NEWTON: Networking and Information Technology
Vol. 4 No. 2 October 2024, Page. 57 - 64
E-ISSN: 2797-0728

Web-based Information System for Matching Fertility and Soil pH with Plant Types

Sujono. [1*], Siti Sufaidah [2], Firda Arya Dinata[3]
[1]Informatika, Universitas KH. A. Wahab Hasbullah
[2] Sistem Informasi, Universitas KH. A. Wahab Hasbullah
[3] Informatika, Universitas KH. A. Wahab Hasbullah

*Email: sujono@unwaha.ac.id
Email: idasufaidah@unwaha.a.id
Email: firdaaryadinata05@gmail.com

ABSTRACT
A web-based information system for matching fertility and soil pH with plant types is an innovative agricultural solution aiming to increase crop yields. This research focuses on the compatibility between soil conditions and the type of plant grown, where pH and soil nutrition are key factors. Many farmers do not have access to adequate information about the condition of their land, so planting is often not optimal. Through this system, farmers can easily access recommendations for plant types that suit their soil conditions, resulting from analysis of soil pH and fertility data.

***Keywords**: Information system, soil pH, fertility, plant types, web-based.*

INTRODUCTION

The agricultural sector plays a crucial role in the economies of many countries, including Indonesia. Optimizing agricultural yields requires a deep understanding of various environmental factors, especially soil conditions. Two key parameters that significantly affect soil fertility are pH levels and nutrient content. Matching soil conditions with suitable plant types is essential to ensure optimal plant growth and maximize crop yields.(Vien et al., 2023)

The importance of soil pH and fertility lies in the fact that soil pH is a measure of the soil's acidity or alkalinity, which greatly influences the availability of nutrients for plants. Soil that is too acidic or too alkaline can hinder nutrient absorption by plants. Each type of plant has an optimal soil pH range in which it can grow well..

A web-based information system can be an effective solution for providing recommendations on suitable plant types for specific soil conditions. Farmers can easily access information about soil suitability for various plant species based on soil pH and fertility data through this system.

Using a web platform allows the data to be visualized in numerical form, making it easier for farmers or users to understand the presented information. It also simplifies the monitoring of soil content by displaying values for the parameters being monitored. The use of a web-based system is essential because it allows farmers to access the information anytime and anywhere. The system is expected to provide continuously updated real-time data and also offer manual CRUD input options..

The waterfall development methodology was chosen and used in the creation of this system. This method was selected because it involves a sequential development process or phases, starting with Requirement Analysis, followed by System Design, Implementation, Integration, and Testing, Operation and Maintenance, and finally, Conclusions and Recommendations. Testing results will be analyzed to ensure they meet the system's requirements before proceeding to the next phase.(Fauzan, 2008).

METHOD

1. Research Methodology for Developing a Web-Based Soil Fertility and pH Matching Information System with Plant Types
2. Requirement Analysis: This involves conducting observations, interviews, document analysis, and literature review to gather precise and accurate information about the requirements for the

web-based information system that matches soil fertility and pH levels with plant types.
3. System Design: Designing the system using flowcharts, Data Flow Diagrams (DFD), and table relationships to explain the basic abstractions of the software to be developed.
4. Implementation: Implementing the system design into code using PHP programming language and MySQL database.
5. Integration and Testing: Integrating all the program code into a complete system and conducting testing to identify and fix any errors.
6. Operation and Maintenance: Maintaining the system to fix any undetected errors from the previous stages and ensuring the system continues to function correctly

