

Application of Case Based Reasoning Method to Diagnose Rice Plant Diseases

Windi¹, Novriyenni ², Husnul³

^{1,2,3}STMIK Kaputama

winditamara129@gmail.com¹, novriyenni.sikumbang@gmail.com², Husnul.khair@gmail.com³

Abstract

Rice (Latin: *Oryza sativa*) is one of the most important cultivated crops in civilization. Although it mainly refers to a type of cultivated plant, rice is also used to refer to several types of the same genus (genus), commonly referred to as wild rice. The problem that often arises is that many rice plants are susceptible to pests and diseases during the planting period. Some pests and diseases that can attack rice plants include: leaf blight, grass, tongguo, rice spout, and dwarf grass. Generally, when rice plants are attacked by pests and diseases, farmers will immediately use pesticides or treatment methods that are sometimes not in accordance with pests. As a result, treatment is not optimal and can even cause new pests and diseases. The purpose of this study is to assist farmers in identifying early symptoms of plant diseases and pests of rice plant diseases using the case base reasoning method, so that the treatment of plant diseases and insect pests is more concentrated and maximal.

Keywords: *expert system, rice plants diseases, case base reasoning*

1. Introduction

Rice is one of the most important cultivated crops in civilization. Although it mainly refers to a type of cultivated plant, rice is also used to refer to several types of the same genus (genus), commonly referred to as wild rice. The rice harvest area in 2022 is estimated at 10.61 million hectares, an increase of 194.71 thousand hectares or 1.87 percent compared to the rice harvest area in 2021 which was 10.41 million hectares. Rice production in 2022 is estimated at 55.67 million tons GKG, an increase of 1.25 million tons GKG or 2.31 percent compared to rice production in 2021 which was around 54.42 million tons GKG.

Rice production in 2022 for food consumption of the population is estimated to be around 32.07 million tons, an increase of 718.03 thousand tons or 2.29 percent compared to rice production in 2021 which was 31.36 million tons. The problem that often arises is that many rice plants are susceptible to pests and diseases during the planting period. Some pests and diseases that can attack rice plants include: leaf blight, grass tongguo, rice spout, and dwarf grass.

Expert systems are systems that are built can imitate or imitate expert intelligence in providing solutions to questions and problem solving. System experts can provide suggestions or solutions to problems obtained from user dialogue consultation sessions. With the help of an expert system, lay or non-expert people can answer questions, solve problems and make decisions that can be made as if by experts. In the field of expert systems, case-based reasoning is a method that can solve a problem based on previous cases. The result of this study is to identify diseases in rice plants using the Case Based Reasoning method.

2. Research Methods

2.1. Understanding Of Expert Systems

An expert system or expert system is usually referred to as a knowledge-based system, which is a computer application that is intended to assist decision making or problem solving in a specific field. This system works by using knowledge and analysis methods that have been defined in advance by experts in accordance with their areas of expertise. This system is called an expert system because its functions and roles are the same as an expert who must have knowledge and experience in solving a problem [1].

According to [2] an expert system is a computer system that is intended to emulate all aspects (emulates) the decision making ability of an expert. Expert systems make maximum use of specialized knowledge like an expert to solve problems. The advantages and disadvantages of expert systems can be explained as follows:

Below are some of the advantages that exist in expert systems, namely [2]:

1. Increasing availability
2. Reducing costs (reduced costs)
3. Reducing danger
4. Permanent (permanence)
5. Multiple expertise (multiple expertise)
6. Improve reliability (increased reliability)
7. Explanation
8. Fast response (fast response)
9. Stable, unemotional, and provide a complete response at all times (steady, unemotional, and complete response at all times)
10. Smart tutor (intelligent tutor)
11. Intelligent database (intelligent database)

The shortcomings of the expert system are as follows [3]:

1. The cost is very expensive to make and maintain
2. Difficult to develop due to limited expertise and availability of experts.
3. Expert systems are not 100% True

2.2 Definition of Diagnosis

Diagnosis is a term adopted from the medical and medical fields as a process for determining the type of disease by looking at the symptoms that appear. In the world of education, the term "diagnosis" is a relatively new term [4].

