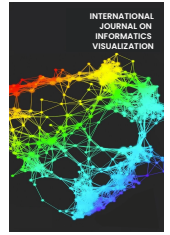




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Land Suitability for Mustard Plants Using Multi-Objective Optimization by Ratio Analysis Method

Heliza Rahmanian Hatta^{a,*}, Riska Ariani^a, Dyna Marisa Khairina^b, Septya Maharani^b,
Vina Zahrotun Kamila^b, Arini Wijayanti^c

^a Department of Informatics, Mulawarman University, Samarinda Ulu, Samarinda, 75119, Indonesia

^b Department of Information System, Mulawarman University, Samarinda Ulu, Samarinda, 75119, Indonesia

^c Ecology and Evolutionary Biology Department, University of California, 1156 High St, Santa Cruz, 95064, United States

Corresponding author: *heliza@unmul.ac.id

Abstract— Mustard can be developed or grown from a financial and business perspective to meet buyer demands and capture significant market opportunities. Mustard is a highly adaptable horticultural crop with a relatively short harvest time. This mustard offers many advantages for the farmer. For example, many farmers plant mustard in Samarinda, East Kalimantan, Indonesia. Despite being highly adaptable, some species of mustard greens do not thrive well in certain soils. Good soil is essential for optimal results when growing mustard greens. The planted mustard can be selected using decision support based on land criteria to get the best results. The purpose of this study is to recommend suitable mustard based on area requirements using a multi-objective optimization by ratio analysis (MOORA) approach. MOORA is a decision-making method that assists in choosing the best alternative from several options or alternatives based on several criteria or objectives. This observation used five criteria: Soil type, soil pH, precipitation, temperature, site elevation, and six mustard alternatives. Based on the trial land, the mustard recommended by the MOORA method is a Spoon Mustard or Pak Choy with a Yi value of 7.6698. So those chosen as mustard planted on the land are Spoon Mustard or Pak Choy. For further research, it is necessary to add or adjust new criteria and sensors in real-time that can be applied to increase efficiency in mustard towards smart farming that focuses on better results while maintaining the balance of nature.

Keywords— Mustard; land; suitability; decision support system; MOORA method.

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I. INTRODUCTION

Mustard originated from East Asia [1], [2], [3]. The introduction of mustard made Indonesia green in the XI century and other subtropical vegetable trade trafficking [4]. Mustard is a group of plants from Brassica that uses leaves or flowers as food (vegetables), both fresh and processed [5], [6]. Mustard can be developed or grown from an economic and business perspective to meet consumer demands and market opportunities [7]. The feasibility of developing mustard cultivation is indicated, for example, by the comparative advantages of the tropical conditions of Indonesia, which are very suitable for commodities. Besides, the harvesting age of the mustard is relatively short, 40-50 days after planting, and the results provide an adequate profit [8], [9].

Land is an area on the earth's surface with unique characteristics. These special characteristics directly influence human land use now and in the future. These

characteristics include the biosphere, atmosphere, soil, geological strata, hydrology, plant and animal populations, and the results of human activities from the past to the present [10], [11]. Based on the understanding above, soil can be viewed as a system of various components. These components can be classified into two categories: structural components, often called land features, and functional components, often called land quality.

Surface land features on the earth are geomorphological units categorized based on elevation, slope, orientation, stratification, rock exposure, and soil type [12]. Land quality is a group of land elements that determine the suitability and suitability of land for certain types of use. Land use constantly changes and occurs in an area because the needs and human activities that inhabit the land change and become increasingly complex [13], [14]. In addition, it can also be caused by changes in government policies, environmental conservation efforts, disease outbreaks, and natural disaster factors [15], [16], [17]. Therefore, the land used for

agriculture must have a soil fertility factor, and the plants planted must follow the soil characteristics.

Land suitability refers to the evaluation of whether a particular piece of land is suitable or appropriate for a particular type of land use or cultivation [18], [19], [20], [21]. Land suitability assessment is critical in agriculture to achieve optimal results and maximize productivity. Plants or crops have different requirements regarding soil characteristics, climatic conditions, water availability, and other factors.

