DECISION SUPPORT SYSTEM FOR SELECTING ORDER TYPES USING THE SAW-AHP METHOD

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ABSTRACT

This study aims to make it easier for users to choose the type of orchid that is suitable for planting in the user's environmental conditions. This research was conducted because there were many orchid enthusiasts who wanted to cultivate it but it was not balanced with knowledge of the characteristics of orchids that can live in ideal environmental conditions. The SAW method plays a role in the initial classification where the results of the SAW method classification are sorted from the largest value to the smallest value, then the 10 best results from the SAW method will be processed by the AHP method and produce the final result, the recommended orchid. The final result obtained in this system is in accordance with the manual calculations performed, this means that the system classifies rules properly and accordingly.

Keywords: *Orchids, SAW method, AHP method.*

1. INTRODUCTION

Orchid plants are very suitable for ornamental plants or for cultivation. Thus, of course there are many fans of orchid plants, but not all know the types of orchids and how these orchids can survive in an ideal environment, especially with those who are still beginners, if they choose the wrong orchid plant for planting, the orchid plant will not survive and will cause losses this is because orchids have many types and all have their own characteristics to survive.

The method used in decision making in selecting suitable orchids is Simple Additive Weighting (SAW) and Analytical Hierarchy Process (AHP). Simple Additive Weighting (SAW) has a basic concept by finding the weighted sum of the performance ratings for each alternative on all attributes (Fishburn, 1967) (Mac Crimson, 1968). Analytic Hierarchy Process (AHP) is a special method of Multi Criteria Decision Making (MCDM) introduced by Thomas L. Saaty. AHP is very useful as a tool in decision-making analysis and has been used well in various fields such as forecasting, employee selection, product concept selection, and others.

Based on the description above, a system is needed that can be used to determine the suitable type of orchid and will provide shop recommendations by displaying the existing link so that users don't have to come to the flower shop by simply making online transactions. The method to be used for the system to be built is the SAW-AHP method..

2. THEORETICAL BASIS

2.1 Decision Support System

Decision Support System (DSS) is defined as a system that supports the work of a manager or a group of managers in solving semi-structured problems by providing information or suggestions for specific decisions (Hermawan, 2005).

2.2 SIMPLE ADDITIVE WEIGHTING (SAW)

The Simple Additive Weighting (SAW) method is often known as the weighted addition method. The basic concept of the SAW method is to find a weighted sum of the performance ratings for each alternative on all attributes (Fishburn, 1967) (MacCrimmon, 1968).

SAW settlement steps as follows:

1. Determine the criteria that will be used as a reference in making decisions, namely Ci.
2. Determine the suitability rating of each alternative on each criterion.
3. Make a decision matrix based on the criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of attribute (profit attribute or cost attribute) in order to obtain a normalized matrix R.
4. The final result is obtained from the ranking process, namely the sum of the multiplication of the normalized matrix R with the weight vector so that the largest value is chosen as the best alternative (Ai) as a solution.

2.3 ANALYTICAL HIERARCHY PROCESS (AHP)

Analytical Hierarchy Process (AHP) is a general theory of measurement used to find ratio scales, both from discrete and continuous pairwise comparisons (Hadianti & Mubarok, 2017). The procedure or calculation steps in the AHP method include:

1. Defining the problem and determining the desired solution, then arranging a hierarchy of the problems at hand. Organizing a hierarchy is the ability of humans to perceive objects and ideas, identify them, and communicate what they observe. To obtain detailed knowledge, our minds organize complex reality into parts which become its main elements, and then this section is divided into parts again, and so on hierarchically (Saaty, 1990).
2. Determine the priority of the elements The first step in determining element priority is to create a pair comparison matrix. The pairwise comparison matrix is filled in use numbers to represent the relative importance of one element to another.
3. Synthesis Considerations for pairwise comparisons are synthesized to obtain overall priority.
4. Measure consistency In making decisions, it is important to know how good the consistency is because we don't want judgmental decisions with low consistency. The things that are done in this step are:

   • Calculate the Consistency Index (CI) with the formula: CI = (λ max-n) / n,

   Where n = number of elements

   • Calculate the Consistency Ratio (CR) with the formula: CR = CI / IR,

   Where CR = Consistency Ratio, CI = Consistency Index, IR = Random Consistency Index.