RESULT AND DISCUSSION

Analysis Results

1. Introduction to Analysis
   This research aims to develop a web-based information system to match plant types with soil conditions based on temperature, humidity, and soil pH. The system integrates sensor data with CRUD features for manual input, allowing users to determine the most suitable plants based on measured soil conditions
2. Metodologi
   a. Data Search by Plant Type: This feature allows users to search for soil temperature, humidity, and pH values based on the desired plant type.
   b. Sensors and Measurements: The system uses sensors to measure soil temperature, humidity, and pH, which are crucial for determining optimal plant growth conditions.
   c. Manual CRUD System:
      - Create: Add new data manually.
      - Read Access stored data for analysis.
      - Update: Modify data based on changes in soil conditions.
      - Delete: Remove unnecessary data.
   d. Plant Matching: Data from CRUD inputs or sensors are analyzed and compared with optimal plant parameters to provide plant recommendations based on soil conditions.
3. Results and Discussion
   a. Search Feature: The system successfully identified optimal temperature, humidity, and pH values for various plant types. For example, search results showed the optimal values for corn, chili peppers, tomatoes, sugarcane, and peanuts according to the entered parameters.
   b. Sensor Measurement Results: Sensor data revealed a range of values for temperature (20°C - 30°C), humidity (40% - 70%), and pH (5.5 - 7.5) depending on location and environmental conditions.
   c. CRUD System Performance: The CRUD system effectively managed the storage, handling, and updating of data. Manual input provides an option to correct data when sensors are not available.
   d. Plant Matching: The matching algorithm proved effective in recommending plants based on soil conditions. For example, corn is suitable for a soil pH of 5.6 with a temperature of 25°C and humidity of 80%.

System Design Results

1. System ERD Planning
   Here’s the translation for designing the Entity-Relationship Diagram (ERD) for your web-based information system:
   Designing an Entity-Relationship Diagram (ERD) for a website system is a crucial step in database development. Below is the ERD for a web-based information system that manages soil pH, soil moisture, and soil temperature while determining suitable plant types:.(Fauzan, 2008).

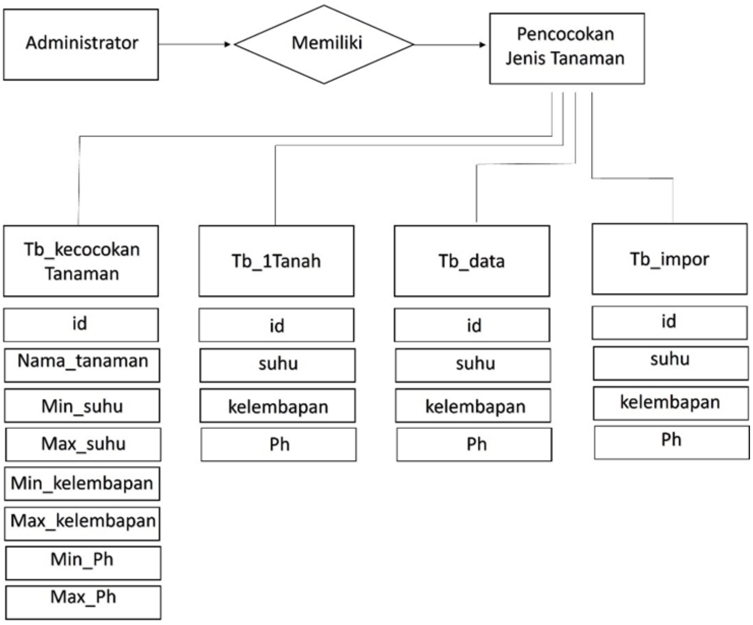

Figure 1. System ERD Planning

2. Designing the DFD (Data Flow Diagram)
   Data Flow Diagram (DFD) is a graphical tool used to illustrate the flow of data within an information system. DFD shows how data moves from one process to another and how data is stored within the system..(Prasetyo et al., 2016)
3. DFD is a type of diagram designed to serve as an abstraction view, showing the system as a single process and its relationship with external entities.