To achieve optimal production, it is necessary to pay attention to land suitability for certain varieties of mustard greens or other plants [22], [23], [24], [25]. This involves evaluating the suitability between the growing requirements of mustard varieties and soil characteristics, such as soil type, pH level, fertility, drainage, temperature, and sun exposure. Farmers can improve crop performance, reduce the risk of crop failure, and increase agricultural productivity by choosing mustard varieties suitable for field conditions.

To assist in making decisions regarding the selection of mustard varieties based on land suitability criteria, a Decision Support System (DSS) method can be used. DSS are computer-based tools that provide valuable information and recommendations to support decision-making processes. In the agricultural context, DSS can utilize various data inputs, such as soil information, climate data, and plant characteristics, to evaluate the suitability of different mustard varieties for certain lands. By using the decision support system method, farmers or the community can obtain alternative decisions and recommendations regarding the selection of mustard varieties based on specific criteria for agricultural land. DSS considers land suitability factors and provides insight into the most suitable mustard varieties according to land characteristics. This helps farmers make an informed decision and select the most appropriate mustard variety likely to thrive and produce optimal yields on their specific farm.

DSS for selecting plants based on land criteria has been widely used to get the best recommendations. Several previous studies have been carried out, such as the selection of bananas using the ELECTRE method [26] and the selection of crops using the Analytical Hierarchy Process (AHP) [18] and Fuzzy Analytical Hierarchy Process (FAHP) methods [27]. Therefore, this study will select mustard varieties based on the land used as an experiment. The decision support method used is the Multi-Objective Optimization by Ratio Analysis (MOORA) method. This research can help the community or farmers determine the mustard varieties planted on their land.

Based on several previous studies [28], [29] MOORA method is a decision-making technique that can be utilized to assist in making decisions when multiple objectives or criteria are involved. The MOORA method is known for its flexibility and ease of understanding. It breaks down the subjective evaluation process into decision weights, allowing decision-makers to assign relative importance or priority to each criterion [30], [31]. By assigning weights, decision-makers can express their preferences and priorities regarding different criteria, thereby reducing subjectivity in the decision-making process.

The MOORA method helps determine the best alternative among a set of alternatives [32], [33], [34], [35]. It considers

multiple criteria simultaneously and provides a systematic approach to ranking or prioritizing alternatives based on their performance on these criteria. The method employs a ratio analysis technique to calculate the overall performance score of each alternative, considering the weights assigned to the criteria. One advantage of the MOORA method is its running time efficiency [36]. It can provide faster results than other decision-making methods, making it suitable for situations where timely decisions are crucial.

In the context of the mentioned decision support system, the MOORA method is expected to assist users in choosing the most suitable mustard variety based on criteria relevant to agricultural land. Utilizing the MOORA method, the decision support system can generate alternative decisions and rankings, helping users make informed choices according to their preferences and the specified criteria.

This research proposes the MOORA method to recommend suitable mustard varieties based on land criteria. The research focuses on determining the best mustard plant recommendation for experimental land in Samarinda, East Kalimantan, Indonesia, considering soil type, soil pH, rainfall, temperature, and location elevation factors. The MOORA method analyzes the data and provides alternative decisions, assisting farmers or the community in selecting the appropriate mustard varieties for their agricultural land. The research aims to help optimize mustard production and achieve the best results based on specific land characteristics.

II. MATERIAL AND METHOD

MOORA is a decision-making method that assists in choosing the best alternative from several options or alternatives based on several criteria or objectives. MOORA is a flexible and easy-to-understand technique that breaks subjective evaluation into decision weights, enabling a systematic and objective analysis of existing alternatives [30], [31]. The MOORA method operates by assigning weights to each criterion based on their level of importance in the decision-making process. These weights reflect the preferences or priorities of the decision-maker and determine the significance of each criterion in the evaluation. These criteria can be either quantitative or qualitative, depending on the context of the decision.

