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Research Article

Application of the Multi-Objective Optimization By Ratio Analysis (MOORA) Method in the Chili Seed Selection System (Case Study of Asuli Village, East Luwu Towuti District)

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Abstract:

Currently chili plants are plants that are needed by the community, these plants can be processed into cooking spices, the food industry and medicines. In East Luwu Regency chili plants are also the main commodity in agriculture, many farmers make chili plants as a business opportunity, but the production of chili plants in East Luwu Regency has decreased, this decrease in production is due to the lack of yields of chili farmers. So that the supply of chili is reduced and can not meet market demand. The lack of yields was caused by farmers using different types of chili seeds because farmers still had difficulty in determining the right type of chili seeds to develop which resulted in chili cultivation failing to harvest. For this reason, a system is needed that can assist farmers in determining chili seeds that are suitable for cultivation in Asuli Village, East Towuti Luwu District. The criteria used in determining the location of the business are harvest time, number of stalks, weight of chilies, altitude and longevity. This study aims to produce a decision support system in recommending the best chili seeds so that they can help farmers increase red chili production among farmers. The method used is the MOORA method, this method was chosen because this method is very simple, stable, and robust, even this method is able to determine goals from conflicting criteria, where criteria can be of beneficial or unfavorable value (cost). In addition, MOORA also has the ability to easily separate subjective elements from an evaluation process into weighted decision criteria that have several decision-making attributes. The results showed that Salo Dua chili seeds were suitable for cultivation in Asuli Village, East Luwu Towuti District.

Keywords: Seeds, Benefits, Chili, Cost, Production.
Dataset link: -

1. Introduction

Chili plants are vegetables that have very good business opportunities so that these plants become very promising commodities to be cultivated. The demand for chilies is increasing every year and the chili prices are soaring high, making farmers make chili plants the main commodity in making a profit [1]. Currently chili plants are plants that are needed by the community, these plants can be processed into cooking spices, the food industry and medicines. In East Luwu Regency chili plants are also the main commodity in agriculture, many farmers make chili plants as a business opportunity, but chili plant production in East Luwu Regency has decreased, it was noted that in 2019 chili plant production could reach 135 quintals and in 2020 production decreased to 99 quintals [2], The decline in production was due to the lack of yields of chili farmers. So that the supply of chili is reduced and cannot meet market demand. The lack of yields was caused by farmers using different types of chili seeds because farmers still had difficulty in determining the right type of chili seeds to develop which resulted in chili cultivation failing to harvest [3]. Problems faced by chili farmers in Asuli Village, Towuti Luwu Timur District, they are not familiar with good chili plant seeds.

Determining chili seeds is only done by estimation without paying attention to other factors. Choosing the type of chili seeds is a way that needs to be done before starting chili cultivation. good quality can affect the quality and yield of farmers so that in determining chili seeds requires a little accuracy and also knowledge about the characteristics of these chilies. Superior chili seeds can be seen from resistance to pests, harvest time, fruit length, fruit weight, and altitude [4]. Besides that, there are also other factors that need to be considered in order to get superior and quality chili seeds.

In this study, the Multi-Objective Optimization By Ratio Analysis (MOORA) method was used, this method was chosen because this method is very simple, stable, and strong, this method is even able to determine goals from conflicting criteria, where criteria can be of beneficial value (benefit) or unprofitable (cost). In addition, MOORA also has the ability to easily separate subjective elements from an evaluation process into weighted decision criteria that have several decision-making attributes [5]. In previous research, the MOORA method was also used in the system for determining chili seeds, where this system provides alternative decisions using the Simple Additive Weighting (SAW) method which can be used as a reference for farmers in determining and providing information about superior chili plants. [6] [7]. The difference between the author's research and this research lies in the criteria used, where the research uses the criteria for plant age, plant height, leaf condition and number of leaves, while the criteria the author uses include pest resistance, land height, harvest time, number of stalks, and weight. chilli. The last research is about determining the selection of chili seeds, namely in 2019. The results obtained from the research on superior red chili seeds are those that get the highest ranking. The method used in determining superior red chili seeds is the Weighted Product Method, and the development of a Decision Support System (SPK) for selecting superior red chilies using the website [8]. Subsequent research on determining chili seeds will be carried out in 2022. The results of this study are in the form of a decision support system application for selecting superior chili seeds at the Tidore City Farmer's Shop based on a web that can provide recommendations to chili seed farmers which one is more suitable to plant based on the specified criteria [9]. It is hoped that the research results can assist farmers in recommending the best chili seeds so that they can help farmers increase red chili production among farmers.