5. Check the consistency of the hierarchy.
   If the score is more than 10%, then the data judgment must be corrected. However, if the consistency ratio (CI / IR) is less or equal to 0.1. then the calculation results can be declared correct.

3. RESEARCH METHODOLOGY

3.1 Problem Analysis

Most users who are still unfamiliar with orchids but want to plant them for decoration or so are still confused about which orchids are suitable for planting in their environment, so the system that will be created aims to help users choose orchids according to existing environmental conditions.

3.2 Orchid plant Analysis

The data used to compile this system are factors that can influence the growth of orchids and factors from users or prospective orchid voters, including height, temperature, light intensity, humidity, planting medium, and price.

3.3 Analysis of Criteria and Alternatives

The data used to develop this decision support system are 6 criteria, 17 sub-criteria, and 25 alternatives.

3.4 The Main Function of the System

The main functions of the system to be created are:

1. Can determine the orchid plants according to the user's wishes

2. Can provide shop recommendation information about orchid plants that have been determined by the system.

3.5 System Flowchart

A flowchart is a chart with certain symbols that describe the process sequence in detail and the relationship between a process (instruction) and other processes in a program. In other words, this flowchart is a graphical description of the sequence of combined procedures that make up a system. The following is a flowchart of the system to be made.

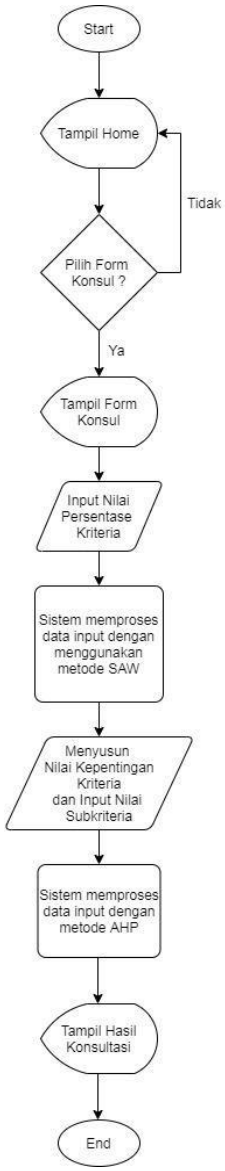


Figure 1. *Flowchart*

To carry out the classification process, the user selects the consultation menu then the user inputs the percentage value of the criteria as desired. The percentage value will be processed by the SAW method and produce a ranking result from the largest to the smallest value. The 10 best results of the ranking were taken and then continued

with the AHP method where the user compiled the importance value of the criteria and sub-criteria, after being processed by the AHP method, the recommended orchid results would be obtained.

3.6 Entity Relationship Diagram

Entity Relationship Diagram (ERD) is a technique used to model the data needs of an organization, usually by System Analysis in the analysis phase of system development project requirements. The following is the ERD of the system to be created.

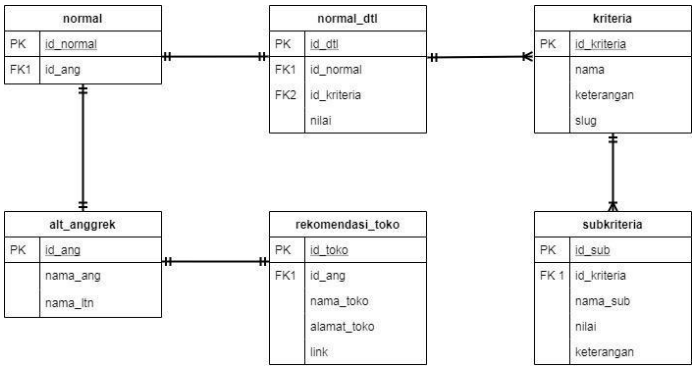


Figure 2. *ERD*

3.7 Data Flow Diagram

Data Flow Diagrams (DFD) or Data Flow Diagrams (DAD) are diagrams that use notations to describe the flow of data in a system or explain the work processes of a system, whose use is very helpful for understanding the system logically, structured and clearly.

