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Potential Increase in Chili Crop Yield Through Superior Seed Selection Using an Intelligent System in Koya Barat, Papua

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ABSTRACT

This study discusses the development of a Decision Support System (DSS) designed to assist in the selection of superior chili seed varieties using the Simple Additive Weighting (SAW) method. The main problem faced by farmers is the difficulty of determining the best seeds in an objective and measurable manner, as the selection process is often based on experience or subjective judgment. In this research, the developed system was designed to consider various evaluation criteria, including productivity level, resistance to disease, adaptability to environmental conditions, harvest period, and fruit quality. Therefore, the system is expected to provide more accurate recommendations that can serve as a reliable reference for farmers in decision-making. The development model used in this research is the iterative development model, which allows the system to be developed and refined in stages through continuous evaluation. Each development phase was assessed to ensure improvements were made until optimal performance was achieved. The system testing process employed the black-box testing method to verify that all functionalities worked according to design, with results showing 100% compliance with the expected functions. In addition, a User Acceptance Test (UAT) was conducted involving a group of farmers in Koya Barat Subdistrict, Jayapura City, Papua, yielding a result of 85% in the "strongly agree" category, indicating that the system is easy to use, informative, and aligned with users' needs. The analysis results revealed that the Mellyana chili variety obtained the highest score and was recommended as the best seed choice. These findings demonstrate that applying the SAW method within a decision support system effectively assists farmers in making rational, efficient, and data-driven decisions when selecting superior chili seeds suited to their regional conditions.

I. Introduction

The Republic of Indonesia is an agrarian country that heavily relies on its agricultural output to address economic crises. One of the objectives of the President of Indonesia is to achieve food self-sufficiency [1-2]. Chili, particularly bird's eye chili, is a high-demand commodity throughout Indonesia, especially in Papua Province. A study reported that the annual demand for chili in Indonesia has steadily increased, reaching up to 1,137,688 tons per year [3]. To address domestic chili shortages, the government imports chili from abroad, as the supply produced by farmers across Indonesia is insufficient to meet national demand [3].

The lack of chili supply from farmers affects market prices, which can become very high, particularly during religious holidays. In Jayapura City, chili prices can reach up to IDR 150,000 per kilogram. Several factors contribute to suboptimal chili harvests, including pest attacks, adverse weather conditions, and the use of non-superior seeds.

This study aims to assist farmers by providing solutions through a decision support system (DSS) application. The application is designed using the Simple Additive Weighting (SAW) method. This method was selected because it effectively identifies the best alternative among several options—in this case, the alternatives are different bird's eye chili seed varieties. The SAW method ranks the alternatives from the highest to the lowest score [4].

II. Literature Review

Several methods can be used to design decision support systems, including the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and the Weighted Product (WP) method. However, a study comparing the SAW and WP methods indicated that SAW achieves higher accuracy [5]. The Simple Additive Weighting (SAW) method has been applied in various previous studies but in different contexts. For instance, SAW was used in a decision support system for replating oil palm plantations, where the study concluded that SAW is suitable for determining replating schedules and recommended adding more criteria for more accurate recommendations. However, no testing of the system or the recommendations was conducted, so accuracy could not be verified [6].

Another study applied SAW for selecting ornamental plants, concluding that the system could assist farmers in providing accurate information to customers [7]. The limitation was the lack of system and user testing. A further application involved selecting rubber seeds, where SAW calculations provided excellent decision recommendations. The study suggested adding a cost criterion for greater variability [8]. Another application of SAW was for mapping flood-prone areas in Semarang City, showing that SAW is effective for local flood mapping based on specific criteria [9]. The limitation was the absence of accuracy validation for both the system and users.

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III. Method

A. Research Stages

This study employs an iterative model for problem-solving. The iterative model is a software development method that uses small, repeated development cycles to collect user feedback through testing, improving software quality [10-12]. Iterative models help algorithms reduce memory usage and processing time for data retrieval, especially for datasets ranging from 1 to 10 million records [13-14]. A visual representation of the iterative model is shown in Figure 1.