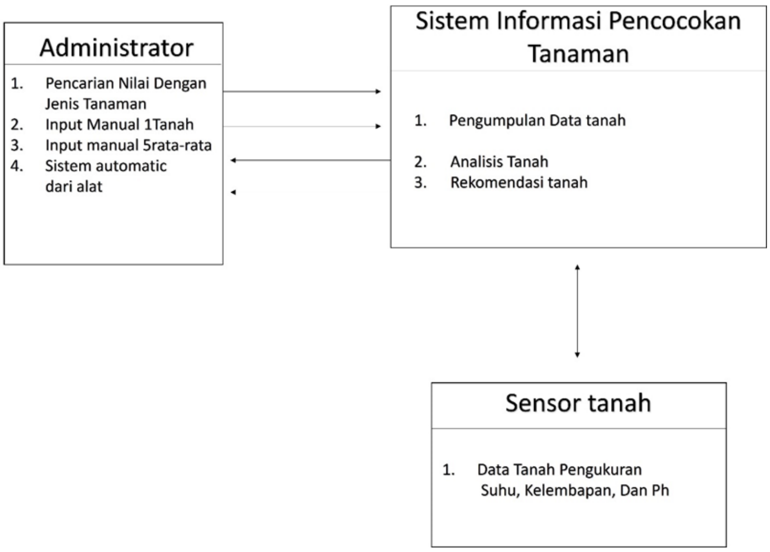

Figure 2. Designing the Data Flow Diagram

4. At Level 1 of DFD
   At Level 1, we detail the main process from the Context Diagram into more specific sub-processes. Below is the Level 1 DFD for the plant matching information system based on soil pH, soil temperature, and soil moisture values..

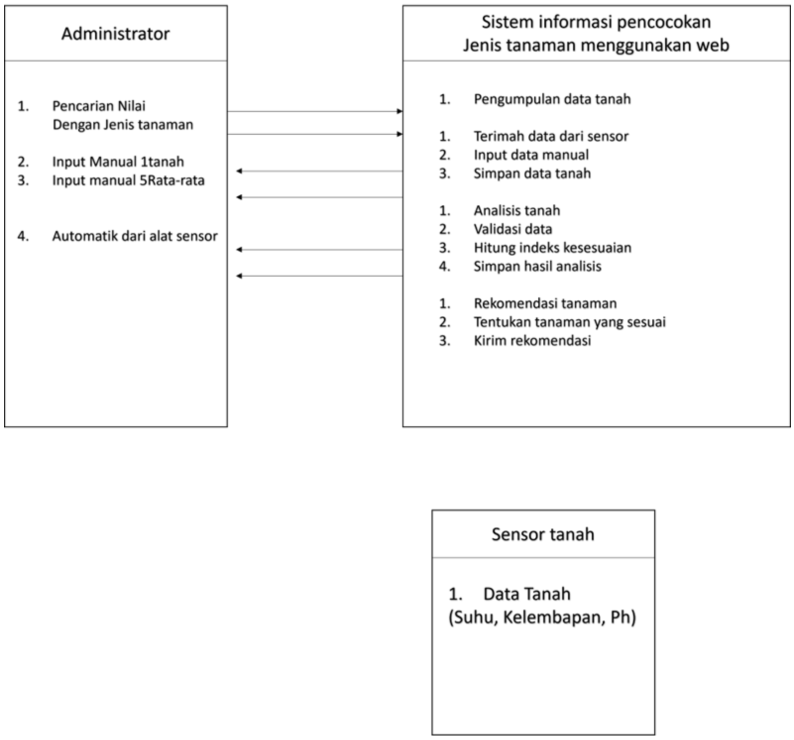

Figure 3. Level 1 of DFD

5. Process Flow in the Software System / Flowchart

   When the Start process is initiated, it initializes the data and then checks the input data received from the sensor devices. This input data is then stored in the database. The next step involves calibrating the data from the database to determine soil parameters such as soil pH, temperature, and moisture. After determining these soil parameters, the system will match them with the plant types programmed into the web system. If a suitable plant match is found, the soil parameter values and the corresponding suitable plant types will be displayed on the created website.

