Medicinal Plants Recommendation System using ROC and MOORA

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Abstract—Kalimantan has extraordinary biodiversity, including medicinal plants. Medicinal plants are a type of plant that certain parts, such as roots, leaves, bark, stems, and the results of their excretions. However, people sometimes need help choosing plants that suit their needs because of the many types of medicinal plants and the need for knowledge regarding their use. Decision support systems (DSS) combine computer capabilities with data processing or manipulation that utilizes unstructured models or solution rules. Furthermore, the method of documenting knowledge of traditional medicine is through the media of information systems. This system helps select medicinal plants according to user needs. This research developed a DSS using Rank Order Centroid (ROC) and Multi-Objective Optimization by Ratio Analysis (MOORA) methods to select medicinal plants for fungal and skin infections, including Furuncles, Tinea corporis, Tinea versicolor, and Acne. ROC method for determining criteria weight values. This research has four criteria: plant part, processing method, use method, and habitus. Determining recommendations for alternative ranking results using the MOORA method. This study aims to help the public get recommendations for medicinal plants in human skin disease treatment. This study aims to increase the preservation of biodiversity, particularly sustainable medicinal plants in the tropical rainforest of East Kalimantan.

Keywords—Decision Support System, Information system, Medicinal plants, MOORA, ROC.

I. INTRODUCTION

Indonesia has incredible biodiversity, including plants with medicinal properties that are known and used by locals. Medicinal plants are natural ingredients or concoctions that have been used for treatment based on experience from generation to generation. Medicinal plants are natural ingredients or concoctions that have been used for treatment based on experience from generation to generation. Many people are switching from chemical medicine to traditional medicine, which uses raw materials from medicinal plants. The medicinal plants have been recommended by the World Health Organization (WHO) as a form of health maintenance, treatment, and prevention of diseases, such as degenerative diseases, chronic diseases, and cancer (Reka et al., 2023). WHO has also supported various efforts to improve the safety and efficacy of traditional medicine. As an alternative medicine, medicinal plants are in great demand by the public because they reduce the consumption of chemical-based medicinal. Consuming chemical drugs for a long time can cause various excessive side effects (Puspitasari et al., 2020).

Climate, environmental factors, allergies, animals, and unhealthy living habits cause skin diseases. Several skin diseases are caused by fungal and bacterial infections, namely Furuncles, Tinea corporis, Tinea versicolor, and Acne. Furuncles are bacterial skin infections. Sufferers of this disease will experience small, hard, red lumps. After a few days, the lump will soften and then enlarge, and the pain it causes will increase. At the top of the lump, a pocket of pus will form (Maher & Anokhin, 2024).

Meanwhile, *Tinea corporis* is a skin disease caused by a fungal infection on the body, arms, and legs. The symptoms are that the sufferer will feel itchy, a red scaly area appears, a widespread rash resembling a ring appears, the skin peels, and feels sore (Leung et al., 2020). Tinea versicolor is a fungal infection of the skin that usually appears on skin pigment. The symptoms that arise are itching, dry, scaly skin, a rash, and pink spots. It can also be brownish, and the most common is white spots on the skin (Leung et al., 2022).

Acne is a skin disease caused by a bacterial infection. It is caused by a skin condition with blockage and inflammation involving a hair follicle and sebaceous glands. Sufferers of this disease will experience complaints of itching, pain, and black or white spots (blackheads) appearing. Various diseases can be treated with medicinal plants. The various types of medicinal plants and the need for knowledge regarding their use often make it difficult to choose suitable plants (Reka et al., 2023).

Decision Support Systems (DSS) are interactive information systems that provide information, modeling, and data manipulation (Ramadiani et al., 2023). They help decision-makers in semi-structured and unstructured situations (Rahman et al., 2023). Based on this

explanation, researchers developed a DSS as a recommendation for medicinal plants for skin diseases using Rank Order Centroid (ROC) and Multi-Objective Optimization by Ratio Analysis (MOORA) methods. This research can recommend alternative medicinal plants for skin diseases, including furuncles, tinea corporis, tinea versicolor, and acne. This research aims to help the public understand the use of medicinal plants and get recommendations for alternative medicinal plants that are good and appropriate for their needs. Increasing public knowledge about medicinal plants can intensify the preservation of biodiversity, mainly medicinal plants in the tropical rainforest of East Kalimantan.

II. RESEARCH METHOD

Biodiversity is a national asset that is greatly substantial for its preservation and utilization. Kalimantan is one of the islands in Indonesia that has incredible biodiversity, including medicinal plants. Plants with medicinal properties are plants in which certain parts, such as roots, leaves, bark, stems, and excretions, are believed to be used as medicine to cure a disease and can also be used to maintain health. Medicinal plants have been known for thousands of years, along with the development of human civilization. Nations such as Greece, China, and India, including our Indonesian ancestors, were well known for their use of medicinal plants (Cahyaningsih et al., 2021). Medicinal plants are natural ingredients or herbal plants for treatment based on experience and medical traditions in the past. The large number of medicinal plants and the need for knowledge regarding their use makes it difficult for people to choose plants that suit their treatment needs (Adinda et al., 2022).