To apply the MOORA method, the decision maker first establishes criteria relevant to the decision problem. The criteria should cover the main aspects or dimensions to consider when evaluating alternatives. Criteria for selecting mustard varieties for agricultural land could include yield potential, disease resistance, water requirements, nutrient uptake, and growth characteristics. After identifying the criteria, the decision maker assigns weight to each criterion, indicating its relative importance. These weights can be determined through pairwise comparisons, surveys, or expert judgment. Decision-makers can use their expertise or consult with related parties to determine these weights. After the criteria weights are determined, the MOORA method uses ratio-based analysis to evaluate alternatives to each criterion. These ratios are calculated by dividing the performance value of an alternative against a specific criterion by the performance value of the best alternative for that criterion. Performance values can be obtained through empirical data, measurements, simulations, or expert opinion. By calculating

the ratios for each alternative and criterion, the MOORA method allows for comparing and ranking these alternatives. The alternative with the highest overall ratio, which considers all criteria, is considered the best choice or the most optimal alternative [32], [33], [34], [35]. The MOORA method provides a systematic and structured approach to decision-making by considering different objectives simultaneously.

One of the advantages of the MOORA method is its ability to manage different criteria and the relationship between these criteria, which allows a comprehensive evaluation of alternatives. This method facilitates a transparent decision-making process by quantifying subjective preferences through weighting and provides a rational basis for choosing the best alternative. In addition, the MOORA method is known for its computational efficiency, which enables faster decision-making based on the time required [36]. This can be particularly advantageous when dealing with many alternatives or when time is a critical factor in decision-making.

The MOORA is a method introduced by Brauers and Zavadkas [37]. According to [28], [31], [32], this relatively new method was first used by Brauers in a multi-criteria retrieval. The MOORA method is flexible and easy to understand by decomposing the subjective aspects of the evaluation process into decision criteria with several decision attributes. This method has good discriminatory power because it can determine the purpose of conflicting criteria. The criteria can be profitable (benefit) or unprofitable (cost). The MOORA method consists of five significant steps.

- 1) *Determine whether the criteria are beneficial (benefit) or unprofitable (cost).*
- 2) *Determine the decision matrix x based on data.*

$$\begin{bmatrix} x_{11} & x_{12} & \cdot & x_{1n} \\ x_{21} & x_{22} & \cdot & x_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ x_{m1} & x_{m2} & \cdot & x_{mn} \end{bmatrix}$$

Information

x = criteria value

- 3) *Normalize the decision matrix x .*

$$X^*_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^n x_{ij}^2}} \quad (1)$$

Information

X^*_{ij} = the optimal choice of the square root of the sum of squares of each choice for each attribute

- 4) *Optimize attribute values without applying weight (W).*

$$Y_i = \sum_{j=1}^g x_{ij} - \sum_{j=g+1}^n x_{ij} \quad (2)$$

Information

X_{ij} = denotes the first sequence of alternatives on the criterion to j

n = number of criteria

- 5) *Optimize attribute values by applying weight (W)*

$$Y_i = \sum_{j=1}^g w_j x_{ij} - \sum_{j=g+1}^n w_j x_{ij} \quad (3)$$

Information

g = value of criteria to be maximized

$(n-g)$ = minimized criterion value

Y_i = the value of the normalized normalization assessment of all

W_j = weight of attribute j

The last process is ranking, by sorting from the highest value. The research framework includes applying the MOORA method to recommend the types of mustard plants that can be planted in experimental fields. The framework consists of several steps aimed at collecting data, analyzing data using the MOORA method, and providing recommendations based on the results.

First, the researchers discussed with farmers and experts in Samarinda, East Kalimantan, Indonesia, to obtain information about the types of mustard greens commonly used as alternatives in that area. This discussion is essential because they have practical knowledge and direct experience in cultivating mustard greens in that location. Furthermore, experts obtained data regarding good growing conditions for each type of mustard plant and the experimental area criteria. Experts know the specific requirements of the different types of mustard plants and can guide the necessary conditions for successful mustard cultivation. After collecting the data, the MOORA method analyzes the information and generates recommendations. The MOORA method involves weighing each criterion, including the land criterion, which reflects its relative importance in the decision-making process. These weights can be obtained through pairwise comparisons or expert opinion. Using the MOORA method, data regarding the types of mustard plants, land criteria, and their weights were evaluated to determine the best alternative to be planted in the experimental land. This method calculates the ratio for each alternative based on its performance against these criteria, considering the assigned weights. The alternative with the highest overall ratio is considered the most suitable choice. Finally, recommendations for the types of mustard plants that can be planted in the experimental field are generated based on the results of the MOORA analysis. These recommendations are then conveyed to the community or farmers to guide the best options for mustard cultivation in a given context.

