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Decision Support System for Determining the Best Pesticide for Rice Plants Using the Moora Method

Resvi Ansiska*, Eva Rianti, Wifra Safitri
Universitas Putra Indonesia YPTK Padang, Jl. Raya Lubuk Begalung Padang, Sumatera Barat – 25221, Indonesia
* resviansiska@gmail.com

Abstract

Along with the very rapid progress and development of technology, with the existence of computer technology, work can be completed quickly and performed effectively and efficiently, especially in the agricultural sector. Pesticides are chemical or organic substances that farmers use to protect rice plants from pests , so farmers often have difficulty choosing pesticides that will be used to prevent rice pests. In fact, the large number of pesticide products on the market and their very different advantages make farmers confused in determining pesticide choices. The Harapan Jaya farmer group always provides counseling and training regarding the management of agricultural products, therefore the farmer group continues to maintain rice production to avoid pests and there is no shortage of rice plants at this time by using pesticide products on the market. Decision Support Systems (DSS) are systems that are able to provide problem solving abilities and communication abilities for problems with structured and unstructured conditions. The method in the decision support system is Multi Objective Optimization on the basis of Ratio Analysis (MOORA). The results obtained from this calculation method are Rodenticide with a value of 0.288 which is ranked first and the fifth rank is Insecticide with a value of 0.047. By implementing a decision support system using the MOORA method, it is hoped that it will help select interconnected outputs, because the decision results are based on criteria data in determining the best pesticide for rice plants.

Keywords : Decision Support System, MOORA, Pesticides, Structured, Rice Plants.

1. Introduction

Along with the very rapid progress and development of technology, with the existence of computer technology, work can be completed quickly and with effective and efficient performance. Not only does it make human performance easier, but by using technology everyone can also find out information in the fields of education, health and of course in the agricultural sector. One of these technological advances is in terms of decision making which is referred to as a process that supports taking a solution from a problem. problem. This decision support system is very supportive in recommending the best pesticides [1][2].

The Harapan Jaya farmer group is a group of people who work in rice fields, they are in a group because there are similarities between them and the same desire . Farmer groups always provide counseling and training regarding the management of agricultural products, therefore farmer groups continue to maintain rice production to avoid pests and there is no shortage of rice plants at this time by using pesticide products on the market [3] .

Pesticides are chemical or organic substances that farmers use to protect rice plants from pests, so farmers often have difficulty choosing the pesticides that will be used to prevent rice pests. In fact, the large number of pesticide products on the market and their very different advantages make farmers confused in determining pesticide choices. Therefore, farmers sample types of pesticides to compare and determine the best type of pesticide on the leaves of the rice plant [4].

A Decision Support System (DSS) or Decision Support System (DSS) is a system that is able to provide problem solving capabilities and communication capabilities for problems with structured and unstructured conditions [5][6][7]. One of the methods available in decision support systems is MOORA. Multi Objective Optimization on the basis of Ratio Analysis (MOORA) is a multiobjective system method of optimizing two or more conflicting attributes simultaneously [8][9][10]. In this way, building an information system for determining the best pesticide for rice crops in the Harapan Jaya farmer group and implementing a decision support system method is expected to help the farmer group in selecting the right one and being able to determine the best pesticide to use.

A Decision Support System is a specific information system intended to assist management in making decisions related to semi-structured issues. This system has the facility to generate various alternatives for use by users [11].

MOORA method (Multi-Objective Optimization on the basis of Ratio Analysis) This method of multi-objective

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optimization (or programming), also known as multi-criteria or multiple attribute optimization, is the process of simultaneously optimizing two or more conflicting attributes (goals) subject to certain limitations. The MOORA method, first introduced by Brauers, is a multi-objective optimization technique applied to solve various types of complex decision-making problems [12].

Decision support systems using the MOORA method are widely used in various research fields such as selecting outstanding students [13], determining the feasibility of house renovations for poor families [14], determining industrial locations [15], locations for building chicken farms [16], and many other studies.

2. Research methodology

In preparing research, it is necessary to have a framework structure with clear stages, this framework is used to solve a problem that is being discussed by the researcher, the framework is in Figure 1.

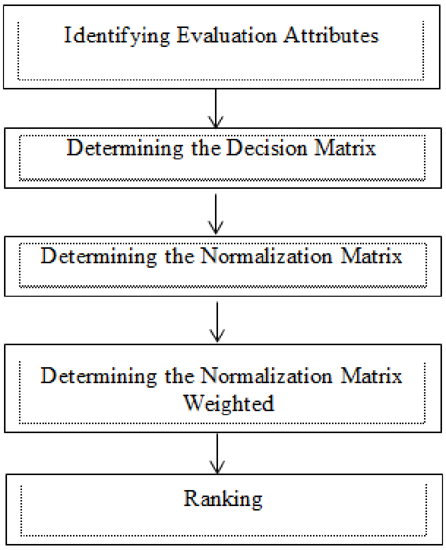


Figure 1. Research Framework

The steps for solving the Moora method are:

1. Determine the objectives to identify the relevant evaluation attributes.
2. Start by determining a decision matrix with alternatives as rows, and criteria as columns.

