Pest Detection Expert System And Method Using Bayes Rice Diseases

Wiwin Cindyitia Wahyuni\(^1\), Arjon Samual Siti\(^2\)

\(^2\) Engineering Informatics Program, STMIK Pelita Nusantara Medan, Jl. Iskandar Muda 1 Medan, North Sumatra 20154, Indonesia

E-mail: wiwincindyitia7@gmail.com

Abstract - Indonesia is included in an agricultural country that is rich in agriculture, fertile land in Indonesia allows for the growth of various types of plants, one of which is rice. But in the cultivation of rice plants, it will never be separated from pests and diseases of rice plants, so that the growth of rice plants is not optimal. Due to the large number of pests and diseases that can attack rice plants, it is necessary to take proper care in dealing with pests and diseases of rice plants to avoid losses that can result in reduced production of rice plants. Therefore an expert system was created which was expected to help farmers in consulting about diseases and pests contained in their rice plants to the experts without having to meet with experts directly. In its identification,

Keywords : Expert systems, disease, pest, Bayes

1. Pendahuluan

Rice (Oryza sativa L.) is a food commodity that gets top priority in agricultural development. In rice cultivation, will never be separated from the name of pests and diseases of rice plants so as to make the growth of rice plants to be not optimal. Due to the many pests and diseases that can attack the rice plant, it would require precise handling in dealing with pests and diseases of rice plants to avoid damages that could result in reduced production of rice plants.\(^1\)

Expert System is a computer program that adopts the knowledge of an expert. Expert systems are very helpful in making a decision, this expert system can collect and store the knowledge of one or several experts in the knowledge base (Knowledge Base).\(^2\)

The use of Bayes Theorem to conclusions because Bayes method provides a fundamental way to incorporate external information into the formula of probability analysis. This process begins with an existing probability distribution for a given set of data analyzed. In general, Bayes theorem is expressed as:

\[
P(A|B) = \frac{P(B|A)P(A)}{P(B)}
\]

Where :
\[P(A|B)\] = Results are sought
\[P(A)\] = weights Bayes
\[P(B)\] = Total Symptom
\[P(B|A)\] = weights Symptoms

2. Theory

2.1. Expert system

Expert System is an artificial intelligence program that combines the knowledge base to base inference system to mimic an expert. (Zulfian Azmi, 2017). Expert systems in place to support problem-solving activities. In addition the expert system can also serve as a clever assistant of an expert. The basic concept of expert system contains expertise, experts, transfer of expertise, inference, rules, and the ability to explain.

2.2. Bayes theorem

According Zulfian Azmi (2017) explains that Bayesian methods are used to meenghitung probability of occurrence of an event based on the effect obtained from the observation. Bayesian methods provide a fundamental way to incorporate external information into the formula of probability analysis. This process begins with an existing probability distribution for a given set of data analyzed. In general, Bayes theorem is expressed as:

\[
P(A|B) = \frac{P(B|A)P(A)}{P(B)}
\]

3. Research methods
Research framework is the concept of a research that connects the visualization of the variables premises other variables, so that research be systematically arranged and can be accepted by all parties. The framework research this time will use the Waterfall Model.

![Diagram of Research Framework](image_url)

**Picture 1. Framework Research**

### 3.1. Stage Data Collection

The collection of data used in this study consisted of primary and secondary data. The primary data was done by face to face and interviewed village agricultural extension, while secondary data obtained from various sources such as books, journals, and the Internet.

### 3.2. analysis Methods

The analysis method is the method to be applied in the research process and are determined by the research method used. In this study using an expert system Methods *Bayes* ie calculate the probability of occurrence of an event based on the effect obtained from the observation.

### 3.3. System planning

The system design is to design or designing a good system, the contents of the operation steps in data processing. Designing systems using Web programming with PHP and HTML programming language and MySQL database with XAMPP. In such a system there will be a design expert system using the method *Bayes*.

### 3.4. Implementation

Implementation is an application or action taken based on the plan that has been prepared or made carefully and in detail earlier. At this stage is a continuation of the implementation phase and will be tested with our data processing practices with Method *Bayes* which is already implemented.

### 3.5. System planning

Stages of system design that will be built using the Unified Modeling Language (UML), which supports the modeling concepts based programming Object Oriented Programming (OOP) as would be applied at the stage of writing program code. At this stage will be obtained documentation of modeling, among others: Use Case Diagram, Use Case Scenario, Sequence Diagram, Activity Diagram, Class Diagram and Entity Relationship Diagram (ERD).