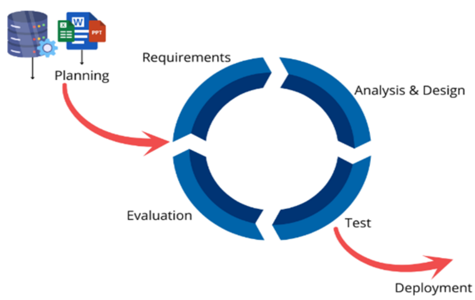

Fig. 1. Iterative System Development Cycle

The iterative model continues until the product meets user requirements and quality standards. Each iteration allows developers to incorporate feedback into the intelligent system or decision support system (DSS). This study uses the SAW method to enhance accuracy, efficiency, and reliability in decision-making.

B. Simple Additive Weighting Method

The Simple Additive Weighting (SAW) method is widely used in decision support systems [9], [15-19]. SAW identifies the best alternative among several options; in this study, the alternatives are bird's eye chili seed varieties. Figure 2 illustrates the SAW computation steps:

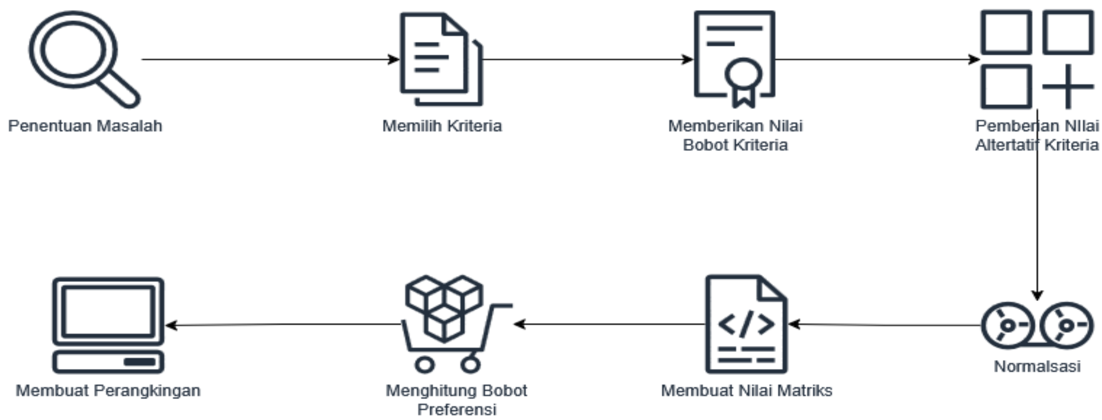

Fig. 2. SAW Method Steps

Steps include:

- Problem identification, including chili seed alternatives;
- Assigning criteria to all alternatives;
- Weighting each criterion;
- Scoring each alternative for each criterion;
- Normalization;
- Constructing the decision matrix;
- Calculating preference scores;

The normalized performance rating can be calculated using the formula:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max\ x_{ij}}\ if\ j\ is\ a\ benefit\ attribute \\ \frac{\min x_{ij}}{x_{ij}}\ if\ j\ is\ a\ cost\ attribute \end{cases} \quad (1)$$

Where:

rij : normalized performance rating

xij : attribute value of each criterion

max xij : maximum values of each criterion

min xij : minimum values of each criterion

for each alternative is calculated as:

$$v_i = \sum_{j=1}^{n} w_j r_{ij} \quad (2)$$

Where:

Vi: preference value for each criterion

Wj: weight of each criterion

rij: normalized performance rating

C. System Design Use Case Diagram

The use case diagram illustrates interactions between users (actors) and the system. The DSS for chili seed selection is shown in Figure 3.

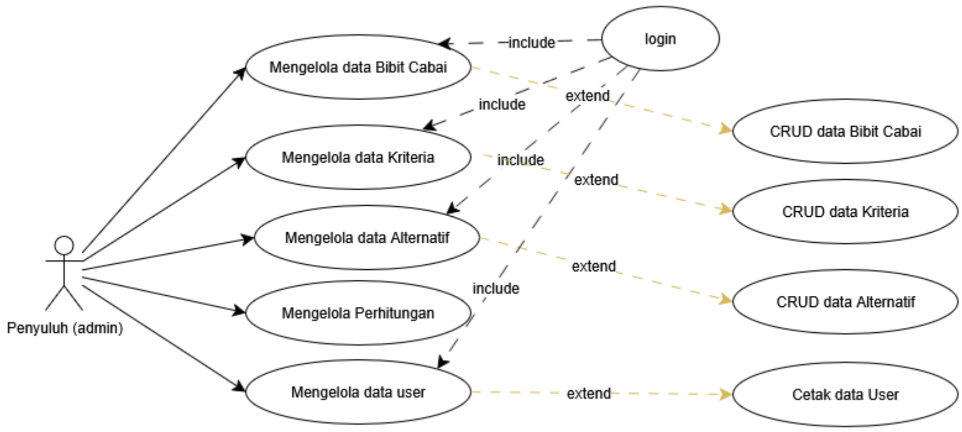

Fig. 3. Use Case Diagram

D. Testing Methods

- Black-box Testing

Black-box testing evaluates system functionality without examining the source code. Inputs and expected outputs are tested to ensure compliance with specifications, identifying errors in functions, interfaces, and integration.