$$X=\begin{bmatrix} X11 & X12 & Xln \\ X21 & X22 & Xjn \\ Xml & Xm2 & Xmn \end{bmatrix}$$

Information :

Xij = Value of alternative I on criterion j

i = 1 ,2 ,…, m as the number of alternatives

j = 1 ,2 ,…, n as the number of criteria

3. Determine the normalization matrix shown in the following equation:

$$\mathbf{Xij} = \frac{\mathbf{Xij}}{\sqrt{[\sum_{\mathbf{i,m=1}} \mathbf{X^2, ij}]}}$$

Information:

Xij = Value of alternative i on criterion j

i = 1 ,2 ,…, m as the number of alternatives

j = 1 ,2 ,…, m as the number of criteria

Xi*j = Dimensionless number included in the interval [0 ,1] representing the normalized value of the alternative on criterion j.

4. Determine the weighted normalization matrix.

$$\mathbf{yi} = \sum_{\mathbf{j=1}}^{\mathbf{g}} \mathbf{Xij} - \sum_{\mathbf{i=g+1}}^{\mathbf{n}} \mathbf{Xij}$$

j = 1 ,2 ,…, g is the number of criteria types to be maximized

i = 1 ,2 ,…, g+1, g+2,…, n is the number of types of criteria to be minimized

yi = the value of the normalized assessment of alternative i against all criteria

xij = value of the alternative on criterion j

Determining the preference value or ranking is done by sorting the optimization value of each alternative from the highest value to the lowest value. The alternative with the highest optimization value is the best alternative

3. Results and Discussion

3.1 Moora Method Calculation

1. Determine the objectives to identify the relevant evaluation attributes.

Criterion Data

The table below describes a group of criteria used in the process of evaluating a particular product or service. Each criterion has a predetermined weight value, which reflects the level of importance of the criterion in the evaluation process. These criteria can be used to assist in decision making or comparison between various product or service options. Criteria data can be seen in Table 1 below:

Table 1. Criteria

No	Criterion Name	Value Weight	Information
1	Active Ingredient	0.25	Benefits
2	Price	0.25	Cos
3	DurabilitySave	0.25	Benefits
4	Exterminate Pests	0.25	Benefits

In the criteria table there is sub-criteria data involved in each criterion which can be seen in Table 2:

Table 2. Sub Criteria

No	Criterion Name	Name Sub Criteria	Weight	Value Weight
1	Active Ingredients	> 2 Active Ingredients	Pretty good	4
		1 Active Ingredient	Enough	2
2	Price	IDR 10,000-RP 25,000	Very good	5
		IDR 25,000-IDR 40,000	Pretty good	4
		IDR 40,000-RP 55,000	Good	3
		IDR 55,000-RP 70,000	Enough	2
		IDR 70,000-IDR 85,0000	Bad	1
3	Storage Durability	>4 Years	Very good	5
		3 Years - 4 Years	Pretty good	4
		2 Years- 3 Years	Good	3
		1 Year – 2 Years	Enough	2
		1 year	Bad	1
4	Exterminate Pests	>5 Pests	Very good	5
		4 Pests	Pretty good	4
		3 Pests	Good	3
		2 Pests	Enough	2
		1 Pest	Bad	1

Based on the criteria and sub-criteria data selected for each alternative, alternative data is produced as shown in Table 3.

Table 3. Alternative Data

No	Alternative name	C1	C2	C3	C4
1	Acaricide	4	3	2	5
2	Fungicide	2	1	2	3
3	Insecticide	2	4	1	2
4	Molluscicide	4	5	4	3
5	Rodenticide	4	4	3	5

2. Define a decision matrix with alternatives as rows, and criteria as columns.

Defining a decision matrix with alternatives as rows and criteria as columns is an important step in multi-criteria decision analysis. The purpose of this step is to describe the relationship between various alternatives (options that can be selected) and criteria (attributes or factors used to evaluate these alternatives) in tabular form. From alternative data a decision matrix and normalization matrix can be produced:

$$X=\begin{Bmatrix} 4 & 3 & 2 & 5 \\ 2 & 1 & 2 & 3 \\ 2 & 4 & 1 & 2 \\ 4 & 5 & 4 & 3 \\ 4 & 4 & 3 & 5 \end{Bmatrix}$$

This decision matrix will be the basis for analyzing and comparing existing alternatives based on various criteria

3. Determine the normalization matrix

Matrix normalization is an important step in multi-criteria decision analysis that helps convert the initial decision matrix, which may have different scales or units, into a matrix with standardized or normalized values. The aim is to ensure that comparisons between criteria and alternatives can be carried out correctly, even though the criteria may have different units or varying scales. The calculation results of matrix normalization $X_{ij}^{*}$are

$$X^{*}ij =\begin{Bmatrix} 0.535 & 0.367 & 0.343 & 0.589 \\ 0.267 & 0.122 & 0.343 & 0.354 \\ 0.267 & 0.489 & 0.171 & 0.236 \\ 0.535 & 0.611 & 0.686 & 0.354 \\ 0.535 & 0.489 & 0.514 & 0.589 \end{Bmatrix}$$

4. Determine the weighted normalization matrix

Weighted normalization matrix is the next step in multi-criteria decision analysis after normalization matrix. This matrix combines a normalization matrix with the weight or relative importance of each criterion. The goal is to give appropriate weight to each value in the normalization matrix according to the level of importance of each criterion in decision making.