### 4. Analysis And Design

#### 4.1. Analysis

The analysis aims to identify issues that exist in the system. This analysis is needed as a basis for the system design stage. In building an expert system to do some analysis phase is to determine the problems the
system to be built, gather the data needed to build the system, presenting knowledge into the knowledge base, production and traceability rules.

a. Analysis Bayes Method

Bayesian methods used to calculate the probability of occurrence of an event based on the effect obtained from the observation. Bayesian methods are used to implement the results in determining the type of pests and diseases of rice.

| Table 1  | Diseases of Rice |
|----------|------------------|
| Code     | Disease name     |
| P01      | Leaf blight      |
| P02      | Leaf spotting    |
| P03      | Stem rot         |
| P04      | Fusarium diseases|
| P05      | Leaf sheaths foul|

| Table 2. | Rice Plant Disease Symptoms Data and Value Probability |
|----------|--------------------------------------------------------|
| Code     | symptom                                               | Weight |
| GP01     | Reddish yellow leaf                                  | 0.06   |
| GP02     | Plants wither and die                                | 0.03   |
| GP03     | Rotten rice seeds germinate and then die moment      | 0.03   |
| GP04     | Rotten rice and dries                                | 0.04   |
| GP05     | Seeds have patches but still contain                  | 0.01   |
| GP06     | Uplh leaf necrotic spots on the outer                 | 0.04   |
| GP07     | Dark patches of raised and gradually widens          | 0.03   |
| GP08     | Trunk fall before cooking                             | 0.06   |
| GP09     | Panicle and immature seed brownish                    | 0.04   |
| GP10     | The leaves dropu                                      | 0.01   |
| GP11     | Root decay                                            | 0.03   |
| GP12     | Spotting grow until the flag leaf                     | 0.01   |
| GP13     | Spotting begins at the surface of the water near the midrib first then expand to the midrib or leaves the top | 0.04 |
| GP14     | Oval or elliptical with a length of 1-3 cm            | 0.03   |
| GP15     | At the center of the color patches into a grayish-white with brown edges and easily separated | 0.01 |
| GP16     | In the humid state of patches grow white threads or mycelia and infect the leaf midrib / leaf | 0.04 |

| Table 3  | Pests of Rice |
|----------|---------------|
| Code     | name Hama     |
| H01      | Rat           |
| H02      | Winches Trunk / sundep     |
| H03      | Golden snail  |
| H04      | Wereng        |
| H05      | Walang Sangit |
| H06      | Bird          |

| Table 4. | Symptoms Data Rice Plant Pests and Probability Value |
|----------|------------------------------------------------------|
| Code     | symptom                                              | Weight |
| GH01     | The reduced production of rice                       | 0.01   |
| GH02     | Middle leaves or shoots of plants will die           | 0.01   |
| GH03     | Rice tillers become stunted and die                   | 0.04   |
| GH04     | Malai Hampa                                           | 0.03   |
| GH05     | Shoots of rice straw becomes dry, yellow and easy to remove | 0.01 |
| GH06     | The loss of rice seeds per plant                      | 0.07   |
| GH07     | Rice discharged from the leaf to the stem of young rice | 0.03 |
| GH08     | Rice was dry, burning                                | 0.04   |
| GH09     | Rice growth becomes stunted                           | 0.04   |
| GH10     | Bending the leaves so that the plant growth appears to be normal | 0.03 |
| GH11     | Dark green leaves                                     | 0.04   |
Table 5. Weight Value Bayes

| Weight Range | Number | Value |
|--------------|--------|-------|
| 0 s / d 12:50| Not sure| 0 s / d 12:30 |
| 0:51 s / d 0.70| Less definitely| 0:31 s / d 0.60 |
| 0.71 s / d 0.90| Certainly| 0.61 s / d 0.80 |
| > 0.90| very definitely| 1 |

b. Case Study for Rice

The case of rice plant diseases that have occurred are as follows:

The value of a probability of symptoms that GP06 = 0.04 = P (E | H1), GP07 = 0.03 = P (E | H2), GP0 = 0.06 = P (E | H3).

a. calculation of Disease Leaf blight

To find out the results of the rice disease, then be calculated as follows:

GP06 = 0
GP07 = 0
GP07 = 0

Then search for the universe by summing the values of the above hypothesis:

\[ \sum_{k=1}^{5} = GP06 + GP07 + GP08 \]

= 0 + 0 + 0
= 0

Next look for the value of P (Hi) is as follows:

P (H1) = P (E | H1) / \[\sum_{k=1}^{5} = 0/0 = 0\]

P (H2) = P (E | H2) / \[\sum_{k=1}^{5} = 0/0 = 0\]

P (H3) = P (E | H3) / \[\sum_{k=1}^{5} = 0/0 = 0\]

Once the value of P (Hi) is known then the next step is:

\[ \sum_{k=1}^{5} = P (E | Hk) * P (Hk) \]

= (0 * 0) + (0 * 0) + (0 * 0)
= 0 + 0 + 0
= 0

The next step is to find the value of P (Hi E) are as follows:

P (H1 | E) = (0 * 0) / 0 = 0
P (H2 | E) = (0 * 0) / 0 = 0
P (H3 | E) = (0 * 0) / 0 = 0

After all values P (Hi E) are known, then total the entire value with the following formula:

\[ \sum_{k=1}^{5} = Bayes 1 + 2 + Bayes Bayes 3 \]

= (0 * 0) + (0 * 0) + (0 * 0)
= 0 + 0 + 0
= 0
= 0 * 100%
= 0%

b. calculation of Disease Leaf spotting

To find out the results of the rice disease, then be calculated as follows:

GP06 = 0
GP07 = 0
GP07 = 0

Then search for the universe by summing the values of the above hypothesis:

\[ \sum_{k=1}^{5} = GP06 + GP07 + GP08 \]

= 0 + 0 + 0
= 0

Next look for the value of P (Hi) is as follows:

P (H1) = P (E | H1) / \[\sum_{k=1}^{5} = 0/0 = 0\]
P (H2) = P (E | H2) / ∑ₖ=₁ P (E | Hk) = 0/0 = 0
P (H3) = P (E | H3) / ∑ₖ=₁ P (E | Hk) = 0/0 = 0

Once the value of P (Hi) is known then the next step is:
∑ₖ=₁ P (E | Hk) = P (E) = 0
= (0 * 0) + (0 * 0) + (0 * 0)
= 0 + 0 + 0
= 0

The next step is to find the value of P (Hi E) as follows:
P (H1 | E) = (0 * 0) / 0 = 0
P (H2 | E) = (0 * 0) / 0 = 0
P (H3 | E) = (0 * 0) / 0 = 0

After all values P (Hi E) are known, then total the entire value with the following formula:
∑ₖ=₁ P (E | Hk) * P (Hk)
= 0 + 0 + 0
= 0

= 0 * 100%
= 0%

c. calculation of Disease Stem rot

To find out the results of the rice disease, then be calculated as follows:
GP06 = 0.04
GP07 = 0.03
GP07 = 0.06

Then search for the universe by summing the values of the above hypothesis:
∑ₖ=₁ GP = GP06 + GP07 + GP08
= 0.04 + 0.03 + 0.06
= 0.13

Next look for the value of P (Hi) is as follows:
P (H1) = P (E | H1) / ∑ₖ=₁ P (E | Hk) = 0.04/0.13 = 0.230769
P (H2) = P (E | H2) / ∑ₖ=₁ P (E | Hk) = 0.03/0.13 = 0.230769
P (H3) = P (E | H3) / ∑ₖ=₁ P (E | Hk) = 0.06/0.13 = 0.461538

Once the value of P (Hi) is known then the next step is:
∑ₖ=₁ P (E | Hk) * P (Hk)
= (0.04 * 0.230769) + (0.03 * 0.230769) + (0.06 * 0.461538)
= 0.009623 + 0.013492 + 0.027692
= 0.046923

The next step is to find the value of P (Hi E) as follows:
P (H1 | E) = (0.04 * 0.230769) / 0.046923 = 0.147541
P (H2 | E) = (0.03 * 0.230769) / 0.046923 = 0.262295
P (H3 | E) = (0.06 * 0.461538) / 0.046923 = 0.590164

After all values P (Hi E) are known, then total the entire value with the following formula:
∑ₖ=₁ P (E | Hk) = P (E) = 0.046923
= (0.04 * 0.147541) + (0.03 * 0.262295) + (0.06 * 0.590164)
= 0.009526 + 0.013492 + 0.027692
= 0.056328
= 0.056328 * 100%
= 5.6328%

d. calculation of Disease Fusarium diseases

To find out the results of the rice disease, then be calculated as follows:
GP06 = 0
GP07 = 0
GP07 = 0

Then search for the universe by summing the values of the above hypothesis:
∑ₖ=₁ GP = GP06 + GP07 + GP08
= 0 + 0 + 0
= 0

Next look for the value of P (Hi) is as follows:
P (H1) = P (E | H1) / ∑ₖ=₁ P (E | Hk) = 0/0 = 0
P (H2) = P (E | H2) / \sum_{k=1}^{5} P (E | Hk) = 0 / 0 = 0
P (H3) = P (E | H3) / \sum_{k=1}^{5} P (E | Hk) = 0 / 0 = 0

Once the value of P (Hi) is known then the next step is:
\sum_{k=1}^{5} P (E | Hk) * P (Hk) = (0 * 0) + (0 * 0) + (0 * 0) = 0 + 0 + 0 = 0

The next step is to find the value of P (Hi E) are as follows:
P (H1 | E) = (0 * 0) / 0 = 0
P (H2 | E) = (0 * 0) / 0 = 0
P (H3 | E) = (0 * 0) / 0 = 0