According to [5] Diagnosis is an analysis of abnormalities or misadjustments of the pattern of symptoms. Similar to the term in the world of medicine, diagnosis is an activity to determine the type of disease by examining its symptoms. Based on this, diagnosis is a process of examining things that are considered wrong or problematic.

2.3 Definition of Disease

Illness is a medical term that describes a disturbance in bodily functions that results in reduced capacity. Disease occurs when the balance in the body cannot be maintained. Illness occurs when a person is no longer in a normal state of health. According to [6] illness is an unpleasant condition that befalls a person, causing disruption to daily activities, both physical, spiritual and social activities.

2.4 Definition of Rice Plants Disease

Rice plants are one of the most planted by farmers so information related to rice pests and diseases needs to be known. The high demand for rice plants that will be used as a staple food provides great opportunities for farmers. The large number of rice fields that grow rice shows the high need in the community. As an important plant for life, growing it well must be considered appropriately so that the harvest is maximized. In the process of suitable planting, pests and diseases are certainly one of the causes of stunted growth, including rice. Knowing every pest and disease that exists is certainly important information for farmers in order to produce quality rice.

Disease in rice plants is an abnormal condition that causes plant function to be disrupted. Some diseases that often attack rice plants, including, are:

- Tungro, a viral disease transmitted by leafhopper pests.
- Leaf spot, a fungal disease that causes brown spots on leaves.
- Fusarium, a fungal disease that causes wilting and rotting of the stem.
- Blast, a fungal disease that causes white spots on leaves and panicle.

The presence of various types of diseases in rice can cause a decrease in the quality of rice production. The disease must be prevented from occurring to the detriment of farmers. There are several ways that farmers can do well to prevent pest and disease attacks on rice as explained through the following reviews:

- a. Pay Attention to the Planting Period; The first preventive step that can be done in order to avoid the occurrence of rice pests and diseases is to pay attention to the planting period. Farmers who pay close attention to the planting period can avoid the occurrence of pest and disease conditions. A suitable period for seedling to harvest must be considered by farmers.
- b. Selection of Rice Varieties; The second step that farmers can take in order to avoid the occurrence of various diseases and rice pests such as red disease in rice is to choose varieties. Especially for rice plants that are attacked by diseases caused by many factors, one of which is fertilization during the first planting period.
- c. One of the right fertilization steps is to determine the appropriate quality and dose of fertilization. So the right fertilizer selection is needed to support the growth of rice plants. Farmers must be able to choose varieties that are more stages of disease and pests so that they are not weak and susceptible to adverse conditions for these farmers. Various varieties are now created to be more resistant to different types of pests and diseases
- d. Maximizing Care; The third step that farmers must take in order to avoid various pests and diseases in rice plants is to maximize their care. Farmers need to pay attention to the best care process so that the harvest runs well.
- e. One good step in doing proper care is to fertilize for more care.

2.5 Definition of The Case Base Reasoning

The Case Based reasoning method is one method for building a system with decision making from new cases based on solutions from previous cases. The concept of the Case Based reasoning method is found from the idea of using documented experiences to solve new

problems. Decision makers mostly use experiences from previous problemsolving to solve problems faced now. If there is a new case, it will be stored in the knowledge base so that the system will learn and the knowledge owned by the system will increase. In general, this method consists of four steps, namely [6], [7], [8]:

- a. Retrieve, getting/retrieving the most similar/relevant case to the new case. This retrieval stage begins by describing some of the problems, and ends if a match is found against the previous problem with the highest level of match.
- b. Reuse, modeling/reusing old case knowledge and information based on the weight of the most relevant similarities to the new case, resulting in proposed solutions where adaptation to the new problem may be needed.
- c. Revise, review the proposed solution then test it on a real case (simulation) and if necessary improve the solution to fit the new case.
- d. Retain, integrating/storing new cases that have succeeded in obtaining solutions so that they can be used by future cases similar to the case.

The formula for finding the closest distance from each case in the database, and how similar the size of similarity of each source case in the database is to the target case The similarity function in the case is formulated as follows:

$$\text{Total Similarity} = \frac{\sum_{i=1}^n W_i \cdot f(T, S)}{\sum_{i=1}^n W_i}$$

Information:

T = New case.

S = Case that is in storage.

N = The number of attributes in each case.

i = Individual attribute between 1 to n.

f = Similarity function between case T and case S.

Wi = The weight given to the attribute to – i.