The research framework picture in Figure 1 visually represents the steps involved in the process, illustrating how data collection, analysis using the MOORA method, and dissemination of recommendations are interrelated to support decision-making in selecting the correct type of mustard for the experimental field.

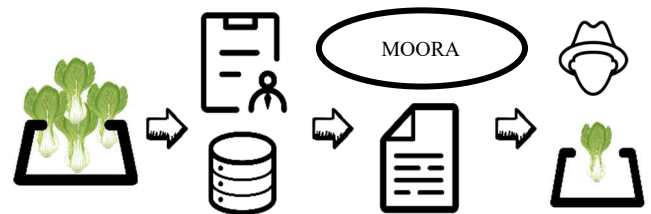


Fig. 1 Research framework

III. RESULTS AND DISCUSSION

The alternative is to use 6 mustard plants often planted in Samarinda, East Kalimantan, Indonesia. The value of the criteria weights according to the trial land to determine the

best mustard plant recommendation. This study uses 5 criteria: soil type, soil pH, rainfall, temperature, and location elevation. The value of each subcriteria can be seen in Tables 1, 2, 3, 4, and 5, which show all criteria types' benefits.

TABLE I
SOIL TYPE CRITERIA

Subcriteria Scale	Subcriteria Value	Description
1	Smooth	Includes sandy clay texture, dusty clay, clay
2	Slightly Smooth	Includes clay loam textures, clayey clay, dusty clay loam
3	Currently	Includes clay texture, dusty clay, dust
4	Rather Rough	Includes textures of sandy loam, fine sandy loam, very fine sandy loam
5	Rough	Includes loamy sand textures and sand

TABLE II
SOIL PH CRITERIA

Subcriteria Scale	Subcriteria Value	Description
1	Alkaline	If the pH value is more than 7.5
2	Neutral	If the pH is 6.6 to 7.5
3	Slightly Acid	If the pH is 5.6 to 6.5
4	Acid	If the pH is 4.6 to 5.5
5	Very Acid	If the pH value is less than 4.5

TABLE III
RAINFALL CRITERIA

Subcriteria Scale	Subcriteria Value	Description
1	Very low	If less than 600 mm/year
2	Low	If 600-1200 mm/year
3	Currently	If 1201-1800 mm/year
4	High	If 1801-2400 mm/year
5	Very High	If more than 2400 mm/year

TABLE IV
TEMPERATURE CRITERIA

Subcriteria Scale	Subcriteria Value	Description
1	Very low	If the temperature is less than 10°C
2	Low	If the temperature is 10-18°C
3	Currently	If the temperature is 19-26°C
4	High	If the temperature is 27-34°C
5	Very High	If the temperature is more than 34°C

TABLE V
LOCATION ELEVATION CRITERIA

Subcriteria Scale	Subcriteria Value	Description
1	Very low	If the area is less than 400 m above sea level
2	Low	If the area is 400-800 m above sea level
3	Currently	If the area is 801-1200 m above sea level
4	High	If the area is 1201-1800 m asl
5	Very High	If the area is more than 1800 m above sea level

Table 6 shows the value of the subcriteria for each alternative to the mustard plant variety, where all the requirements are benefit types. This value from the conversion results for each mustard is based on Table 1-5.