Calculation results of normalized weight values against the normalization matrix

$$Xwj = \begin{pmatrix} 0.134 & 0.092 & 0.086 & 0.147 \\ 0.067 & 0.031 & 0.086 & 0.089 \\ 0.067 & 0.122 & 0.043 & 0.059 \\ 0.134 & 0.153 & 0.173 & 0.089 \\ 0.134 & 0.122 & 0.129 & 0.147 \end{pmatrix}$$

5. Ranking

The next step is to arrange these alternatives in a certain order based on the optimization values that have been generated. The alternative with the highest score or value is placed at the top rank, while the alternative with the lowest score is placed at the lowest rank. The following are the results of the optimization values, shown in Table 4.

Table 4. Optimization Value Results

Alternative	Max (C1+C3+C4)	Min (C2)	Yi = Max-Min	Ranking
Acaricide	0.134 + 0.086 + 0.147	0.092	0.275	2
Fungicide	0.067 + 0.086 + 0.089	0.031	0.211	4
Insecticide	0.067 + 0.043 + 0.059	0.122	0.047	5
Molluscicide	0.134 + 0.173 + 0.089	0.153	0.243	3
Rodenticide	0.134 + 0.129 + 0.147	0.122	0.288	1

After getting the optimization value results, it was concluded that the first rank was Rodenticide with a value of 0.288 and the fifth rank was Insecticide with a value of 0.047. To determine the best pesticide, look at the highest value calculation results.

3.2 System Implementation

After the system has been designed including detailed design, namely output design, input design, and file design, namely database design and has been created, the next step is to implement the system that has been created in the Pesticide Decision Control System in the Harapan Jaya Farmer Group Using the Multi-Objective Method . *Optimization On The Basis Of Ratio (Moora)* .

System Testing

System testing is carried out to ensure whether the application that has been designed and created can run and provide information as expected. In this test, several activities take place in stages, including system testing:

1. Login Page

In this system testing where *the user* will fill in the input form in the form of an appropriate username and password and then validate it on the system's MySQL database, and after the system's MySQL database has validated it as appropriate or correct, then enter the dashboard page shown in Figure 2

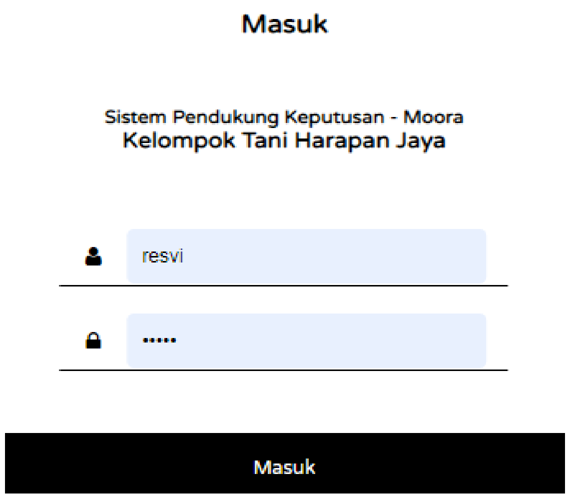
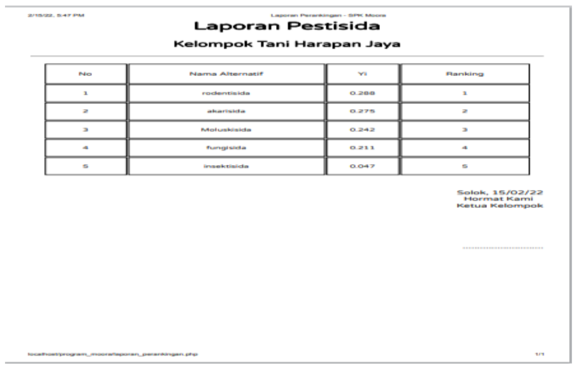


Figure 2 Login Input Form Page

2. Decision Report Page Display

In testing, the admin system displays a ranking report where the data is displayed, data from the results of calculations on optimization values and then the ranking report data can be printed as shown in Figure 3


Laporan Pestisida
Kelompok Tani Harapan Jaya

No	Nama Alternatif	Yi	Ranking
1	rodentisida	0.288	1
2	akarisida	0.275	2
3	Moluskisida	0.242	3
4	fungisida	0.211	4
5	insektisida	0.047	5

Solok, 15/02/22
Hormat Kami
Ketua Kelompok

Figure 5.2 Ranking Report Print Page

4. Conclusion _

After building a decision support system using the PHP programming language, it can make it easier for farmer groups to determine the best pesticide for rice crops. A decision support system using the Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) method can display reports on the results of the best pesticide decisions for the Harapan Jaya Farmers Group accurately and quickly. The system can help select interconnected outputs, because the decision results are based on criteria data in determining the best pesticide for rice plants.

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