Generally, knowledge of traditional medicine is only mastered by older people. The current younger generation needs to be more motivated to gain knowledge from older people. Sometimes, people follow the rules of use from generation to generation without knowing the correct way to use them to produce a good reaction in the body. Nevertheless, we know that plants with medicinal properties come from nature. If they are not used properly, they can also produce side effects, even though they are minimal compared to modern medicines. It is slowly starting to be left behind due to various causal factors, including the lack of distribution of knowledge caused by documentation that still needs to be completed. Therefore, there needs to be an effort to document knowledge of medicinal plants that are used in traditional medicine. This can be made possible through technology that can provide recommendations for medicinal plants that suit user needs, such as a decision support system (Wati et al., 2020).

Medicinal plants can overcome various diseases, such as skin diseases and fungal and bacterial infections that often occur in Indonesia, as well as Furuncles, Tinea corporis, Tinea versicolor, and Acne. An effort to preserve medicinal plants in Kalimantan is to develop a biodiversity information system that describes taxonomic

data, data descriptions, and taxonomic relationships with diverse data stored in databases (Budiman et al., 2018). Another study is information systems about 233 species of medicinal plants in the tropical forests of Kalimantan (Dengen et al., 2018). In addition, the information system has data on 748 species of medicinal plants from 45 Dayak ethnic groups found on the island of Borneo (Widians et al., 2018).

A decision support system (DSS) is an alternative solution to several alternative solutions and actions that help solve a problem (Wati et al., 2021). Another opinion says that the Decision Support System (DSS) is a system that supports managerial decision-makers in semi-structured decision conditions or situations (Tejawati et al., 2022). DSS is widely used to make various alternative recommendations for medicinal plants (Wati et al., 2020) (Budiman et al., 2021).

The MOORA method's criteria weighting uses direct scoring in ranking, which is weak. Based on this condition, the author applies another method so that the weighting of each criterion becomes more effective and accurate. This research also applies the Rank Order Centroid (ROC) method to weigh the criteria. This research develops DSS using the ROC and MOORA methods in selected medicinal plants to treat human skin diseases, namely, Furuncles, Tinea corporis, Tinea versicolor, and Acne. This study applies the determination of criteria weights and sub-criteria weights. Criteria weights are determined using ROC, while ranking alternative priorities uses MOORA.

This research lasted for seven months, from January 2021 to August 2021. Data for this study was gathered from the Samboja Center for the Application of Standards for Environmental and Forestry Instruments (BPSILHK) in 2021 with Mrs. Noorcahyati, S.Hut, MP, as a researcher there. Up to 50 plants can be utilized as an alternative treatment for human skin diseases. The utilization of each plant that the Samboja BPSILHK has recorded has been tested so that the community can use it. Several plants were obtained based on information from people's experience. Accordingly, each medicinal plant may have advantages and disadvantages in its use. Through a DSS, it is possible to calculate the advantages and disadvantages of medicinal plants by applying the ROC and MOORA methods to obtain alternative recommendations for medicinal plants.

A. ROC

ROC (Rank Order Centroid) is a method based on the level of importance or priority. Generally, the ROC method gives a value to each criterion according to the ranking assessed, such as the statement "Criterion 1 is more important than criterion 2, which is more important than criterion 3," and so on to criterion n. ROC is notated in Equation (1). The weight value (W) can be generated with Equation (2) (Alam et al., 2023).

$$Cr \geq Cr_2 \geq Cr_3 \geq \cdots \geq Cr_m \qquad (1)$$

$$Wm = \frac{1}{m}\sum_{i=1}^{m}\left(\frac{1}{i}\right) \qquad (2)$$

B. *MOORA*

The problem in Multi-Criteria Decision Making (MCDM) is determining a weighting model that uses opinion-based decision-making. One of the method approaches used is the method. The method used in the ranking process involving multi-criteria is Multi-Objective Optimization by Ratio Analysis (MOORA).