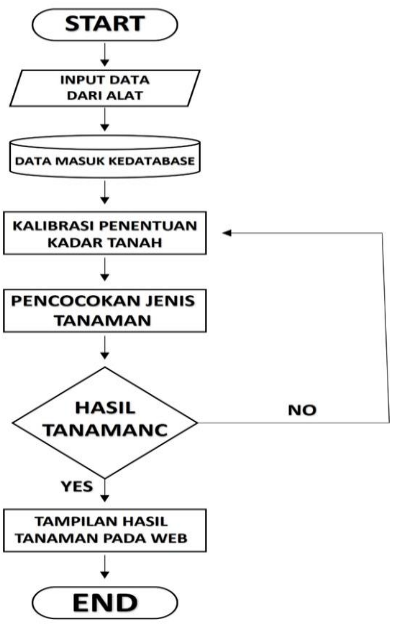

Figure 4. Prose Flow of DFD

6. Database Creation Procedure
   For the creation of the database used as a data source in the information system, it consists of several tables, which are categorized as follows:
   a. Static Tables
      Static tables are tables in the database where the data does not frequently change or get updated.
   b. Dynamic Tables
      Dynamic tables are tables in the database where the data is frequently changed or updated..
7. Table Structure Design in the Database
   Table Design is the design intended to manage table data and store information that will later be processed for report generation. Below are the tables used:
   a. Plant compatibility table
      The plant compatibility database table stores essential information related to accurate values of temperature, humidity, and pH needed to determine the types of plants that have been entered into the database.

Table 1. Structure Design in the Database

No	Name	type	invaluable	Extra
1.	ID	int	no	A. I
2.	name_plant	Varchar	Yes	
3.	min_temp	Decimal (5,2)	Yes	
4.	max_temp	Decimal (5,2)	Yes	
5.	min_humid	Decimal (5,2)	Yes	
6.	max_humid	Decimal (5,2)	Yes	
7.	min_ph	Decimal (5,2)	Yes	
8.	max_ph	Decimal (5,2)	Yes	

   b. Table 1 of Soil
      The 1soil database table stores data input from the website (manual input) that is used to match plant types created in the program. However, this determination is only for identifying the suitable plant type for a single soil condition.

Table 2. The Soil Database Table Store

No	Name	type	invaluable	Extra
1.	ID	int	no	A.I
2.	Temperature	Decimal (5,2)	Yes	
3.	humidity	Varchar	Yes	
4.	pH	Decimal (5,2)	Yes	

   c. Table data
      The data database table stores data input from the website (manual input) that is used to match plant types created in the program. This table is designed for a program that determines the suitable plant type based on the average values of five different soil types.

Table 3. Data Database

No	Name	type	invaluable	Extra
1.	ID	int	no	A.I
2.	temperature	Decimal (5,2)	Yes	
3.	humidity	Varchar	Yes	
4.	pH	Decimal (5,2)	Yes	

d. Table of input
The imput database table stores data collected automatically from sensor devices, including values such as temperature, humidity, and pH. Additionally, this data can be used to determine the suitable plant type, but only based on the 1tanah determination.

Table 4. Table of Input

No	Name	type	invaluable	Extra
1.	ID	int	no	A.I
2.	temperature	Decimal (5,2)	Yes	
3.	humidity	Varchar	Yes	
4.	pH	Decimal (5,2)	Y	

8. Implementasi interfaces sytem
The implementation of the system interface is carried out on each page or view created in the plant matching system for temperature, humidity, and pH. The interfaces include the following views:
a. Home and About Pages

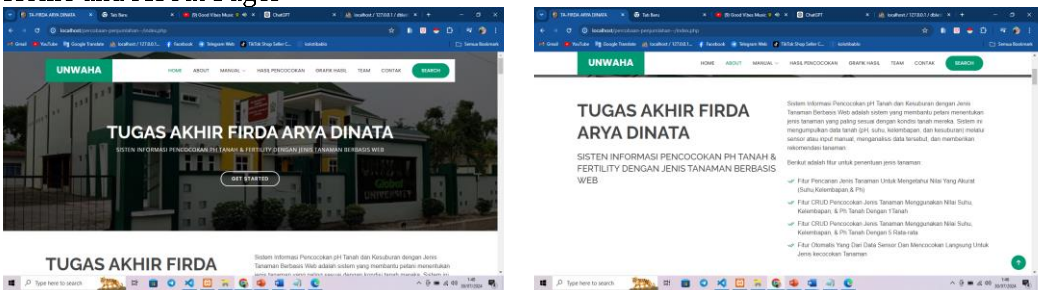

Figure 5. Home and About Pages

b. Search Interface for Plant Types and Manual CRUD for 1tanah, and Determining Suitable Plants

