EDUMASPUL
JURNAL PENDIDIKAN
Vol. 7 – No. 1, year (2023), page 1336-1340
| ISSN 2548-8201 (Print) | 2580-0469) (Online) |

Naïve Bayes and Laplacian Correction Method in Agrarian Application of Vegetable Crops

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Receive: 10/01/2023	Accepted: 10/02/2023	Published: 01/03/2023

Abstract

Indonesia is one of the agricultural countries with the livelihood of the population coming from agro-industrial agriculture. Onfarm agricultural activities, commodities that are widely cultivated are vegetable and fruit crops. The problem that occurs at this time is that physically the vegetables grown experience failure and a decrease in the quality of growth. Socially, many people complain about the quality of vegetables in the market, and this has an impact on the economic decline of farmers. For this reason, this research aims to assist farmers in classifying their land information data. The data classification is a web-based application that will process data in the form of soil type, soil texture, soil pH, temperature, rainfall, soil fertility, soil moisture, altitude, wind speed and sunlight. The data processing uses the Naïve Bayes and Laplacian Correction methods. The trial was conducted in Padang Panjang City, West Sumatra, Indonesia. The results of this research are in the form of a web-based Vegetable Crop Agrarian application. test data used as much as 27 data on the types of vegetables that have the potential to be planted in Padang Panjang City and produce the most recommended crops, namely Radish vegetables. This interprets that the application can be built well and presented as an alternative in helping farmers before planting crops in Indonesia.

Keywords: *Naïve Bayes, Laplacian Correction, Data Mining, Agriculture, Vegetable Specifier*

Introduction

Indonesia is one of the largest agricultural countries in the world. For example, the city of Padang Panjang is an agricultural city with the main livelihood of the population coming from agriculture (Widyawati, et al., 2022). Agriculture is the cultivation of plants in a land to meet human needs (Apriyani, et al., 2021). The main activity in Padang Panjang city is onfarm agriculture. Onfarm agriculture which is widely commoditized is the cultivation of vegetables and fruits.

In production, vegetable and fruit plants function as traps, which capture solar energy, mineral nutrients, and heat. Plants that obtain these substances will be fertile and produce high economic value (Reski & Budayawan, 2021). Like vegetable plants that have economic value if they have good shape, size, and quality (Alifah et al., 2019). Organically grown vegetables generally do not contain chemical residues in them, (Tasrif et al,, 2019). Therefore, vegetable crops should be grown organically. However, the next problem that arises is the determination of the type of vegetables that are suitable on a land.

The Department of Agriculture in determining crops suitable for agriculture conducts an assessment of the criteria of a land. The criteria of a land are soil type, soil texture, soil pH (acidity), temperature, rainfall, soil fertility, soil moisture, altitude,

wind speed, sunlight and plants (Hidayat et al., 2021). However, it is very difficult to be mastered and calculated manually by every farmer. This makes many farmers do vegetable planting only with the try and error method. This all makes an impact that is not good for farmers, both the impact of trial failures and the quality of the results of vegetable planting trials that decrease.

Furthermore, there is no standardized method to support the decision to determine whether land is suitable for planting certain types of vegetables. Previous researchers have done this research to solve these problems. Like Apriani e al (2021) who developed a Decision Support System for Determining Vegetable Commodities Based on Land Characteristics Using the Promethee Method (Alifah, Nurfida, & Hermawan, 2019). However, from this research there are still shortcomings in terms of calculating soil type, soil moisture, soil texture, soil fertility, and the level of sun exposure.

The five criteria are very influential criteria in the management of vegetables on a land. This is because the soil is a medium for growth and sunlight that helps plants to carry out photosynthesis. Therefore, this research aims to propose a decision support system with a novelty in the selection of plant species on a land. The novelty is the combination of Naïve Bayes and Laplacian Correction methods in providing a good recommendation for suitable types of vegetables on a land.

Research Methods

1. Naïve Bayes

Naïve Bayes is one of the algorithms found in classification techniques. This algorithm is a classification with probability and statistical methods proposed by Thomas Bayes, namely by predicting future opportunities based on previous experience (Widyawati et al, 2022). Naïve Bayes classification assumes that the presence or absence of certain characteristics of a class has nothing to do with the characteristics of other classes. The equation of Bayes' Theorem can be seen in formula (1).

$$P(C|X) = \frac{P(X|C).P(C)}{P(X)} \quad \text{.....}$$

X : Sample data that has an unknown class (label). C: Hypothesize that X is class data (label).
P(C) : Probability of hypothesis C
P(X) : The probability of the observed sample data (probability C). P(X|C)
: Probability based on the condition in the hypothesis.

Each category needs to be used carefully according to the stages of using the Naïve Bayes method. The flow of using the Naïve Bayes method is as follows.

a. Calculate the new case probability value of each hypothesis with the existing class (label) "P(Ci)".
b. Calculate the accumulated probability value of each class "P(X|Ci)".
c. Calculates the value of P(X|Ci) x P(Ci).
d. Determine the class of the new case.