MOORA has good selectivity because it can determine conflicting goals and criteria. However, when using the MOORA method, the resulting weights use direct scoring. The first stage in calculating the MOORA method is create a decision matrix, denoted in Equation (3) (Widians et al., 2023).

$$X = \begin{bmatrix} X_{11} & X_{12} & \cdot & X_{1n} \\ X_{21} & X_{22} & \vdots & X_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ X_{m1} & X_{m1} & \cdot & X_{mn} \end{bmatrix} \quad (3)$$

The normalization calculation in Equation (4). At the same time, the value (y_i) can be optimized with Equation (5) and normalized weights using Equation (6) (Haviluddin et al., 2022).

$$x_{i\,j}^* = x_{i\,j} \sqrt{\left| \sum_i^m 1 x_{i\,j}^2 \right|} (j = 1,2, \dots n) \quad (4)$$

$$y_i = \sum_{j=i}^g x_{i\,j}^* - \sum_{j=g+1}^n Xij \quad (5)$$

$$y_i = \sum_{j=i}^g wj X_{i\,j}^* - \sum_{j=g+1}^g wj x_{i\,j}^* (j = 1,2 \dots, n) (6)$$

The final stage is determining the ranking of the results of the y_i values by identifying criteria that have cost and benefit values to calculate the preference value as a result. The value of y_i can be positive or negative depend on the maximum total in the decision matrix. Thus, the best alternative has the highest y_i value, while the worst alternative has the lowest y_i value.

III. RESULT AND DISSCUSSION

This research uses DSS to recommend medicinal plants for skin diseases. Fifty types of medicinal plants were used in this research. There are 42 plant data for Tinea corporis, 11 for furuncles treatment; Tenia versicolor has seven plants and 11 for acne treatment. There are seven alternative medicinal plants for selecting plants with medicinal properties for tinea versicolor, namely Coconut (*Cocos nucifera*), Meniran (*Phyllanthus urinaria*), Galangal (*Alpinia galanga*), Gelinggang (*Cassia alata L.*), Basil (*Ocimum basilicum*), Guava (*Psidium guajava*).

In this research, criteria weights and sub-criteria weights are determined using ROC and the MOORA method to determine priority alternative rankings. In determining the kind of medicinal plant that is suitable for a type of disease, each plant has its criteria, not only looking at its properties but also from several aspects. We use criteria including plant parts, processing methods, use methods, and habitus. Table 1 describes criteria weights based on priority comparisons using the ROC method in Equations (1) and (2).

Table 1. Criteria

Criteria	Description	Type	Weight
C1	Plant parts	Benefit	0.52
C2	Process	Benefit	0.27
C3	Use	Benefit	0.15
C4	Habitus	Benefit	0.06

The weights of the criteria and sub-criteria have been obtained, and the priority order of alternative medicinal plants has been determined using the MOORA method. Furthermore, a decision matrix should be created based on the value of each weight of the criteria and sub-criteria used as parameters in decision-making. The results of the decision matrix are in Table 2.

Table 2. Decision Matrix

Code	Alternative	Plant parts	Process	Use	Habitus
A1	Coconut (*Cocos nucifera*)	0.143	0.857	0.714	0.571
A2	Meniran (*Phyllanthus urinaria*)	0.571	0.143	0.143	0.572
A3	Galangal (*Alpinia galangal*)	0.143	0.857	0.143	0.143
A4	Gelinggang (*Cassia alata L.*)	0.571	0.857	0.714	0.286
A5	Basil (*Ocimum basilicum*)	0.571	0.857	0.715	0.286
A6	Guava (*Psidium guajava*) (leaves)	0.571	0.857	0.714	0.571
A7	Guava (*Psidium guajava*) (flowers)	0.143	0.857	0.714	0.571

The next step is to create the normalized matrix using Equations (4). Normalization matrix results are in Table 3.

Table 3. Normalization Matrix

Code	Alternative	Plant parts	Process	Use	Habitus
A1	Coconut (*Cocos nucifera*)	0.122	0.407	0.444	0.468
A2	Meniran (*Phyllanthus urinaria L.*)	0.489	0.068	0.089	0.468
A3	Galangal (*Alpinia galangal*)	0.122	0.407	0.089	0.117
A4	Gelinggang (*Cassia alata L.*)	0.489	0.407	0.445	0.234
A5	Basil (*Ocimum basilicum*)	0.489	0.407	0.444	0.234
A6	Guava (*Psidium guajava*) (leaves)	0.489	0.407	0.444	0.468
A7	Guava (*Psidium guajava*) (flowers)	0.122	0.407	0.444	0.468

The next stage calculates the weighted normalization value using Equations (5) and (6). Then, the ranking was carried out from largest to smallest, listed in Table 4.