Table 1. Black-box Testing Results

No	Test Scenario	Input	Expected Process	Expected Output	Test Result	Remarks
1	User login	Valid username & password	System verifies login	Dashboard access	✓	Pass
2	Login failure	Incorrect username/password	Access denied	Error message	✓	Pass
3	Add criteria	New criteria data	System saves to DB	Criteria appears	✓	Pass
…	…	…	…	…	…	…

- User Acceptance Test (UAT)

UAT evaluates system suitability for end-users, validating function, usability, and reliability. Results inform system acceptance and readiness for real-world deployment. Figure 4 shows UAT results.

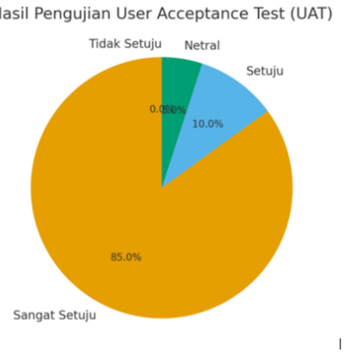

Fig. 4. UAT Results

IV. Results and Discussion

The SAW method was applied to select the best chili seed based on the pre-defined criteria.

A. *Criteria*

The selected criteria are listed in Table 2.

Table 2. Criteria and Weights

Code	Criterion	Weight	Type
C1	Seed Price (IDR/100g)	20	Cost
C2	Fertilizer Requirement (kg/ha)	15	Cost
C3	Disease Resistance (1–5)	20	Benefit
C4	Productivity (kg/ha)	30	Benefit
C5	Plant Age (Months)	15	Benefit

B. *Alternatives*

Based on farmer interviews, five chili varieties were analyzed (Table 3).

Table 3. Chili Seed Alternatives

Code	Alternative
A1	ORI 212
A2	Absolute 69
A3	Kaliber
A4	Mellyana
A5	Bintang Asia

C. *Decision Matrix*

Table 4. Decision Matrix

Alt/Kri	C1	C2	C3	C4	C5
A1	69000	20	5	26	3
A2	75000	15	4	24	3
A3	65000	17	2	30	5
A4	55000	12	3	21	8
A5	68000	14	3	17	18

Each alternative has strengths and weaknesses. A4 (Mellyana) offers the lowest price with high productivity, while A5 (Bintang Asia) excels in productivity but has low fertilizer efficiency.

D. Normalization and Preference Calculation

Normalized values were calculated for all alternatives (example calculations shown above). The weighted sum results in preference scores:

Table 5. Normalization and Preference Calculation

Alternative	Score	Rank
A1	73.44	3
A2	69.16	5
A3	69.67	4
A4	74.66	1
A5	73.03	2

Mellyana (A4) is the top recommendation.

E. Interface Design

The intelligent system interface is simple, interactive, and user-friendly. Users can input criteria such as pest resistance, productivity, and fruit quality. Results are displayed as rankings or recommendations, complemented with graphics and icons for clarity. Figures 5–10 show login, main menu, criteria, alternatives, normalization matrix, and ranking results.