The similarity usually falls in the range from 0 to 1, where 0 is absolutely no matching or similar case, and a value of 1 means 100% match. The new case (T) is the case that will be targeted and will be compared to the source case. The total number of attributes (n) is the number of attributes present in the case. Once the similarity between new cases and all stored cases has been counted, the most similar cases are retrieved (the cases with the highest similarity values). These cases are then reused to help solve the next new case.

3. Results And Discussion

3.1. Flowcharts System

A flowchart is a graphical representation of the steps that must be followed in solving a problem consisting of a set of symbols, where each symbol represents a specific activity.

The flowchart begins with the reception of the input and ends with the appearance of the output. A program flowchart is a section that describes in detail the steps of the program process [6], [9], [10].

This flowchart is the first step in making a program. After the flowchart is compiled, then the programmer (programmer) translates it into the form of a program with a programming language. In making flowcharts there is no formula or benchmark that is absolute.

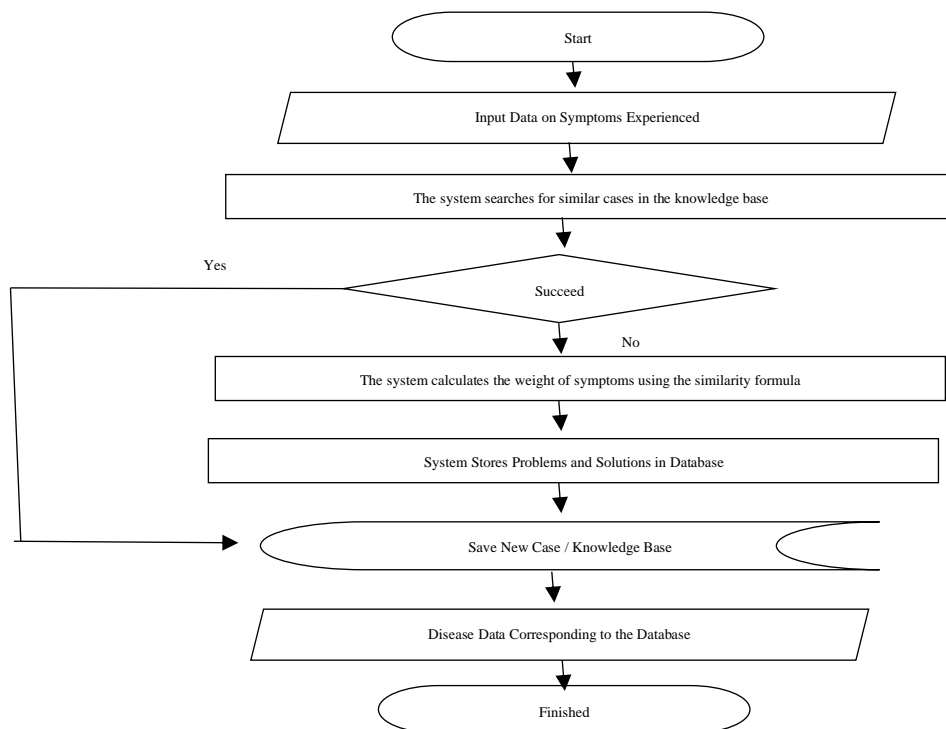


Figure 2: System Flowchart

3.2 Use Case Diagrams

Use case is functional of a system, so that users or applications can understand about the application to be built. Use case more precisely describes the workflow that will occur between the user and the system from the beginning of system creation to the end.