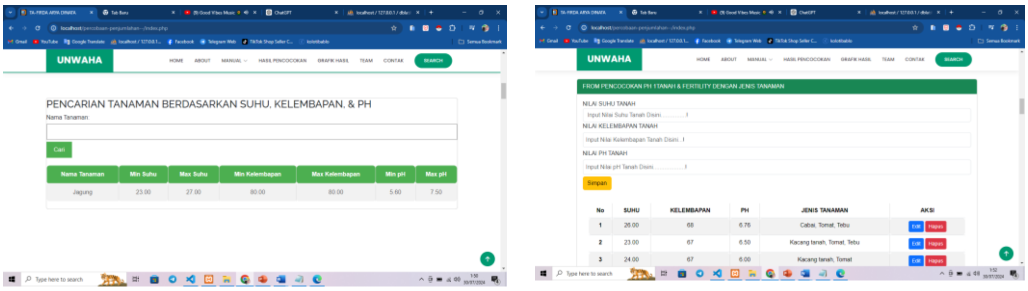

Figure 6. Interface of Plant Type and Manual CRUD

c. CRUD Interface for Average of Five Soil Types, Results from Averages, and Matching Detected Plant Types

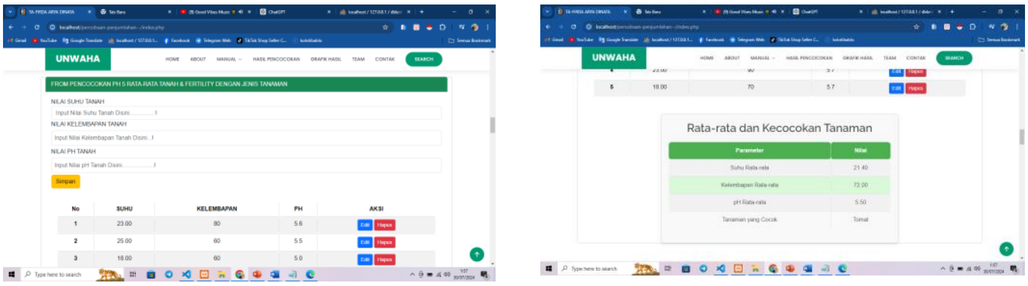

Figure 7. CRUD Interface of Five Soil Types

d. Interface for Sensor Matching Results and Graphs from Sensor Data Database

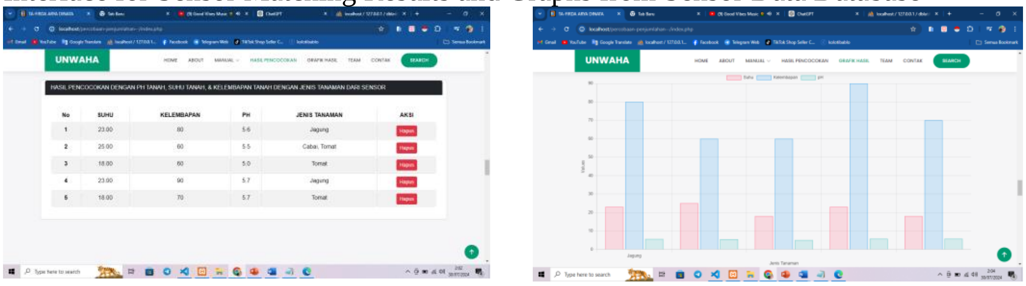

Figure 8. Interface for Sensor Matching Result and Graphs

9. System Testing

After the system development process is complete, the next crucial step is to test the developed system to ensure that the web system functions correctly and is free from errors. This testing is conducted using the black-box method.(Gobel & Adam, 2021)

The black-box method focuses on functional testing of the application, aiming to evaluate whether all features and functions of the web application work as expected, without considering the internal code structure. The web system testing with this method can be seen in the following table.