3.7.1 Context Diagram

Context diagram is a diagram that consists of a process and describes the scope of a system. The following is a Context Diagram of the system to be created.

Figure 3. *Context Diagram*

3.7.2 DFD Level 1

DFD Level 1 is a DFD made with the results of the decomposition of the Context Diagram (DFD Level 0). DFD Level 1 aims to provide a deeper view of the entire system. The following is DFD Level 1 of the system to be created.

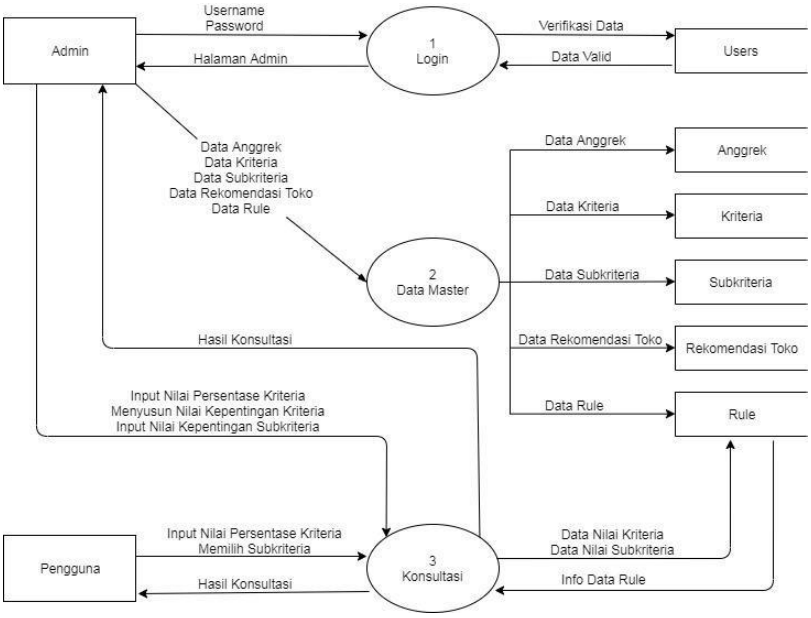


Figure *4. DFD Level 1*

4. INTERFACE IMPLEMENTATION

User Interface (User Interface) is a communication mechanism between the user (user) and the system. The user interface (User Interface) can receive information from the user (user) and provide information to the user (user) to help direct the path of tracking problems until a solution is found.

4.1. Main User Page

The main user page is the initial view of the system that will be created which is intended for users or users. Users can only access the consultation menu, the login menu is for admins.

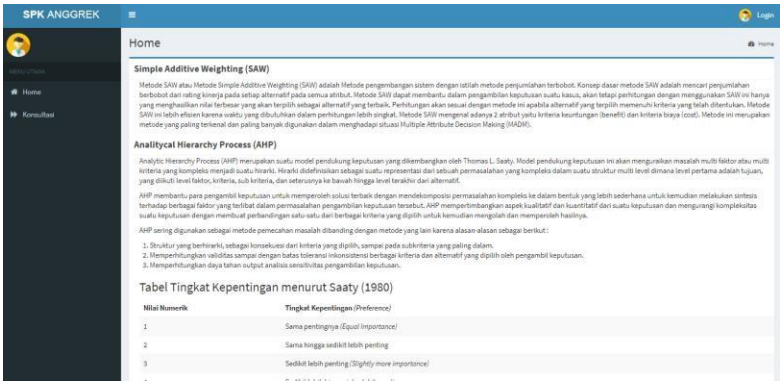


Figure *5. User Main Page Display*

4.2. Admin Main Page

The main admin page is the initial display of the system that will be created which is for admins. On this page the admin can process data such as adding, deleting or changing orchid data, criteria, sub-criteria and shop recommendations and can compile rules on the master data menu. And also can carry out consultations with the aim of checking whether the calculations carried out by the system are appropriate or not.