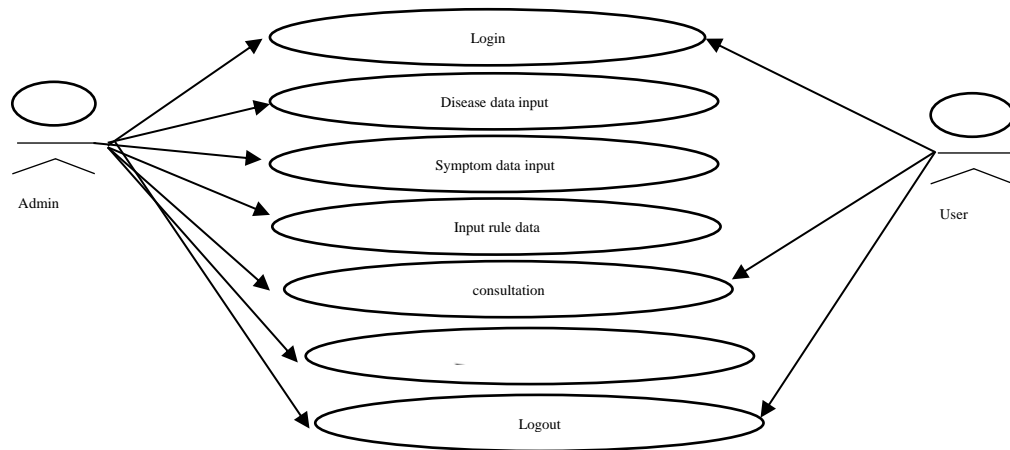


Figure 3: Use case diagrams

3.3 Application of the Certainty Factor Method

In accordance with the needs based on data obtained from the Agriculture Office of Langkat Regency, there are disease data on rice plants, namely:

Table 1: Rice Plant Disease Data

Disease Code	Disease Name
P01	Leaf Blight
P02	Tungro
P03	Blas (Blast)
P04	Grass dwarf

Table 3: Symptoms

Symptomatic Code	Symptom
G01	Similar to plants attacked by stem borers or exposed to hot water
G02	The appearance of gray (yellowish) spots on the edges of the leaves
G03	Leaves in a severe state, wither and die
G04	Begins to be unable to support panicles and breaks
G05	Blackish-brown spot at the base of the neck
G06	Center spot of white color
G07	Rhombus-shaped
G08	Blackish-brown spots
G09	Reduced or slight tillering
G10	Old leaves like tuft brown spots
G11	Leaves of green-gray color fold
G12	In plants that have reached the tillering phase until the ripening phase
G13	Leaf discoloration
G14	Plants grow stunted
G15	The color of the leaves of the plant slightly turns yellow to orange
G16	Brown spots
G17	Saplins multiply
G18	Short and narrow leaves
G19	Leaves pale green/yellowish color
G20	Bercka attacks leaves
G21	Saplins grow upright

The relationship between symptoms and disease can be shown in tabel 4 below:

Table 3: Relation of Symptoms and Name of Disease

Symptom Code	Symptom	P01	P02	P03	P04
G01	Similar to plants attacked by stem borers or exposed to hot water	*			

G02	The appearance of gray (yellowish) spots on the edges of the leaves	*			
G03	Leaves in a severe state, wither and die	*			
G04	Begins to be unable to support panicles and breaks			*	
G05	Blackish-brown spot at the base of the neck	*		*	
G06	Center spot of white color			*	
G07	Rhombus-shaped	*	*	*	
G08	Blackish-brown spots	*	*	*	
G09	Reduced or slight tillering			*	
G10	Old leaves like tuft brown spots			*	
G11	Leaves of green-gray color fold	*			
G12	In plants that have reached the tillering phase until the ripening phase	*			
G13	Leaf discoloration	*	*	*	*
G14	Plants grow stunted			*	
G15	The color of the leaves of the plant slightly turns yellow to orange			*	
G16	Dwarf plants				*
G17	Brown spots				*
G18	Saplings multiply				*
G19	Short and narrow leaves	*			*
G20	Leaves pale green/yellowish color				*
G21	Leaf spot affects	*	*		*
G22	Saplings grow upright				*

Table 4: Table of user values

No	Information	Value
1	Yes	1
2	No	0

Sample case:

The example of a case that occurs is that there has been an abnormality in rice plants with symptoms of gray (yellowish) spots on the edges of the leaves, rhomboid-shaped, blackish-brown spots, reduced / slight saplings, old leaves such as brown tuft spots, leaf discoloration, plant leaf color slightly yellowed to orange, and spots attacking the leaves. This makes it difficult for farmers to determine the diseases experienced in rice plants. Therefore, a new case consultation data table was created to facilitate the diagnosis of diseases in rice plants using the Case Based Reasoning method.