Table 5. Web System testing

No	Jenis Pengujian	Hasil Yang Diharapkan	Hasil Pengujian	Ket
1.	CRUD Dengan Pencarian Jenis Tanama	Hasil pencarian nilai suhu, kelembapan, dan ph. Menggunakan jenis tanaman	Pencarian dengan jenis tanaman dan muncul nilai suhu, kelembapan, dan ph.	Sesuai
2.	CRUD Input Nilai Manual	Tabel input manual dan data masuk ke database	Tabel input manual dan sudah bisa tersimpan di database	Sesuai
3.	Pencocokan Jenis Tanaman Otomatis	Pencocokan jenis tanaman menggunakan nilai dari database yang sudah tersimpan dan tampil di system web	Hasil system website sudah tampil sesuai data yang tersimpan di database dan sudah muncul jenis tanamannya	Sesuai
4.	CRUD Input Manual Dengan 5 Nilail Rata-rata dan muncul 1 nilai setelah itu muncul jenis tanaman yang sudah di program	CRUD input manul dan hasil nilai dari 5 rata-rata yang tersimpan dan muncul nilai 1 dari setiap nilai suhu,kelembapan, dan ph	Tabel CRUD input manual dan hasil 5 rata-rata sudah muncul jadi 1 nilai dan mencocokan otomasi jenis tanaman	Sesuai
5.	Pengiriman Data Dari Sensor Dan Pencocokan Jenis Tanaman	Data dari sensor mengirim dan menyimpan di database setelah itu muncul jenis tanaman yang cocok.	Hasil data yang sudah terkirim dan menyimpan sudah tampil di web dan otomatis muncul jenis tanaman yang cocok	Sesuai
6.	Grafik Data Dari Sensor	Data dari database yang tersimpan dari sensor muncul grafik dengan nilai dan jenis tanaman di bawah grafik	Grafik sudah muncul di system web dari database, tetapi jenis tanaman masih Sebagian yang terbaca dibawah	Tidak sesuai

The testing results also indicate that the developed application has good functional accuracy and operates effectively, meaning that the web system is well-suited for implementing an information system for matching soil pH and fertility with plant types.

CONCLUSIONS

In this research, a web-based information system for matching soil fertility and pH with suitable plant types has been successfully designed and implemented. The primary goal of this system is to assist farmers or other users in determining the most appropriate plant types to grow based on their soil parameters, such as pH, temperature, moisture, and fertility.

REFERENCES

Fauzan, R. M. (2008). Perancangan Sistem Pemesanan Produk Berbasis Web pada CV. Hanif Niaga Group. In *Program Studi Teknik Informatika Fakultas Sains Dan Teknologi Universitas Islam Negeri Syarif Hidayatullah Jakarta*.

Gobel, C. Y., & Adam, N. (2021). E-Commerce Pemasaran Hasil Panen Komoditas Pertanian Menerapkan User Centered Design. *Jurnal Media Informatika Budidarma*, *5*(4), 1519. https://doi.org/10.30865/mib.v5i4.3125

Prasetyo, N. D., Supratman, D., Ahmad, W., Fauzi, H., & Murti, S. (2016). Perancangan Sistem Informasi E-Farming Berbasis Web Untuk Mengetahui Tingkat Kelayakan Panen Pada Sektor Pertanian. *Seminar Nasional Aplikasi Teknologi Informasi (SNATi)*, 1907–5022.

Vien, B. H., Hadary, F., & Yurisinthae, E. (2023). Sistem Monitoring pH Tanah, Suhu dan Kelembaban Tanah pada Tanaman Jagung Berbasis Internet Of Things (IOT). *Jurnal Teknik Elektro*, *11*(1), 1–9.