization stage, as it directly distinguishes between benefit and cost criteria, which ultimately determines the final ranking of the alternatives.
2. The SAW method is simpler because it directly calculates the preference value (Vi) from the normalized results multiplied by their respective weights, making the process faster even though it is not as detailed as MOORA. In the SAW method, the most significant element is the assignment of criterion weights, since the final preference value is highly dependent on the contribution of each criterion to the total score.

Figure 7. Comparison chart of Moora and Saw methods

3.7 Test Result

The results obtained using the MOORA and SAW methods indicate that the system is able to generate the fertilizer alternative rankings accurately and consistently. The normalization, weighting, and calculation processes in both methods operate in accordance with their theoretical foundations, and the outputs produced by the system match the manual calculations presented in Chapter III. This confirms that the implementation of both methods within the system is correct and reliable.

4. CONCLUSION

Based on the results, implementation, and evaluation of the decision support system for selecting the best fertilizer using the MOORA and SAW methods, several conclusions can be drawn. The system successfully implements both methods, producing results that are fully consistent with manual calculations, thus ensuring computational accuracy. MOORA provides a more detailed and transparent calculation process through its optimization stage (Yi), while SAW offers a simpler and faster computation through direct preference scoring (Vi). The system effectively accelerates the fertilizer selection process, reduces calculation errors, and presents comparative results clearly. Overall, the system fulfills the research objective by supporting fast, objective, and computerized decision-making for determining the optimal fertilizer for oil palm seedlings.

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REFERENCES

[1] E. F. Adwar and W. Wildian, "Rancang Bangun Sistem Absensi Berbasis RFID Terkoneksi Website Menggunakan Bahasa Pemrograman PHP dan MySQL," Jurnal Fisika Unand, vol. 9, no. 3, pp. 311–317, 2020, doi: 10.25077/jfu.9.3.311-317.2020.

[2] A. Afif, R. Hendratama, and R. Wibisono, "Penerapan metode MOORA dalam sistem pendukung keputusan," Jurnal Teknologi Informasi dan Komputer, vol. 1, pp. 181–191, 8 C.E.

[3] Anmolliza, A. Zakir, and A. Rafika Dewi, "Perbandingan Metode Moora dan Metode Simple Additive Weighting (SAW) untuk Menentukan Pupuk Terbaik Pada Tanaman Kacang Panjang," Jurnal TEFSIN (Jurnal Teknik Informatika dan Sistem Informasi), vol. 1, no. 2, pp. 54–62, 2023. [Online]. Available: http://jurnal.unusumbar.ac.id:8090/ojs/index.php/jts

[4] S. Chomsiyah, Zakiyah, and Darodjat, "JURNAL LOCUS: Penelitian & Pengabdian," JURNAL LOCUS: Penelitian & Pengabdian, vol. 3, no. 1, pp. 79–91, 2024, doi: 10.36418/locus.v1i8.229.

[5] D. M. El Faritsi, D. Saripurna, and I. Mariami, "Sistem Pendukung Keputusan Untuk Menentukan Tenaga Pengajar Menggunakan Metode MOORA," Jurnal Sistem Informasi Triguna Dharma (JURSI TGD), vol. 1, no. 4, p. 239, 2022, doi: 10.53513/jursi.v1i4.4948.

[6] K. Fauzia, "Perancangan Sistem Informasi Akuntansi Piutang Usaha Berbasis Web Menggunakan PHP dan MySQL," Jurnal Tekno Kompak, vol. 14, no. 2, p. 80, 2020, doi: 10.33365/jtk.v14i2.746.

[7] HALOMOAN, "Peran Tenaga Kerja Perkebunan Kelapa Sawit Dalam Peningkatan Ekonomi Keluarga (Studi Kasus di Desa Sungai Magelang Kabupaten Pasaman Barat)," 2021.

[8] R. N. Hidayat, B. Santoso, and L. P. Sumirat, "Sistem Pendukung Keputusan Pemilihan Siswa Berprestasi Menggunakan Metode Simple Additive Weighting dan Weighted Product," MALCOM: Indonesian Journal of Machine Learning and Computer Science, vol. 5, no. 1, pp. 379–390, 2024. [Online]. Available: https://www.journal.irpi.or.id/index.php/malcom/article/view/1787

[9] R. Intan, "Penerapan Metode Multi Objective Optimization on the Basis of Ratio Analysis Dalam Sistem Pendukung Keputusan Pemberian Pinjaman," Bab I, pp. 1–16, Apr. 2020.

[10] Munawir et al., "Analisis Pengembangan Kelapa Sawit di Kalimantan," Aliansi: Jurnal Manajemen dan Bisnis, vol. 18, no. 1, pp. 83–90, 2023, doi: 10.46975/aliansi.v18i1.468.

[11] A. B. Rahutomo, M. Karuniasa, and E. Frimawaty, "Peningkatan Produktivitas Lahan Pekebun melalui Sertifikasi Kelapa Sawit Berkelanjutan di Indonesia," Analisis Kebijakan Pertanian, vol. 21, no. 1, pp. 43–55, 2023, doi: 10.21082/akp.v21i1.43-55.

[12] A. Rizki, A. Febriyanto, M. D. Pratama, K. Faozi, S. J. Group, and T. Selatan, "Berbasis Web untuk Mempermudah Pengelolaan Data Perpustakaan di SD Negeri Lebakwangi," vol. 3, no. 3, pp. 356–359, 2025.

[13] W. Saw, M. Nu, R. Widayanti, D. Sa, and D. Mahendra, "Sistem Pendukung Keputusan Pemilihan Guru Berprestasi dengan Metode Simple Additive Weighting (SAW) di SMA Maarif NU Pandaan," Jurnal Ilmiah Komputasi, vol. 23, no. 4, pp. 621–630, 2024, doi: 10.32409/jikstik.23.4.3665.

[14] Q. Arista, N. S. Nandasari, and A. Yusuf, "Perbandingan Penggunaan Metode SAW dan AHP Untuk Sistem Pendukung Keputusan Penerimaan Karyawan Baru," Teknika: Engineering and Sains Journal, vol. 4, pp. 7–12, 2020.