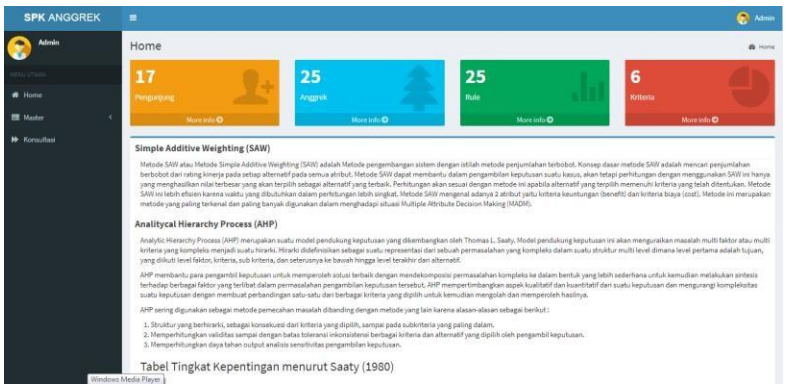


Figure 6. *Admin Main Page Display*

4.3. Consultation page

The consultation page is a display of the consultation menu. Serves to carry out consultations about suitable orchids to be selected by filling in the importance of each criterion and selecting the sub-criteria according to your wishes.

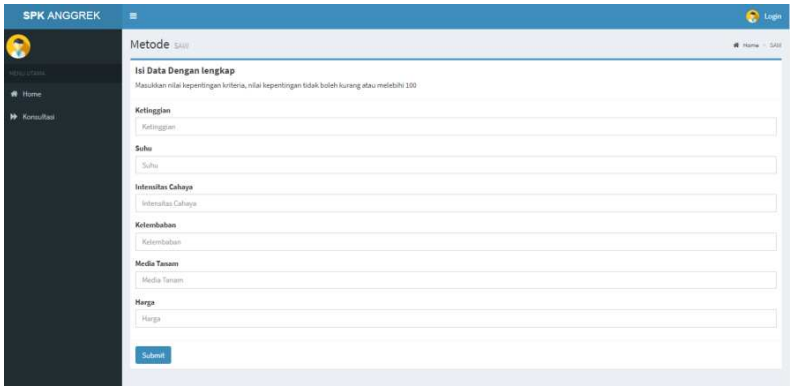


Figure 7. *Consultation page*

5. RESULTS AND DISCUSSION

5.1 System Testing

The purpose of this test is to determine whether the results issued are in accordance with the results of user input and the results of manual calculations of each method used in the system. At the testing stage, it is done by manual calculation of each method with a different input value, and at the analysis stage the test is carried out with a system that has been made with the input value based on the Testing stage.

5.2 Testing

The test is carried out by inputting weights to the SAW method with a weighted value for the Altitude Criteria of 50 and the Price Criteria of 50, which means that these two criteria are considered important and ignore other criteria. On Table 1 represents the SAW method process and the 10 best results issued. The 10 best results from the SAW method will be processed by the AHP method. The input value and the pairwise comparison matrix in the AHP method can be seen in table 2.

Table 1. SAW Method

No	Criteria	Weight Value	Result
1	Height	50	1. A. Giant Moon (100)
2	Temprature	0	2. A. Ribbon shoes (83,3)
3	Light Intensity	0	3. A. Tiger (75)
4	Humidity	0	4. A. Jambrut (75)
5	Growing Media	0	5. A. Root (75)
6	Price	50	6. A. Odd (75) 7. A. Chocolate Vanda (70,83) 8. A. Moon (70,83) 9. A. D. Insigne (70,83) 10. A. D. Discolor (70,83)

Table 2. *Pairwise Comparison Matrix Criteria AHP Method*

	Weight	Temperature	I. Light	Odd	M. Growing	Price
Weight	1	2	2	3	3	1,00
Temperature	0,50	1	1	2	2	0,50
I. Light	0,50	1	1	2	2	0,50
Odd	0,33	0,50	0,50	1	1	0,33
M. Growing	0,33	0,50	0,50	1	1	0,33
Price	1	2	2	3	3	1
TOTAL	3,66	7,00	7,00	12,00	12,00	3,67

Table 2 is a matrix of pairwise comparison of criteria, the next process is to calculate the priority value and determine the consistency value which includes the values of λmax, CI, and CR. For brevity, the consistency value has been calculated and the results include λmaks = 1.692, CI = -0.862, CR = -0.695. CR value <0.1, which means that the input value in table 2 is CONSISTENT.