Formula (1) explains that the probability that a sample of a certain characteristic will be included in class C (posterior) is the probability of class C occurring (before the entry of the sample, often called prior), multiplied by the probability of occurrence of the sample characteristics in class C (also called likelihood), divided by the probability of occurrence of the sample characteristics globally (also called evidence). Therefore, the formula can also be solved as follows (2).

$$Posterior = \frac{Prior\ x\ Likehood}{Evidence} \quad \text{.....}$$

The evidence value is always fixed for each class in a sample. The posterior value will later be compared with the posterior value of other classes to determine what class a sample will be classified (Reski & Budayawan, 2021).

2. Laplacian Correction

Laplacian Correction (or Laplace Estimator) is a way to handle 0 (zero) probability values. Based on a lot of data in the training set, in each calculation the data

is added 1 (one) and will not make a significant difference to the probability estimate so that it can avoid the case of a probability value of 0 (zero) (Randa, 2023). The "justified" probability result is not much different from the previous probability result so that the probability value of 0 (zero) can be avoided (Hidayat et al., 2021).

Result And Discussion

1. Research Results

As training data, 27 data on the challenge of several types of vegetables in a field in Padang Panjang were tested.

Table 1. Training data calculation results

No	Vegetable Name	Calculations	Results
1	Potatoes	0,0001/0,00268	0,0423
2	Onion Leaves	0,0003/0,002689	0,1159
3	Hybrid Chili	2,1595/0,002689	0,0080
4	Local Eggplant	1,1301/0,002689	0,0042
5	Celery	1,3277/0,002689	4,9370
6	Red Onion	3,1864/0,002689	0,0011
7	Long Beans	6,8665/0,002689	0,0025
8	Tomatoes	7,8220/0,002689	0,0002
9	Carrots	0,0002/0,002689	0,0799
10	Caisim	2,7466/0,002689	0,0102
11	Sweet Corn	5,0625/0,002689	1,8825
12	Kailan	1,3733/0,002689	0,0051
13	Kapri	1,3733/0,002689	0,0051
14	Cabbage	1,2257/0,002689	0,0045
15	Siamese Pumpkin	0,0001/0,002689	0,0459
16	Cucumber	0,0001/0,002689	0,0459
17	Radish	0,0004/0,002689	0,1792
18	Garlic	1,2060/0,002689	0,0044
19	Melinjo	0,0008/0,002689	0,3102
20	Cauliflower	6,1798/0,002689	0,0229
21	Kale	2,0412/0,002689	7,5905
22	Kool	4,1199/0,002689	0,0153
23	Lembayung	6,1798/0,002689	0,0229

The highest value in the results of the probability of likehood calculation is 0.17927, so the suitable vegetable to be planted on farmland according to the input of application users is Radish. The application form of this calculation is as follows.

a. Log in page

To log into an application usually as a user must input identity information as a user, user information using e-mail and password.

Figure 1. Log in Page Display

b. Training Data Menu

When the user selects the training menu, the application display will be as shown in Figure 2.

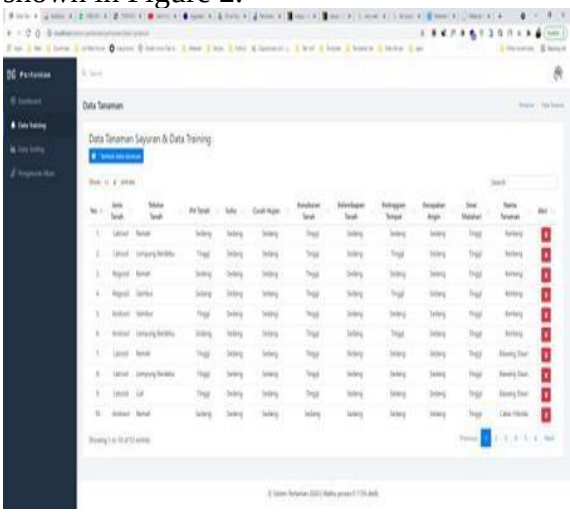

Figure 2. Training Data Menu

This menu contains data on vegetable plants and if you want to delete data, you

can press the delete button. When the user clicks the delete button on the action, a notification will appear "are you sure you want to delete this data?" then select ok or cancel.