After all values P (Hi E) are known, then total the entire value with the following formula:
\sum_{k=1}^{5} (0 * 0) + (0 * 0) + (0 * 0) = 0 + 0 + 0 = 0 * 100% = 0%

e. calculation of DiseaseLeaf sheaths foul

To find out the results of the rice disease, then be calculated as follows:
GP06 = 0
GP07 = 0
GP07 = 0

Then search for the universe by summing the values of the above hypothesis:
\sum_{k=1}^{5} = GP06 + GP07 + GP08 = 0 + 0 + 0 = 0

Next look for the value of P (Hi) is as follows:
P (H1) = P (E | H1) / \sum_{k=1}^{5} = 0 / 0 = 0
P (H2) = P (E | H2) / \sum_{k=1}^{5} = 0 / 0 = 0
P (H3) = P (E | H3) / \sum_{k=1}^{5} = 0 / 0 = 0

Once the value of P (Hi) is known then the next step is:
\sum_{k=1}^{5} P (E | Hk) * P (Hk) = (0 * 0) + (0 * 0) + (0 * 0) = 0 + 0 + 0 = 0

The next step is to find the value of P (Hi E) are as follows:
P (H1 | E) = (0 * 0) / 0 = 0
P (H2 | E) = (0 * 0) / 0 = 0
P (H3 | E) = (0 * 0) / 0 = 0

After all values P (Hi E) are known, then total the entire value with the following formula:
\sum_{k=1}^{5} (0 * 0) + (0 * 0) + (0 * 0) = 0 + 0 + 0 = 0 * 100% = 0%

From the calculation above, it can be concluded based on the Bayes is the plant's largest rice disease

Stem rot with a percentage value 5.6328%.

5. Conclusion

Based on the formulation and discussion of the previous chapters can be concluded as follows: Indesigning the application of expert system to diagnose diseases and pests of rice plants using Bayes Theorem, firstly we have the first set of disease symptoms and hamanya, then determine the data of diseases and pests of rice plants, and then determine the type of rice plant that will serve as the object in diagnosing diseases and pests, and then did rule base assessment and final diagnoses of the data of rice plants there is. The system has been designed further implemented by entering the data
corresponding to that of the previous chapters, kemudian if the results of its output in accordance with the data manually then in this assay system is running well, add data to the database, the update command to change the data in the database, the delete command to delete data in the database.

6. Reference

[1] Zulfian Asmi and Verdi Yasin, 2017, "Introduction to Expert Systems and Methods", Jakarta: Partners Media Discourse

[2] Hengki Tamando Sihotang, 2018, "Expert System To Diagnose Disease in Maize With Bayes Method", Journal Of Informatic Pelita Nusantara, Vol. 3 (No. 1), 2

[3] Intan Purnama Sari, Mohammad Yunus and Hasryanty, 2015, "Some Genotype Resistance Against Attacks Banggai local rice brown planthopper (Nilaparvata lugensSTALL) (Hemiptera: DELPHACIDAE)", EJ Agrotekbisnis, Volume 3 (No. 4), 2

[4] Sri Wulandari, Fajrion Muhammad Noor, Kusrini and Ajie Kusuma Ward, 2019 "Expert System of Rice Pest and Disease Diagnosis Using Bayesian Methods", Journal Informatic Pelita Nusantara, Vol. 3 (No. 1), 2

[5] Barus, Verawati Monica., Et al., (2017). "Expert System for Diagnosing Plant Pests At Guava Using Bayes Method." INFOTEK Journal, Vol. 02 No. 01

[6] Hartatik, and I Ketut Putra Yasa., (2015). "Expert System To Detect Plant Pests Terorema Ginger Using Bayes." TIE Scientific Journal Vol. 16 No. 2

[7] Utami, Ardhini Warhi., Ricco Shehelmiaji Son., (2015). "Identification of Plant Disease Expert System Onion Method Using Bayes’ Theorem.", Journal of Information Management, Vol. 04 No. 04

[8] Wahyudi, Muhammad Johan., Abdul Fadill., (2013). "Expert System For Detecting Udang Galah with Terorema Bayes, "Journal of Information Engineering Bachelor Vol. 1 No. 2

[9] Bima Satria, Masrul Erwin Harahap, Jamilah, (2017), "Increasing Productivity of Rice (Oryza sativa. L) Through Application Some Plant Spacing and Cropping Systems," Journal of Agro-FP USU, Vol. 5 No. 3

[10] Fita Anggriani, Agus Suryanto, Nurul Aini, (2013), "Age of the System and Plant Seed Rice Rice (Oryza sativa. L) Varieties Inpari 13", Journal of Crop Production, Vol. 1, No. 2