Table 3. *Pairwise Comparison Matrix for Altitude Subcriteria for AHP Method*

	D. Low	Medium	D. Height
D. Low	1	0,33	1
Medium	3,00	1	3
D. Height	1,00	0,33	1
Total	5,00	1,67	5

Table 4. *Normalization Matrix for Altitude Sub-Criteria AHP Method*

	D. Low	Medium	D. Height	∑Line	Priority
D. Low	0,20	0,20	0,20	0,60	0,20
Medium	0,60	0,60	0,60	1,80	0,60
D. Height	0,20	0,20	0,20	0,60	0,20

Table 5. *Matrix Pairwise Comparison of Temperature Sub-Criteria AHP Method*

	Hot	Moderate	Cold
Hot	1	2,00	2
Moderate	0,5	1	1
Cold	0,5	1,00	1
Total	2	4,00	4

Table 6. *Normalization Matrix for Temperature Sub-criteria AHP Method*

	Hot	Moderate	Cold	∑Line	Priority
Hot	0,5	0,5	0,5	1,5	0,50
Moderate	0,3	0,3	0,3	0,8	0,25
Cold	0,3	0,3	0,3	0,8	0,25

Table 7. *Sub-criteria Pairwise Comparison Matrix I. Light AHP Method*

	Low	Moderate	Height
Low	1	0,50	1,00
Moderate	2	1	2,00
Height	1	0,50	1
Total	4	2	4,00

Table 8. *Sub-criteria Normalization Matrix I. Light AHP Method*

	Low	Moderate	Height	∑Line	Priority
Low	0,3	0,3	0,3	0,8	0,25
Moderate	0,5	0,5	0,5	1,5	0,50
Height	0,3	0,3	0,3	0,8	0,25

Table 9. *Matrix Pairwise Comparison of M. Growing Subcriteria AHP Method*

	Moss	Fern	Charcoal	Wood Shavings	Coconut Husk
Moss	1	1	0,50	1	1,00
Fern	1	1	0,50	1	1,00
Charcoal	2	2	1,00	2	2,00
Wood Shavings	1	1	0,50	1	1,00
Coconut Husk	1	1	0,50	1	1
Total	6	6	3	6	6,00

Table 10. *Normalization Matrix of Sub-Criteria M. Growing AHP Method*

	Moss	Fern	Charcoal	Wood Shavings	Coconut Husk	∑Line	Priority
Moss	0,167	0,167	0,167	0,167	0,167	0,833	0,167
Fern	0,167	0,167	0,167	0,167	0,167	0,833	0,167
Charcoal	0,333	0,333	0,333	0,333	0,333	1,667	0,333
Wood Shavings	0,167	0,167	0,167	0,167	0,167	0,833	0,167
Coconut Husk	0,167	0,167	0,167	0,167	0,167	0,833	0,167

Table 11 *Matrix Pairwise Comparison of Price Subcriteria for AHP Method*

	Expensive	Moderate	Cheap
Expensive	1	0,33	1,00
Moderate	3	1	3,00
Cheap	1	0,33	1
Total	5	1,67	5,00

Table 12 *Normalization Matrix of Price Sub-Criteria AHP Method*

	Expensive	Moderate	Cheap	∑Line	Priority
Expensive	0,2	0,2	0,2	0,6	0,20
Moderate	0,6	0,6	0,6	1,8	0,60
Cheap	0,2	0,2	0,2	0,6	0,20

In tables 3 - 12, the sub-criteria input value and the priority value of each sub-criteria will be used to calculate the final result. The next step is to calculate the final result where the best 10 results from the SAW method will be processed so that later the highest value will be obtained which is the recommended orchid.