2. Method:

Decision Support Systems (DSS) or Decision Support Systems (DSS) is an information system that is flexible, interactive, can be adapted and developed to provide information, modeling and data manipulation so that it can produce various alternative decisions and answers to assist management in dealing with various problems that arise. semi structured and unstructured situations [10]. SPK is part of a computer-based information system including knowledge-based systems or knowledge management that is used to support decision making in an organization or company [11]. There are four main stages in decision making that are interconnected and sequential, namely:

a. Intelligence Stage

   This stage decides to study the reality that occurs so that the book of isa identifies the problems that occur, usually an analysis is carried out from the system to its constituent subsystems so that the output is in the form of a problem statement document.

b. Desain Stage

   In this stage the decision maker finds, develops and analyzes all possible solutions, namely by creating a model that can represent the real conditions of the problem. From this stage, the output is an alternative solution document

c. Selection Stage

   In this stage the decision maker chooses one of the alternative solutions made at the design stage which is seen as the most permanent action to overcome the problem at hand. From this stage, a solution document and an implementation plan are obtained.

d. Implementation Stage

   The decision maker carries out a series of action solutions selected at the selection stage. Successful implementation is marked by the answers to the problems encountered, while failure is marked by problems that are often tried to be overcome. From this stage a report on the implementation of the solution and its results is obtained [12].

The Decision Support System Component consists of 4 subsystems, among others [13]:

a. Data Management

The data management subsystem includes a database consisting of data that is relevant to the situation and is managed by software called the Database Management System (DBMS). Data management can be interconnected with the company's data warehouse, a repository for relevant company data for making decisions

b. Model Management

The model management subsystem is a software package containing models of financial, statistical, management science, or quantitative models that provide appropriate software analysis and management capabilities. This software is called a model base management system

c. Dialog Management

The dialog subsystem (User Interface Subsystem) is a subsystem that can be used by the user to communicate with the system and also to give SPK commands. Web browsers provide a familiar and consistent graphical user interface structure. The term user interface covers all aspects of communication between the user and the system.

d. Knowledge Based Management

The knowledge-based management subsystem is a subsystem that can support other subsystems or act as an independent component. These components form a decision support system application system that can be connected to a company intranet, extranet or the internet. Architecture of a decision support system.

One of the methods in a decision support system is the MOORA (Multi-Objective Optimization on The Basis Of Ratio Analysis) method. The Multi-Objective Optimization by Ratio Analysis (MOORA) method is a method introduced by Brauers and Zavadkas (2006). This relatively new method was first used by Brauers in a decision with multi-criteria. The MOORA method has a degree of flexibility and ease of understanding in separating the subjective part of an evaluation process into decision weighting criteria with several decision-making attributes [14]. The MOORA method is easy to understand and flexible in separating objects up to the decision weighting criteria evaluation process. The MOORA method also has a good level of selectivity because it can determine conflicting goals and criteria, namely criteria that are beneficial or unprofitable (Cost). The steps for calculating the MOORA method are as follows [15]:

a. Create A Decision Matrix

Represents all available data and information for each attribute in the form of a decision matrix. Equation (1) shows an x_{mxn} matrix, where x_{ij} is the performance measurement of the i_{th} alternative on the j_{th} attribute, m is the number of alternatives and n is the number of attributes/criteria. Next, a comparison is made between each performance of the alternatives on the attribute with a denominator that represents all the alternatives on that attribute.