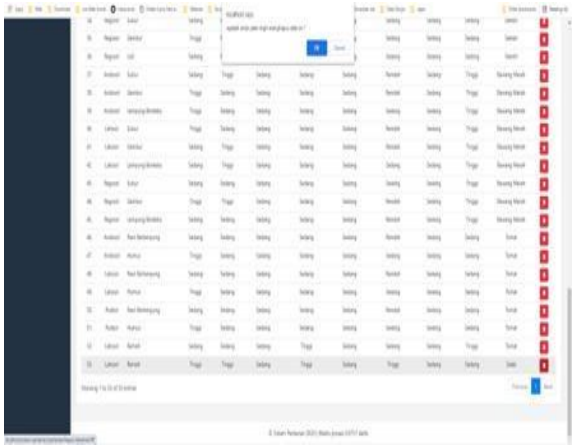

Figure 3. Delete Trining Data Process

In the above display if the user clicks the ok button before the delete button then it will appear "plant data successfully deleted" then the plant data has been successfully deleted in the database.

c. Testing Data Menu

When the user selects the testing data menu, the display will look like Figure 4. Users can add testing data and perform View and delete actions on this page.

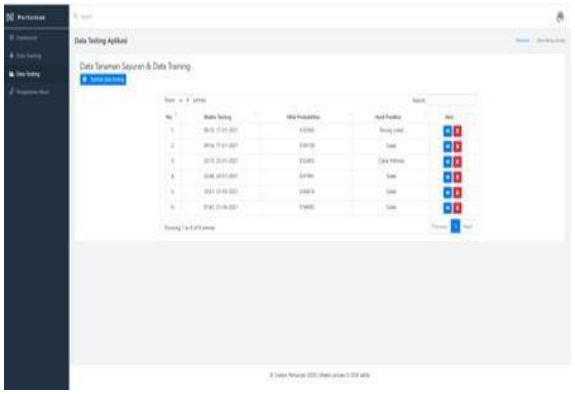

Figure 4. Testing Data Menu Page

In the testing data, there is a feature to add testing data, users can add the desired testing data. There is an add testing data and reset button on the system as shown in Figure 5.

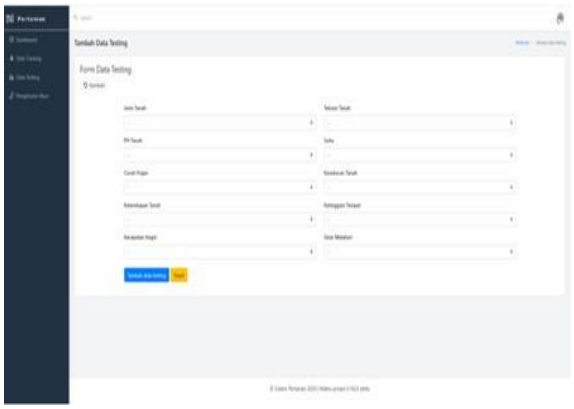

Figure 5: Add Testing Data Feature

If the user clicks the add testing data button, a notification will appear "data successfully added" where the data added by the user has been successfully stored in the database.

d. Testing Result Data Menu

If the user presses the detailed testing data button, all calculations and vegetable determination diagrams will be displayed as shown in Figure 6.

Figure 6. Detail of Testing Data

Discussion

The Agrarian Application of Vegetable Crops has been successfully developed. In the Agrarian Application of Vegetable Crops, classification accuracy testing is carried out to determine the level of accuracy of plants carried out by the system using the Naïve Bayes method along with the Laplacian Correction data checking method. Testing is done using a data table of predictions that will be compared with the original class of input data, (Amirah, Ramadani, & Novriyenni,

2022; Edde & Budayawan, 2021; Heriansyah, & Magdalena, 2023).

Testing will be done using 10 classifications and determining the highest probability value of each plant's data. The Naïve Bayes calculation results are then followed by verification of the division value if it is 0 using laplacian correction. The process results from the laplacian correction result data which determines the highest value of each process. Then the highest value of data processing is Radish data. This result is obtained after processing is selected using the Naïve Bayes method and the Laplacian Correction selection method, (Budayawan, 2019; Fajra et al., 2022; Indrajaya, 2018).

In this application anyone can access the system by registering first. After registering, users can determine the conditions and find what plants should be planted based on the conditions that have been inputted, (Budayawan et al., 2019; Suardika, 2019; Tasrif et al,, 2019). The advantages of the application can determine what plants are worth planting based on certain conditions. The information displayed is as interesting as possible with the use of tables, and graphs. Apart from that, the use of website-based applications allows users to use the application anywhere and anytime, (Huda, Ardi & Mubai, 2021; Telaumbanua et al., 2022).

Conclusion

The application of agrarian application of vegetable crops using Naïve Bayes and Laplacian Correction methods was successfully developed. Testing of this application in determining vegetables that are suitable for planting on a land is successfully implemented in the form of a web-based application. Tests were carried out on data as many as 27 types of vegetables that can be planted in the Padang Panjang city area, Indonesia. The classifications used are soil type, soil texture, soil pH (acidity), temperature, rainfall, soil fertility, soil moisture, altitude, wind speed, sunlight and plants. test results in the form of recommendations for planting Radish vegetables are very precise and approved by farmers. Therefore, the application of agrarian application of vegetable crops is suitable for use as a system to assist farmers in determining the type of vegetable or fruit crops that they will plant.

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