Tabel 13. *Rules of the 10 Best Results of the SAW Method*

Orchid	Weight	Temperature	I. Light	Humidity	Grow	Price
A. Giant Moon	D. Height	Cold	Moderate	Enough	Moss	Expensive
A. Ribbon Shoes	D. Height	Cold	Moderate	Enough	Moss	Moderate
A. Tiger	D. Height	Moderate	Moderate	Enough	Charcoal	Cheap
A. Jambrut	D. Height	Moderate	Moderate	Enough	Charcoal	Cheap
A. Root	D. Height	Cold	Moderate	Enough	Fern	Cheap
A. Odd	Low	Hot	Moderate	Enough	Coconut Husk	Expensive
A. Chocholate Vanda	Medium	Moderate	Moderate	Enough	Fern	Moderate
A. D. Discolor	Medium	Hot	Moderate	Enough	Moss	Moderate
A. Moon	Medium	Moderate	Moderate	Enough	Moss	Moderate
A. D. Insigne	Medium	Moderate	Moderate	Enough	Charcoal	Moderate

Table 14. *Calculation of Final Results*

Orchid	Weight	Temperature	I. Light	Humidity	M. Grow	Price	Total
A.Giant Moon	0,054	0,037	0,074	0,082	0,014	0,054	0,315
A. Ribbon Shoes	0,054	0,037	0,074	0,082	0,014	0,162	0,423
A. Tiger	0,054	0,037	0,074	0,082	0,027	0,054	0,328
A. Jambrut	0,054	0,037	0,074	0,082	0,027	0,054	0,328
A. Root	0,054	0,037	0,037	0,082	0,014	0,054	0,278
A. Odd	0,054	0,074	0,074	0,082	0,014	0,054	0,352
A. Vanda Coklat	0,162	0,037	0,074	0,082	0,014	0,162	0,530
A. D. Discolor	0,162	0,074	0,074	0,082	0,014	0,162	0,568
A. Bulan	0,162	0,037	0,074	0,082	0,014	0,162	0,530
A. D. Insigne	0,162	0,037	0,074	0,082	0,027	0,162	0,544

Table 13 lists orchids that are included in the 10 best results from the SAW method and their characteristics. Table 14 is the end of the AHP method process where the 10 best results of the SAW method are calculated by multiplying the priority value of the criteria with the priority value of the sub-criteria according to the rules that have been compiled. To determine the recommendation results, by looking at the highest value in the column of numbers, in Table 14 the highest value is owned by the Dendrobium Discolor orchid with a value of 0.568.

5.3 Testing Analysis

The test analysis is carried out using a system that has been created based on the above tests. The purpose of this test analysis is to measure the level of system suitability with manual calculation tests that have been carried out. Based on table 1 at the testing stage, testing was carried out with the system that had been created, and the results can be seen in Figure 8.

10 Hasil Terbaik Dari Metode SAW

No	Nama	Hasil Perhitungan
1	Anggrek Bulan Raksasa	100
2	Anggrek Kasut Pita	83.5
3	Anggrek Jambrut	75
4	Anggrek Akar	75
5	Anggrek Ganjil	75
6	Anggrek Macan	75
7	Anggrek Dendrobium Insigne	71
8	Anggrek Dendrobium Discolor	71
9	Anggrek Vanda Coklat	71
10	Anggrek Bulan	71

Figure 8. *The SAW Method Test Results*

Table 15. *SAW Method*

No	Criteria	Weight Value	Result	Suitability
1	Weight	50	1. A. Giant Moon (100) 2. A. Ribbon Shoes (83,3) 3. A. Tiger (75) 4. A. Jambrut (75) 5. A. Root (75) 6. A. Odd (75) 7. A. Chocholate Vanda (70,83) 8. 8. A. Moon (70,83) 9. A. D. Insigne (70,83) 10. A. D. Discolor (70,83)	CORRESPONDING
2	Temperature	0		
3	Intensity Light	0		
4	Humidity	0		
5	Growing Media	0		
6	Price	50		

In table 1, the weight value input process is carried out and the calculation results are also listed in table 1, in Figure 8 the system process results are based on the weight values in table 1 and the results obtained are similar to table 1. It can be concluded that the level of suitability for the SAW method is appropriate.