TABLE VI
DATA TABLE

Alternative	Criteria				
	Soil Type (C ₁)	Soil pH (C ₂)	Rainfall (C ₃)	Temp (C ₄)	Elevation of Location (C ₅)
White Mustard or Petsai (A1)	4	2	3	3	3
Mustard Greens or Bitter Mustard (A2)	4	2	2	4	2
Bok Choy (A3)	3	2	2	4	1
Choy Sum (A4)	3	3	3	3	1
Spoon Mustard or Pak Choy (A5)	4	3	3	3	3
Kailan or Chinese Broccoli (A6)	4	3	3	4	2

Table 6 is converted into a matrix form according to the stages of the MOORA method to become an X matrix.

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

The next step is to normalize using (1) for each data in each criterion.

For criteria 1 (soil type):

$$A_{11} = \frac{4}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{4}{9,0553} = 0,4417$$

$$A_{21} = \frac{4}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{4}{9,0553} = 0,4417$$

$$A_{31} = \frac{3}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{3}{9,0553} = 0,3312$$

$$A_{41} = \frac{3}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{3}{9,0553} = 0,3312$$

$$A_{51} = \frac{4}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{4}{9,0553} = 0,4417$$

$$A_{61} = \frac{4}{\sqrt{4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 4^2}} = \frac{4}{9,0553} = 0,4417$$

For criteria 2 (soil pH):

$$A_{12} = \frac{2}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{2}{6,2449} = 0,3202$$

$$A_{22} = \frac{2}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{2}{6,2449} = 0,3202$$

$$A_{32} = \frac{2}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{2}{6,2449} = 0,3202$$

$$A_{42} = \frac{3}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{6,2449} = 0,4803$$

$$A_{52} = \frac{3}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{6,2449} = 0,4803$$

$$A_{62} = \frac{3}{\sqrt{2^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}} = \frac{3}{6,2449} = 0,4803$$

For criteria 3 (rain fall):

$$A_{13} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{2} = \frac{3}{6,6332} = 0,4522$$

$$A_{23} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{2} = \frac{3}{6,6332} = 0,3015$$

$$A_{33} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{3} = \frac{3}{6,6332} = 0,3015$$

$$A_{43} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{3} = \frac{3}{6,6332} = 0,4522$$

$$A_{53} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{3} = \frac{3}{6,6332} = 0,4522$$

$$A_{63} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 3^2}}}{3} = \frac{3}{6,6332} = 0,4522$$

For criteria 4 (temperature):

$$A_{14} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{4} = \frac{3}{8,6602} = 0,3464$$

$$A_{24} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{4} = \frac{3}{8,6602} = 0,4618$$

$$A_{34} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{3} = \frac{3}{8,6602} = 0,4618$$

$$A_{44} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{3} = \frac{3}{8,6602} = 0,3464$$

$$A_{54} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{4} = \frac{3}{8,6602} = 0,3464$$

$$A_{64} = \frac{\frac{3}{\sqrt{3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2}}}{4} = \frac{3}{8,6602} = 0,4618$$

For criteria 5 (elevation of location):

$$A_{15} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{2} = \frac{3}{5,2915} = 0,5669$$

$$A_{25} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{1} = \frac{3}{5,2915} = 0,3779$$

$$A_{35} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{1} = \frac{3}{5,2915} = 0,1889$$

$$A_{45} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{3} = \frac{3}{5,2915} = 0,1889$$

$$A_{55} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{2} = \frac{3}{5,2915} = 0,5669$$

$$A_{65} = \frac{\frac{3}{\sqrt{3^2 + 2^2 + 1^2 + 1^2 + 3^2 + 2^2}}}{2} = \frac{3}{5,2915} = 0,3779$$

After we get the values that have been normalized for all data, the result is made in the form of an X matrix.

$$X = \begin{bmatrix} 0,4417 & 0,3202 & 0,4522 & 0,3464 & 0,5669 \\ 0,4417 & 0,3202 & 0,3015 & 0,4618 & 0,3779 \\ 0,3312 & 0,3202 & 0,3015 & 0,4618 & 0,1889 \\ 0,3312 & 0,4803 & 0,4522 & 0,3464 & 0,1889 \\ 0,4417 & 0,4803 & 0,4522 & 0,3464 & 0,5669 \\ 0,4417 & 0,4803 & 0,4522 & 0,4618 & 0,3779 \end{bmatrix}$$