Table 4. Minimum and maximum Alternative Values

Code	Alternative	Max (C1+C2+C3 C4)	Min	Yi = Max – Min
A1	*Coconut (Cocos nucifera)*	0.268	0	0.267
A2	*Meniran (Phyllanthus urinaria)*	0.315	0	0.315
A3	*Galangal (Alpinia galangal)*	0.194	0	0.193
A4	*Gelinggang (Cassia alata L.)*	0.444	0	0.445
A5	*Basil (Ocimum basilicum)*	0.444	0	0.444
A6	*Guava (Psidium guajava) (leaves)*	0.459	0	0.459
A7	*Guava (Psidium guajava) (flower)*	0.268	0	0.268

Table 5. Alternative Ranking

Code	Alternative	Pi
A1	*Guava (Psidium guajava) (leaves)*	0.459
A2	*Gelinggang (Cassia alata L.)*	0.444
A3	*Basil (Ocimum basilicum)*	0.444
A4	*Meniran (Phyllanthus urinaria)*	0.315
A5	*Coconut (Cocos nucifera)*	0.267
A6	*Guava (Psidium guajava) (flowers)*	0.268
A7	*Galangal (Alpinia galanga)*	0.193

Table 5 shows the top five alternatives for tinea versicolor are leaves of Guava (*Psidium guajava*), with ROC-MOORA results of 0.459. The following recommended plants are Gelinggang (*Cassia alata L.*), Basil (*Ocimum basilicum*), Meniran (*Phyllanthus urinaria*), and Coconut (*Cocos nucifera*).

Implementation DSS using the ROC and MOORA methods obtained the top five medicinal plants rankings for tinea versicolor skin disease: Guava (*Psidium guajava*), Gelinggang (*Cassia alata L.*), Basil (*Ocimum basilicum*), Meniran (*Phyllanthus urinaria*), and Coconut (*Cocos nucifera*).

Figure 1 is the implementation of system. Users can see pictures and detailed explanations regarding the types of plants suitable for the kind of skin disease.
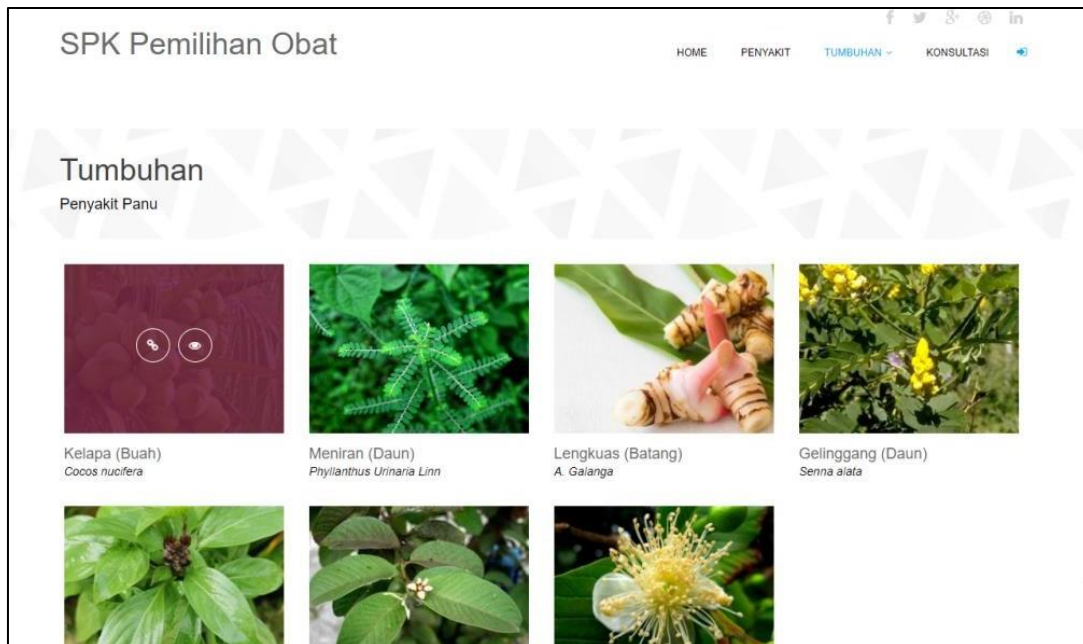

Figure. 1. Implementation of System

IV. CONCLUSION

The research developed a DSS for medicinal plant recommendations for fungal and bacterial infectious skin diseases using ROC and MOORA methods. The ROC method assigns a weight value to each criterion according to the ranking assessed based on priority level. Furthermore, MOORA determines ranking and alternative recommendation systems. Data was collected from the Center for Implementation of Standard Environmental and Forestry Instruments Samboja (BPSILHK Samboja), East Kalimantan. This system manages disease data, plant data, and user consultation data to produce output in the form of rankings of medicinal plants as alternative recommendations for treating skin diseases such as Furuncles, Tinea corporis, Tinea versicolor, and Acne.

Implementation of the system obtained the top five medicinal plants rankings for tinea versicolor skin disease: Guava (*Psidium guajava*), Gelinggang (*Cassia alata L.*), Basil (*Ocimum basilicum*), Meniran (*Phyllanthus urinaria*), and Coconut (*Cocos nucifera*). This system may display the ranking of plants as alternative medicines for skin diseases, complete with information on how to process and use them. This study aims to increase public knowledge about medicinal plants that can improve the preservation of biodiversity, including medicinal plants in the tropical forests of East Kalimantan.

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