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

b. Make a normalization matrix

Normalization aims to unite each element of the matrix so that the elements in the matrix have a uniform value. The equation for calculating the normalization matrix is as follow Equation (2):

$$y_{ij} = \frac{x_{ij}}{\sqrt{\sum_{n=1}^{m} x_{ij}^2}} \quad (2)$$

Information:

i: 1, 2, 3, …, n is the attribute or criterion sequence number

j: 1, 2, 4, …, m is the alternate sequence number

x_{ij}: alternative matrix j on criterion i

x_{ij}^2: alternative normalization matrix j on criterion i

c. Calculate the Optimization Value

The normalized value is added to the maximized status attribute (benefit type attribute) and subtracted from the minimized status attribute (cost type attribute).

3. Results and Discussion

Based on the research that has been done, the research results obtained are as follows:

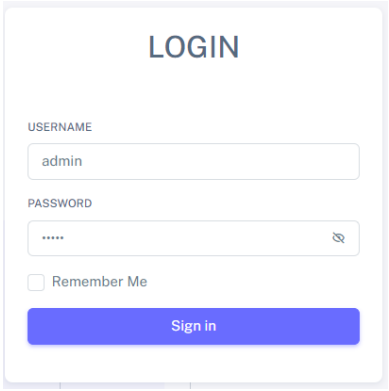

Figure 1. Admin Login Display

Figure 1 is the admin login display, on this page the admin enters the username and password to be able to enter the main page of the system.

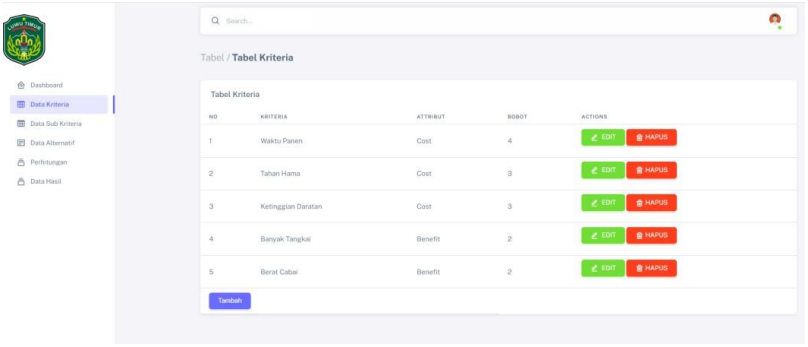

Figure 2. Criteria Data Display

Figure 2 is a display of criteria data, on this page the admin can manage criteria data such as adding data, editing and deleting data.

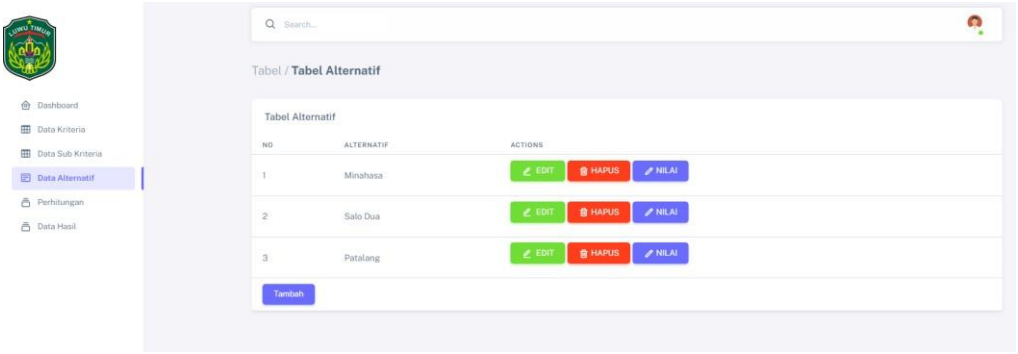

Figure 3. Alternative Data Display

Figure 3 is an alternative data display, on this page the admin can manage alternative data such as adding, editing and deleting data and can also provide an assessment of each alternative based on its criteria and sub- criteria.