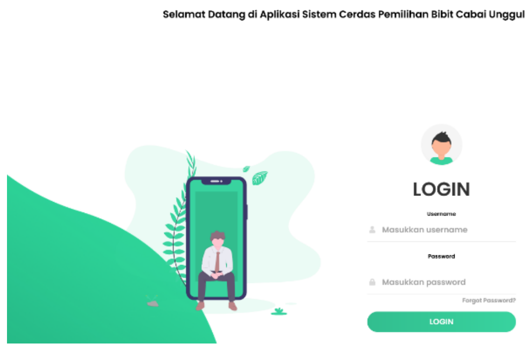

Fig. 5. Login

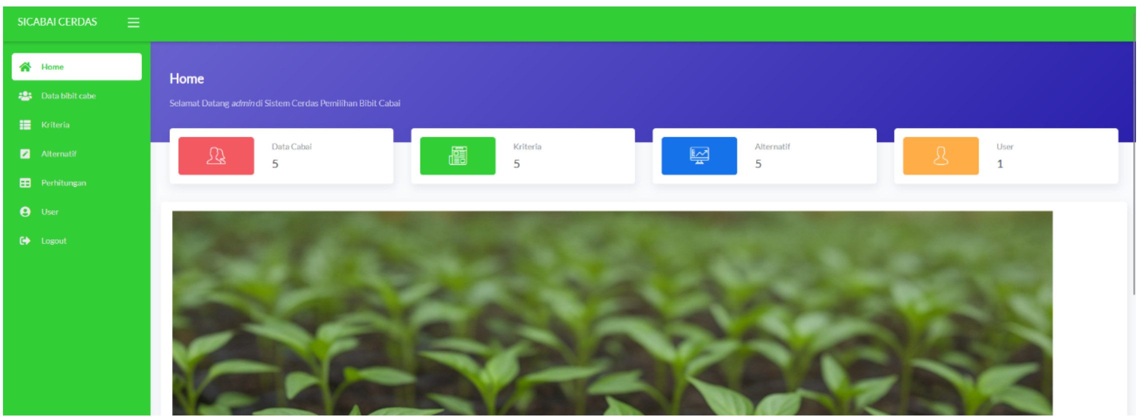

Fig. 6. Main Menu

The main menu page displays the system's core features in a structured and easily accessible manner. The responsive and simple design facilitates navigation. This interface allows users to quickly and efficiently select the services they need.

Data Kriteria

Show 10 entries Search:

No/Code	Nama Kriteria	Atribute	Bobot	Opsi
C1	Harga Bibit Cabe/100 Gram	cost	20	Edit
C2	Kebutuhan terhadap Pupuk (Kg/Ha)	cost	15	Edit
C3	Ketahanan Terhadap Penyakit (Skala 1-5)	benefit	20	Edit
C4	Produktivitas Hasil Panen (Ha)	benefit	30	Edit
C5	Umur Tanaman cabe (Bulan)	benefit	15	Edit

Showing 1 to 5 of 5 entries Previous 1 Next

Fig. 7. Criteria

The criteria page in the decision support system displays a list of assessment factors used in the selection process. Each criterion is assigned a weight and attributes, allowing users to understand its level of importance. The simple layout facilitates effective analysis and decision-making.

Perangkingan

no	Nama	Jumlah Perhitungan Metode SAW	ket
1	Cabe Rawit Mellyana	74.66666667	peringkat 1
2	Cabai Rawit ORI 212	73.44202899	peringkat 2
3	Cabe Rawit Bintang Asia	73.03361345	peringkat 3
4	Cabe Rawit Kaliber	69.67797888	peringkat 4
5	Cabe Rawit Absolute 69	69.16666667	peringkat 5

Fig. 8. Normalization Matrix

The normalization matrix page in the SAW method DSS is useful for displaying standardized data calculation results. This normalization process facilitates comparisons between alternatives based on criteria at different scales. With a clear display, users can understand the standardized values, resulting in more objective and accurate decisions.

Matrik Normalisasi

No	Nama	Harga Bibit Cabe/100 Gram	Kebutuhan terhadap Pupuk (Kg/Ha)	Ketahanan Terhadap Penyakit (Skala 1-5)	Produktivitas Hasil Panen (Ha)	Umur Tanaman cabe (Bulan)
1	Cabai Rawit ORI 212	0.797101449	0.6	1	0.866666667	0.166666667
2	Cabe Rawit Absolute 69	0.733333333	0.8	0.8	0.8	0.166666667
3	Cabe Rawit Kaliber	0.846153846	0.705882353	0.4	1	0.277777778
4	Cabe Rawit Mellyana	1	1	0.6	0.7	0.444444444
5	Cabe Rawit Bintang Asia	0.808823529	0.857142857	0.6	0.566666667	1

Fig. 9. Ranking Results

Based on the criteria and weight data that has been processed, the Mellyana cayenne pepper is the first recommendation that is suitable for planting in the West Koya area, taking into consideration 5 criteria.