The first step:

Consultation users are given a choice of answers, each of which is weighted as follows:

Table 5: New Case Consultation Data

No	Symptom	Weight
G02	The appearance of gray (yellowish) spots on the edges of the leaves	5
G07	Rhombus-shaped	1
G08	Blackish-brown spots	1
G09	Less tillering	5
G10	Old leaves like tuft brown spots	3
G13	Leaf discoloration	1
G15	The color of the leaves of the plant slightly turns yellow to orange	5
G21	Leaf spot affects	1

From the consultation data, a CBR process for late blight (P01) will be carried out with the following formula:

$$T \quad Si = \frac{\sum_{t=1}^n W.Si (J T \int S)}{\sum_{t=1}^n W}$$

$$T \quad Si = \frac{(0*5)+(1*5)+(0*3)+(0*3)+(1*1)+(1*1)+(0*5)+(0*5)+(0*1)+(0*3)+(0*1)}{5+5+3+3+1+1+5+5+1+3+1} = 0,21$$

From the consultation data, a CBR process for Tumgro disease (P02) will be carried out with the following formula:

$$T \quad Si = \frac{\sum_{t=1}^n W.Si (J T \int S)}{\sum_{t=1}^n W}$$

$$T \quad Si = \frac{(1*1)+(1*1)+(1*5)+(1*3)+(1*1)+(0*5)+(1*5)+(1*1)}{1+1+5+3+1+1+5+5+1} = 0,77$$

From the consultation data, a CBR process for blast disease (P03) will be carried out with the following formula:

$$T \quad Si = \frac{\sum_{t=1}^n W.Si (J T \int S)}{\sum_{t=1}^n W}$$

$$T \quad Si = \frac{(0*5)+(0*3)+(0*5)+(1*1)+(1*1)+(1*1)}{5+3+5+1+1+1} = 0,18$$

From the consultation data, a CBR process for grass dwarf disease (P04) will be carried out with the following formula:

$$T \quad Si = \frac{\sum_{t=1}^n W.Si (J T \int S)}{\sum_{t=1}^n W}$$

$$T \quad Si = \frac{(1*1)+(0*5)+(0*5)+(0*5)+(0*3)+(0*5)+(1*1)}{1+5+5+5+3+5+1} = 0,08$$

From the calculation process in new cases using the CBR method, the results of recommended values are obtained as follows:

Table 6: Recommended Votes

Code	Disease Name	Value
P01	Leaf Blight	0,21
P02	Tungro	0,77
P03	Blast	0,18
P04	Grass dwarf	0,08

From table 6, rice plants from the calculation results using the CBR method are affected by tungro disease with a recommendation value of 0.77 or 77%

4. Conclusion

From table III.12, rice plants from the calculation results using the CBR method are affected by tungro disease with a recommendation value of 0.77 or 77%.

References

- [1] Arhami, M. (2005). Arief, M. (2007). Basic Concepts of Expert Systems. Andi: Yogyakarta Identifying Palm Plant Diseases. x, No.x(x), 1–5.
- [2] Arief, M. Rudianto. 2011. Dynamic Web Programming Using PHP and MySQL. Yogyakarta. Andi Offset.
- [3] Dwi Prasetyo, Educate. 2003. PHP and MySQL Collaboration Tips and Tricks for creating interactive web databases, Elex Media Komputindo: Jakarta.
- [4] Information, S., & Yamin, Y. M. (2019). Android-based palm oil uses the forward chaining method.
- [5] Rika Rosnelly (2012), Systems Expert Concepts and Theories. Yogyakarta : Publisher CV. ANDI OFFSET
- [6] Sri Kusumadewi. (2003.). Artificial intelligence : techniques and their applications / Sri Kusumadewi. Yogyakarta :: Graha Ilmu,.
- [7] Micah Dayan. (2021), Application of Case Based Reasoning (CBR) Method to Identify Diseases in Palm Plants,
- [8] Minarni, (2017), Expert System for Identification of Rice Plant Disease (CBR).
- [9] Sutanta, E., 2004, Sistem Basis Data, Penerbit Graha Ilmu, Yogyakarta Utara ; Sukrisno.*Konsep Dasar Pengolahan Dan Pemrograman Database Dengan SQL, Server, Mss. Access, Dan MS. Visual Basic : - / Ema Utami .2005*
- [10] Wendra, Y., Alwendi, Ardi, & Aldo, D. (2020). Metode Case Based Reasoning Untuk Identifikasi Penyakit Tanaman Padi. *Jursima*, 8(2), 103–110.