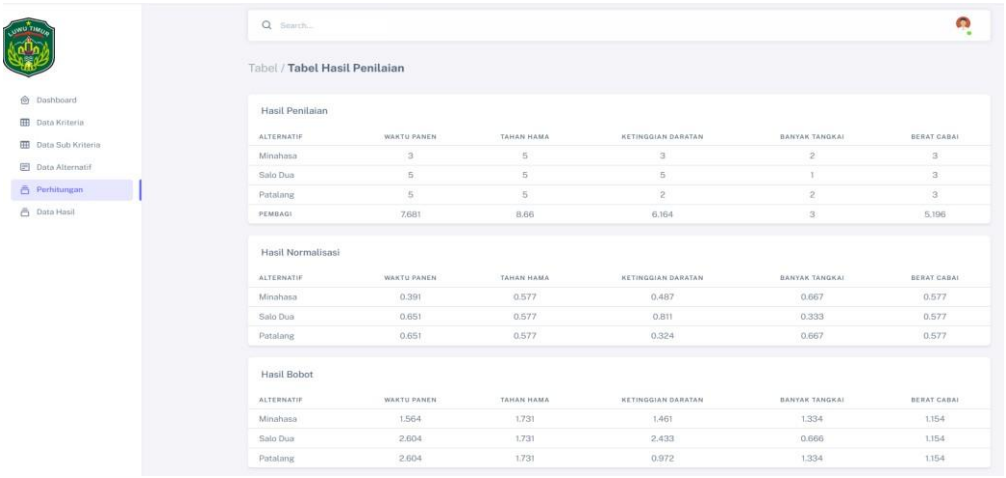

Figure 4. Assessment Data Display

Figure 4 is a display of assessment data, on this page the system displays the results of the assessment that have been inputted by the previous admin which is then carried out by the normalization process.

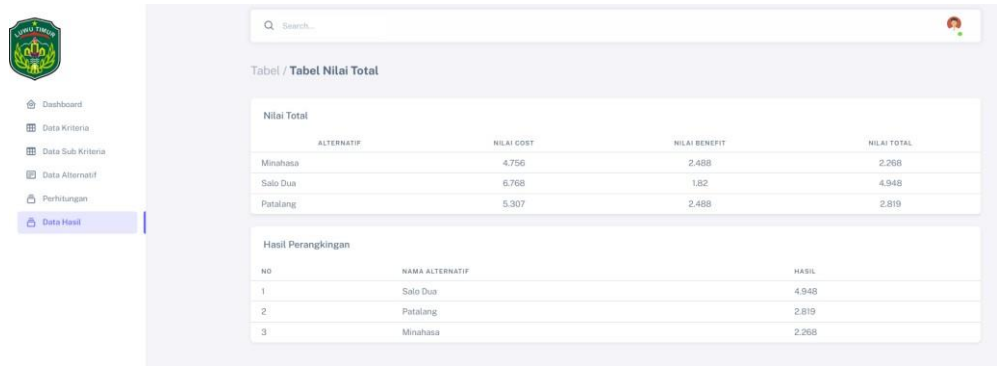

Figure 5. Results Data Display

Figure 5 is a display of the result data, on this page the system displays the results of the total value from the calculation of the MOORA method which results that the salo dua seeds are the best chili seeds.

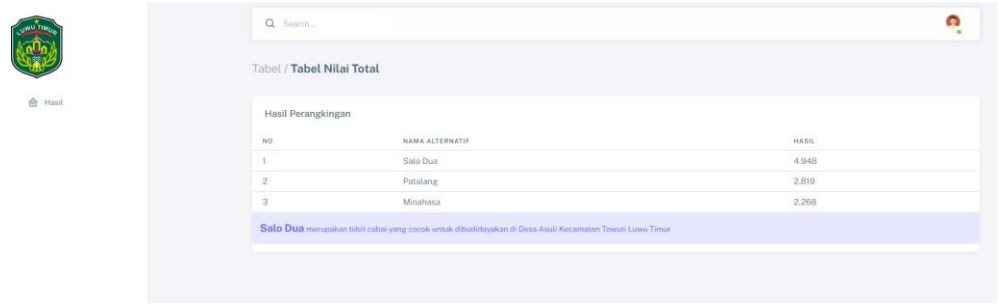

Figure 6. User Results Data Display

Figure 6 is a display of user results data, on this page the user can see chili seeds that are suitable for cultivation in Asuli Village, East Luwu Towuti District.