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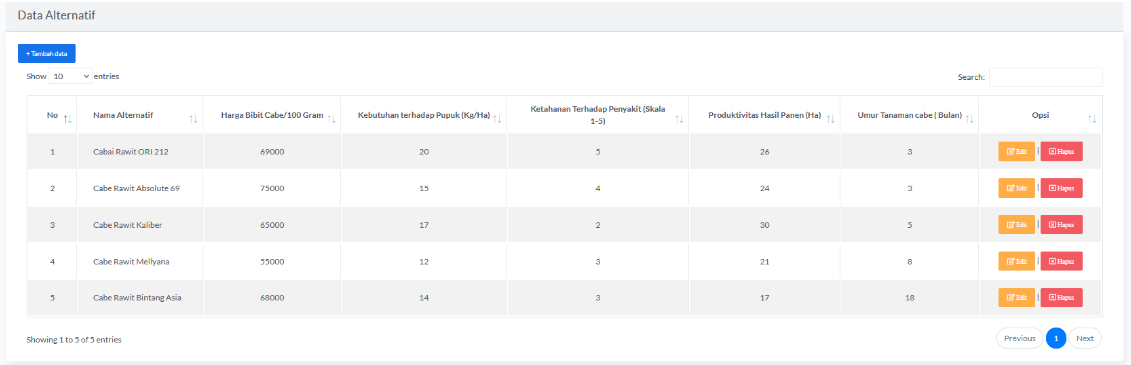

Fig. 10. Alternatif Page

The alternative data page is a page that displays data on the types of seeds most frequently planted by farmers in West Koya.

V. Conclusion

This study demonstrates that the SAW-based Decision Support System (DSS) effectively supports the selection of superior chili seeds in Koya Barat, Papua. Based on five criteria—seed price, fertilizer requirement, disease resistance, productivity, and plant age—the Mellyana chili variety is recommended as the top choice. The system underwent black-box testing, achieving 100% functional accuracy, while the User Acceptance Test (UAT) showed that 85% of users strongly agreed that the system is easy to use and relevant to their needs.

The proposed DSS provides a practical tool for farmers to make objective, data-driven decisions in selecting chili seeds, potentially increasing productivity and reducing losses. However, the study has some limitations, including the limited number of criteria and the focus on a single region. Future research could expand the system to include additional agronomic and economic factors, incorporate larger datasets, or test the system in other regions to enhance its generalizability.

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References

[1] A. Fadiliya and A. Mayangsari, "ANALISIS FAKTOR-FAKTOR YANG MEMPENGARUHI KEPUTUSAN PETANI DALAM MELAKUKAN USAHATANI CABAI RAWIT (studi kasus di Desa Bungatan Kecamatan Bungatan Kabupaten Situbondo)," AGRIBIOS, vol. 19, no. 2, p. 89, Nov. 2021, doi: 10.36841/agribios.v19i2.1297.

[2] A. P. R. Pinem, N. Hidayati, and K. Kholidin, "KLASIFIKASI PRIORITAS DISTRIK TERHADAP KETAHANAN PANGAN MENGGUNAKAN METODE JARINGAN SYARAF TIRUAN," Telematika, vol. 11, no. 2, p. 1, Aug. 2018, doi: 10.35671/telematika.v11i2.712.

[3] S. Andriyani and F. M. Yuma, "KOMBINASI METODE ANALITICAL HIERARCHY PROCESS DAN WEIGHTED PRODUCT DALAM PENENTUAN BENIH CABAI UNGGUL," JURTEKSI (Jurnal Teknologi dan Sistem Informasi), vol. 6, no. 2, pp. 117–124, Apr. 2020, doi: 10.33330/jurteksi.v6i2.596.

[4] S. Andriyani and F. M. Yuma, "KOMBINASI METODE ANALITICAL HIERARCHY PROCESS DAN WEIGHTED PRODUCT DALAM PENENTUAN BENIH CABAI UNGGUL," JURTEKSI (Jurnal Teknologi dan Sistem Informasi), vol. 6, no. 2, pp. 117–124, Apr. 2020, doi: 10.33330/jurteksi.v6i2.596.

[5] Y. I. Anas et al., "Decision Support System Pemilihan Bibit Unggul Tanaman Kelengkeng Menggunakan Metode Saw (Simple Additive Weighting)," in Seminar Nasional Inovasi Teknologi, 2020, pp. 17–22.

[6] S. Rafika, S. Siswan, and L. Arlina, "SISTEM PENDUKUNG KEPUTUSAN PENENTUAN REPLANTING PADA TANAMAN KELAPA SAWIT DI PT.UKINDO BLANKAHAN ESTATE MENGUNAKAN METODE SAW," Jurnal Ilmiah Kaputama (JIKA), vol. 5, no. 1, pp. 167–171, 2021.