The next step is optimization using (3), where weights are considered. The weights used are taken from experts (W) = 4,4,4,3,2 with the type of benefit for each criterion. Results can be seen in Table 7.

$$Y_1 = (0.4417 \times 4) + (0.3202 \times 4) + (0.4522 \times 4) + (0.3464 \times 3) + (0.5669 \times 2)$$

$$= 1.7668 + 1.2808 + 1.8088 + 1.0392 + 1.1338$$

$$= 7.0294$$

$$Y_2 = (0.4417 \times 4) + (0.3202 \times 4) + (0.3015 \times 4) + (0.4618 \times 3) + (0.3779 \times 2)$$

$$= 1.7668 + 1.2808 + 1.206 + 1.3854 + 0.7558$$

$$= 6.3948$$

$$Y_3 = (0.3312 \times 4) + (0.3202 \times 4) + (0.3015 \times 4) + (0.4618 \times 3) + (0.1889 \times 2)$$

$$= 1.3248 + 1.2808 + 1.206 + 1.3854 + 0.3778$$

$$= 5.5748$$

$$Y_4 = (0.3312 \times 4) + (0.4803 \times 4) + (0.4522 \times 4) + (0.4364 \times 3) + (0.1889 \times 2)$$

$$= 1.3248 + 1.9212 + 1.8088 + 1.0392 + 0.3778$$

$$= 6.4718$$

$$Y_5 = (0.4417 \times 4) + (0.4803 \times 4) + (0.4522 \times 4) + (0.3464 \times 3) + (0.5669 \times 2)$$

$$= 1.7668 + 1.9212 + 1.8088 + 1.0392 + 1.1338$$

$$= 7.6698$$

$$Y_6 = (0.4417 \times 4) + (0.4803 \times 4) + (0.4522 \times 4) + (0.4618 \times 3) + (0.3779 \times 2)$$

$$= 1.7668 + 1.9212 + 1.8088 + 1.3854 + 0.7558$$

$$= 7.638$$

TABLE VII
WEIGHT TABLE

Y_i	Value	Rank	Alternative
Y_1	7.0294	3	White Mustard or Petsai (A1)
Y_2	6.3948	5	Mustard Greens or Bitter Mustard (A2)
Y_3	5.5748	6	Bok Choy (A3)
Y_4	6.4718	4	Choy Sum (A4)
Y_5	7.6698	1	Spoon Mustard or Pak Choy (A5)
Y_6	7.638	2	Kailan or Chinese Broccoli (A6)

The last step is the ranking process based on Table 7. The ranking results are obtained with the final value in Y_i . Then, the recommendation with the highest and most significant Y_i value is Y_5 , which is 7.6698. So, alternative A5 is the chosen alternative as the best alternative (mustard variety), which is suitable to be planted on the trial land. So those chosen as mustard planted on the land are Spoon Mustard or Pak Choy. The results of these recommendations are expected to help the community or farmers to get the best results. The results of this ranking prove that the MOORA method can recommend suitable mustard varieties based on land criteria.

IV. CONCLUSION

This study successfully applied the MOORA method to provide recommendations for mustard plants that match the criteria for the land used. The criteria for this study were soil type, soil pH, temperature, rainfall, and location elevation based on the needs of the mustard plant. This helps identify the essential factors to consider when selecting mustard varieties. An experimental field in Samarinda, East Kalimantan, Indonesia, showed that suitable mustard greens were Spoons Mustard or Pak Choy. The results of this study provide a helpful guide in selecting suitable mustard varieties for planting in the experimental field based on existing criteria and requirements. The MOORA method used in this study can be applied in similar studies to other crop selections or even in a broader decision-making context.

Future research may involve adding or adapting new criteria to consider other relevant factors in selecting plant

varieties. This could include further consideration of climate, pests, disease, or economic factors. Research may consider using temporal data with sensors to look at changes in growing criteria and land requirements over time in real time. This can assist in gaining a more comprehensive understanding of environmental change and its influences, and farmers can optimize the use of resources such as water and fertilizer, thereby reducing waste and environmental impact.

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