Manual Calculation

a. Alternative Data Assessment

Give the value of each alternative data based on each of the criteria shown in **Table 1**.

Table 1. Assessment of Alternative Data

Alternative	C1	C2	C3	C4	C4
Minahasa	3	5	3	2	3
Salo Dua	5	5	5	1	3
Patalang	5	5	2	2	3

b. Normalized Decision Matrix

The normalized matrix value is obtained from the square of each criterion row which is then addedup and squared as the calculation.

$$C1 = \sqrt{3^2 + 5^2 + 5^2} = 7{,}681$$

$$A1 = \frac{3}{7{,}681} = 0{,}391$$

$$A2 = \frac{5}{7{,}681} = 0{,}651$$

$$A3 = \frac{3}{7{,}681} = 0{,}391$$

Perform step b for the other criteria so that the normalization results table is obtained in **Table 2**

Table 2. Results of Normalization

Alternative	C1	C2	C3	C4	C4
Minahasa	0,391	0,577	0,487	0,667	0,577
Salo Dua	0,651	0,577	0,811	0,333	0,577
Patalang	0,651	0,577	0,324	0,667	0,577

c. Weighted Normalized Decision Matrix

In obtaining the weighted matrix values obtained by multiplying the normalized value of each alternativewith the weight value of each criterion as calculated.

$$y_{11} = w_1 \times r_{11} = 4 \times 0{,}391 = 1{,}564$$

$$y_{21} = w_1 \times r_{21} = 4 \times 0{,}651 = 2{,}604$$

$$y_{31} = w_1 \times r_{31} = 4 \times 0{,}391 = 1{,}564$$

Perform step c for the other criteria so that the weighted normalization results are obtained in **Table 3**

Table 3. Table of Weighting Results

Alternative	C1	C2	C3	C4	C4
Minahasa	1,564	1,731	1,461	1.334	1,154
Salo Dua	2,604	1,731	0,666	0,666	1,154
Patalang	2,604	1,731	1,334	1.334	1,154

d. Determine the value of the costs and benefits of each alternative

In determining the cost or benefit value, it is obtained by adding up the weight values for each criterionincluded in the cost or benefit criteria and subtracting the results of the cost and benefit values for eachalternative to find the total value as calculated

Minahasa (Cost) = $1{,}564 + 1{,}731 + 1{,}461 = 4{,}756$

Minahasa (Benefit) = $1{,}334 + 1{,}154 = 2{,}488$

Total = 4,756 − 2,488 = 2,268

Perform Step d for the other alternatives so that the cost and benefit values of each alternative areobtained as follow **Table 4**.

Table 4. Table of Alternative Cost and Benefit Values

Alternative	Cost	Benefit	Total
Minahasa	4,756	2,488	2,268
Salo Dua	6,768	1,82	4,948
Patalang	5,307	2,488	2,819

e. Ranking Results

Displays the results of ranking each alternative by sorting the total value from the largest to the smallest

Table 5. Table of Alternative Cost and Benefit Values

No	Alternatif	Hasil
1	Salo Dua	4,948
2	Patalang	2,819
3	Minahasa	2,268

Based on **Table 5**, the results show that chili seeds are suitable for cultivation in Asuli Village, EastTowuti Luwu District.

4. Conclusion

The conclusions from the research that has been conducted for approximately 5 months from January to May 2023 are: a) Has produced a decision support system that assists farmers in determining chili seeds that are suitable for cultivation in Asuli Village, East Towuti Luwu District. b) Based on the results of the study, it was found that the Salo Dua chili seeds were chili seeds that were suitable for cultivation in Asuli Village, East Luwu Towuti District.

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