[7] E. Erlangga, Y. Yolandari, T. Thamrin, and A. K. Puspa, "Analisis Penerapan Metode Simple Additive Weighting (SAW) Pemilihan Tanaman Hias," Explore:Jurnal Sistem informasi dan telematika, vol. 12, no. 1, p. 56, 2021, doi: 10.36448/jsit.v12i1.2010.

[8] P. N. Perdamaian, E. Maria, and Rusmini, "Sistem Pendukung Keputusan Pemilihan Bibit Karet Menggunakan Metode Simple Additive Weighting (SAW) Berbasis Web," Buletin Poltanesa, vol. 21, no. 2, pp. 58–63, Dec. 2020, doi: 10.51967/tanesa.v21i2.324.

[9] R. E. Setyani and R. Saputra, "Flood-prone Areas Mapping at Semarang City by Using Simple Additive Weighting Method," Procedia Soc Behav Sci, vol. 227, no. November 2015, pp. 378–386, 2016, doi: 10.1016/j.sbspro.2016.06.089.

[10] M. Riesener, C. Doelle, S. Perau, P. Lossie, and G. Schuh, "Methodology for iterative system modeling in agile product development," Procedia CIRP, vol. 100, pp. 439–444, Jan. 2021, doi: 10.1016/J.PROCIR.2021.05.101.

[11] I. G. S. Rahayuda and N. P. L. Santiari, "Implementasi dan Perbandingan Metode Iterative Deepening Search dan Held-Karp pada Manajemen Pengiriman Produk," Sisfo, vol. 07, no. 02, pp. 165-180 Sistem, Jan. 2018, doi: 10.24089/j.sisfo.2018.01.005.

[12] N. Ibrahim, N. Dong, and M. A. A. Abdalla, "On dual-loop model-free adaptive iterative learning control and its application," J Process Control, vol. 147, p. 103376, Mar. 2025, doi: 10.1016/j.jprocont.2025.103376.

[13] S. Vats et al., "Iterative enhancement fusion-based cascaded model for detection and localization of multiple disease from CXR-Images," Expert Syst Appl, vol. 255, p. 124464, Dec. 2024, doi: 10.1016/J.ESWA.2024.124464.

[14] K. Zhang, Q. Zhu, X. P. Xie, and R. Su, "A Self-triggered Adaptive Dynamic Programming Scheme for Unknown Nonlinear Systems by Iterative Model Predictive Process," IEEE Transactions on Automation Science and Engineering, 2025, doi: 10.1109/TASE.2025.3571535.

[15] E. Pawan, P. Hasan, and R. M. H. Thamrin, "Utilization SAW Method to Choose Goods Suppliers at PT.King Computer," CCIT Journal, vol. 13, no. 1, pp. 111–124, Feb. 2020, doi: 10.33050/ccit.v13i1.928.

[16] E. Pawan, N. S. Irjanto, R. N. Aprilianti, and S. Syaraswati, "Implementasi Metode Simple Additive Weighting pada Sistem Pendukung Keputusan Pemilihan Bibit Cabai Rawit Unggul," Jurnal Bumigora Information Technology (BITe), vol. 4, no. 2, pp. 167–178, Dec. 2022, doi: 10.30812/bite.v4i2.2386.

[17] G. Mangapul and B. P. Adhi, "Sistem Pendukung Keputusan Untuk Menentukan Penerima Beasiswa Di Fakultas Teknik Univeristas Negeri Jakarta Dengan Model Fuzzy Multiple Attribute Menggunakan Metode SAW," PINTER : Jurnal Pendidikan Teknik Informatika dan Komputer, vol. 1, no. 2, pp. 126–133, 2017, doi: 10.21009/pinter.1.2.5.

[18] Q. Chu et al., "Investigation on microstructure evolution, mechanical properties and corrosion resistance of dual phase stainless steel joints welded by GTAW and SAW methods," International Journal of Pressure Vessels and Piping, vol. 209, p. 105183, Jun. 2024, doi: 10.1016/J.IJPVP.2024.105183.

[19] S. S. Sawant, "Band selection strategies for hyperspectral image classification based on machine learning and artificial intelligent techniques –Survey," 2021. doi: 10.1007/s12517-021-06984-w.