Penjumlahan Nilai ∑ Baris Dengan Prioritas

Kriteria	∑baris	Prioritas	Hasil
Ketinggian	3.234	0.269	3.503
Suhu	1.04	0.149	1.189
Intensitas Cahaya	1.04	0.149	1.189
Kelembaban	0.3	0.082	0.382
Media Tanam	0.3	0.082	0.382
Harga	3.234	0.269	3.503
		Total	**10.149**
		Principe Eigen Vector (λ maks)	**1.691**
		Consistency Index	**-0.862**
		IR (6 Kriteria)	**1.24**
		Consistency Ratio	**-0.695**
		Prosentase Ratio	**0%**

Figure 9. *The Results of Testing Criteria for the AHP Method*

In Figure 9, the results of the calculation of the consistency value of the criteria in which the value of interest are inputted are based on table 2.The results obtained are the value of CR = -0.695 and are in accordance with the previous explanation after table 2. It can be concluded that the test results are the level of conformity of the calculation criteria the AHP method is appropriate.

Matriks Perbandingan Sub Kriteria Ketinggian

Sub Kriteria	Medium	Dataran Rendah	Dataran Tinggi
Medium	1	3	3
Dataran Rendah	0.333	1	1
Dataran Tinggi	0.333	1	1
Jumlah	**1.667**	**5**	**5**

Matrik Normalisasi Sub Kriteria Ketinggian

Sub Kriteria	Medium	Dataran Rendah	Dataran Tinggi	∑Baris	Priority Vector
Medium	0.6	0.6	0.6	1.8	0.6
Dataran Rendah	0.2	0.2	0.2	0.6	0.2
Dataran Tinggi	0.2	0.2	0.2	0.6	0.2

Figure 10. *Results of Altitude Sub-Criteria Testing for the AHP Method*

Matriks Perbandingan Sub Kriteria Suhu

Sub Kriteria	Panas	Sedang	Dingin
Panas	1	2	2
Sedang	0.5	1	1
Dingin	0.5	1	1
Jumlah	**2**	**4**	**4**

Matrik Normalisasi Sub Kriteria Suhu

Sub Kriteria	Panas	Sedang	Dingin	∑Baris	Priority Vector
Panas	0.5	0.5	0.5	1.5	0.5
Sedang	0.25	0.25	0.25	0.75	0.25
Dingin	0.25	0.25	0.25	0.75	0.25

Figure 11. *Results of the AHP Method Temperature Sub-Criteria Test*

Matriks Perbandingan Sub Kriteria Intensitas Cahaya

Sub Kriteria	Rendah	Sedang	Tinggi
Rendah	1	0.5	1
Sedang	2	1	2
Tinggi	1	0.5	1
Jumlah	4	2	4

Matrik Normalisasi Sub Kriteria Intensitas Cahaya

Sub Kriteria	Rendah	Sedang	Tinggi	∑Baris	Priority Vector
Rendah	0.25	0.25	0.25	0.75	0.25
Sedang	0.5	0.5	0.5	1.5	0.5
Tinggi	0.25	0.25	0.25	0.75	0.25

Figure 12. *The results of testing the light intensity of the AHP method*

Matriks Perbandingan Sub Kriteria Media Tanam

Sub Kriteria	Moss	Pakis	Arang	Serutan Kayu	Sabut Kelapa
Moss	1	1	0.5	1	1
Pakis	1	1	0.5	1	1
Arang	2	2	1	2	2
Serutan Kayu	1	1	0.5	1	1
Sabut Kelapa	1	1	0.5	1	1
Jumlah	6	6	3	6	6

Matrik Normalisasi Sub Kriteria Media Tanam

Sub Kriteria	Moss	Pakis	Arang	Serutan Kayu	Sabut Kelapa	∑Baris	Priority Vector
Moss	0.167	0.167	0.167	0.167	0.167	0.833	0.167
Pakis	0.167	0.167	0.167	0.167	0.167	0.833	0.167
Arang	0.333	0.333	0.333	0.333	0.333	1.667	0.333
Serutan Kayu	0.167	0.167	0.167	0.167	0.167	0.833	0.167
Sabut Kelapa	0.167	0.167	0.167	0.167	0.167	0.833	0.167

Figure 13. *Results of Testing for Growing Media with AHP Method*

Matriks Perbandingan Sub Kriteria Harga

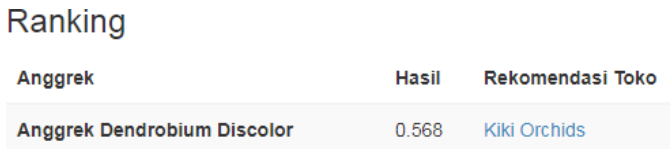
Sub Kriteria	Mahal	Sedang	Murah
Mahal	1	0.333	1
Sedang	3	1	3
Murah	1	0.333	1
Jumlah	5	1.667	5

Matrik Normalisasi Sub Kriteria Harga

Sub Kriteria	Mahal	Sedang	Murah	∑Baris	Priority Vector
Mahal	0.2	0.2	0.2	0.6	0.2
Sedang	0.6	0.6	0.6	1.8	0.6
Murah	0.2	0.2	0.2	0.6	0.2

Figure 14. *The Results of Testing the Price Sub-Criteria AHP Method*

In Figures 10-14 are the results obtained from the system process carried out by inputting the value of the interest of the sub-criteria based on tables 3-12. The results obtained are in accordance with the results of manual calculations in tables 3-12. AHP method subcriteria is appropriate.


Ranking

Anggrek	Hasil	Rekomendasi Toko
Anggrek Dendrobium Discolor	0.568	Kiki Orchids

Figure 15. *Final Result of AHP Method Calculation*

Figure 15 is the final result of the AHP method process obtained. The results obtained are in accordance with the highest value in table 14, namely 0.568 where this value is owned by the Dendrobium Discolor Orchid. In the SAW method the weight values that are filled are in the Altitude and Price criteria and the value input in the Altitude sub-criteria prefers the Medium category, the Temperature sub-criteria prefers Heat, the Light Intensity sub-criteria prefers Medium and the Price sub-criteria prefers the Medium category. This is in accordance with the rule of Dendrobium Discolor orchids where Altitude = Medium, Temperature = Heat, Light Intensity = Medium and Price = Medium. It can be concluded that the suitability level of the overall process of the system is appropriate.

6. CONCLUSIONS AND SUGGESTIONS

6.1 Conclusion

Based on the rules that have been formulated in the Decision Support System for Choosing the Types of Orchid Plants Using the SAW-AHP Method, the following conclusions can be drawn:

[1]. The process in the system, the SAW method first classifies the data by considering the value of the criteria only, then the classification process is carried out using the AHP method which considers the criteria and sub-criteria values which produce more accurate results.
[2]. Based on the test results, the results of the classification of the SAW method and the AHP method can be concluded that in accordance with manual calculations carried out with the stages of each method used.

6.2 Suggestion

After going through the evaluation process, there are suggestions that can be considered to develop a Decision Support System for Choosing Orchid Plants Using the SAW-AHP Method, including:

[1]. It is recommended that users before conducting a consultation are expected to read the explanation first on the Home page so that users can better understand using this application.
[2]. It is necessary to update this application if a new type of orchid has been found, it should be added as a new rule.

7. REFERENCE

[1]. Kristania, Yustina Meisella. 2018. Implementasi Kombinasi Metode AHP Dan SAW Dalam Pendukung Keputusan Penentuan Kredit Perumahan Rakyat, Jurnal Telematika Volume 11 No.1 Februari 2018.
[2]. Mahendra, Gede Surya, dkk. 2019. SPK Penentuan Lokasi ATM Menggunakan Metode AHP dan SAW. Jurnal Nasional Teknologi dan Sistem Informasi Volume 05 No.1 2019.
[3]. Ulandari, Ni Wayan Ari, dkk. 2018. Implementasi Metode AHP dan SAW dalam Sistem Pendukung Keputusan Prediksi Potensi Akademik Mahasiswa STMIK STIKOM Bali. Jurnal SENAPATI September 2018.
[4]. Priadana, Adri. 2018. Sistem Pendukung Keputusan Pemilihan Deleted Domain Dengan Metode AHP dan SAW. Jurnal Teknomatika Volume 10 No.2 Januari 2018.