

Vasu Vaidya :- An AI-Powered Sustainable Farming Ecosystem and Insights For Soil & Crop Health .

Theme: agricultural_technology

ID: DEG2026-23279



Project Overview

CURRENT STAGE

Testing Phase

OBJECTIVE

The goal of VASUDHA is to provide real-time soil intelligence using AI and IoT to optimize fertilizer type, quantity, and timing, reduce fertilizer overuse, predict crop yield, and build a complete farming ecosystem offering step-by-step guidance to farmers while promoting sustainable agriculture and healthier soil.

ABSTRACT

VASUDHA is a smart farming solution using AI technology that optimizes hardware and software components to provide real-time soil intelligence. The portable IoT soil test kit will examine different factors of the soil, while the Geo-Mapping feature will provide immediate computerized soil analysis reports. The AI & Deep Learning component maximizes fertility (type of fertilizer, amount of usage, costs, & timing) & determines crop yield through End-to-End Farming Assistance, including Crop Sowing & Plantations. The AI ChatBot will provide immediate instructions through sustainable, health-evolved soils & unemployed fertilizers.

PROBLEM STATEMENT

India faces severe soil degradation, expensive traditional soil testing methods, and widespread fertilizer overuse, leading to environmental damage, health risks, and significant economic losses. Farmers often lack access to affordable, timely, and portable soil testing hardware, resulting in delayed or high costing soil analysis. This causes poor fertilizer application, soil depletion, unpredictable crop yields, and reduced productivity. To address these challenges, there is a crucial need for a smart, AI-driven solution combining portable IoT soil testing hardware, real-time soil intelligence, optimized fertilizer recommendations, crop yield prediction, and comprehensive farming guidance to promote sustainable agriculture and safeguard farmers' livelihoods.

PROPOSED SOLUTION

Experience technology, driven farming at its best with VASUDHA, a comprehensively smart farming solution. It is a unique blend of best hardware technologies along with the latest software that helps in addressing the fundamental issues in farming. One of the most important features of the system is the provision of an IoT, based soil testing kit. It allows farmers to carry out testing of soil parameters on their farms by using the most accurate and real, time data, thereby drastically cutting down the necessity for lab tests and consequent inaccurate analyses. The system uses geo, mapping technology to generate soil reports that reveal not only the overall health of the soil but also the levels of nutrients available and any deficiencies present. Based on these reports, AI deep learning engines deliver fully optimized recommendations regarding the most efficient use of fertilizers, thus avoiding overuse, lowering environmental pollution, and keeping the cost to a minimum. Additionally, the data models of this system generate yield predictions that facilitate resource planning. The VASUDHA system is further equipped with AI, Powered Chat, Bots that provide personalized expert guidance to farmers at every stage of farming, from planting to harvesting.



Technical Architecture

METHODOLOGY

Soil data are in situ collected using a portable IoT soil testing kit that

WORKING MECHANISM

How VASUDHA Works

measures nitrogen, phosphorus, potassium (NPK), pH, electrical conductivity, moisture, and temperature. This process does not require any laboratory-based testing.

Every collected soil sample is geo-tagged for accurate geo-mapping, allowing studies of particular regions and generating digital soil maps. Sensor readings are broadcasted directly by employing ESP32 microcontrollers via cloud services such as Thingspeak for secure data storage and real-time monitoring.

Analytical models identify nutrient deficiencies, analyze soil patterns, optimize fertilizer type, quantity, timing, and cost, and predict crop yield. This, in turn, makes the fertilizer recommendation engine produce personalized, crop-specific, and cost-effective nutrient management plans, balancing organic and inorganic inputs to minimize the risk of overuse.

Digital soil reports communicated via email give local language outputs on soil health scores, nutrient visualizations, and recommendations. Real-time guidance on sowing, fertilization, crop management, and harvesting is delivered through an AI-powered chatbot. Continuous learning from historical data and farmer feedback supports adaptive, scalable, and accurate system performance.

1. Soil Testing using IoT Hardware:

The farmers employ a portable IoT kit for testing the soil. This kit will enable the farmer to take tests from the soil to determine its parameters such as pH, moisture, and other components. The parameters include nitrogen, phosphorus, potassium, and other nutrients.

2. Data Transmission to Cloud:

The soil information is transmitted through IoT connectivity to a cloud database, which ensures safe storage and easy access for processing by AI.

3. AI & Deep Learning Analysis:

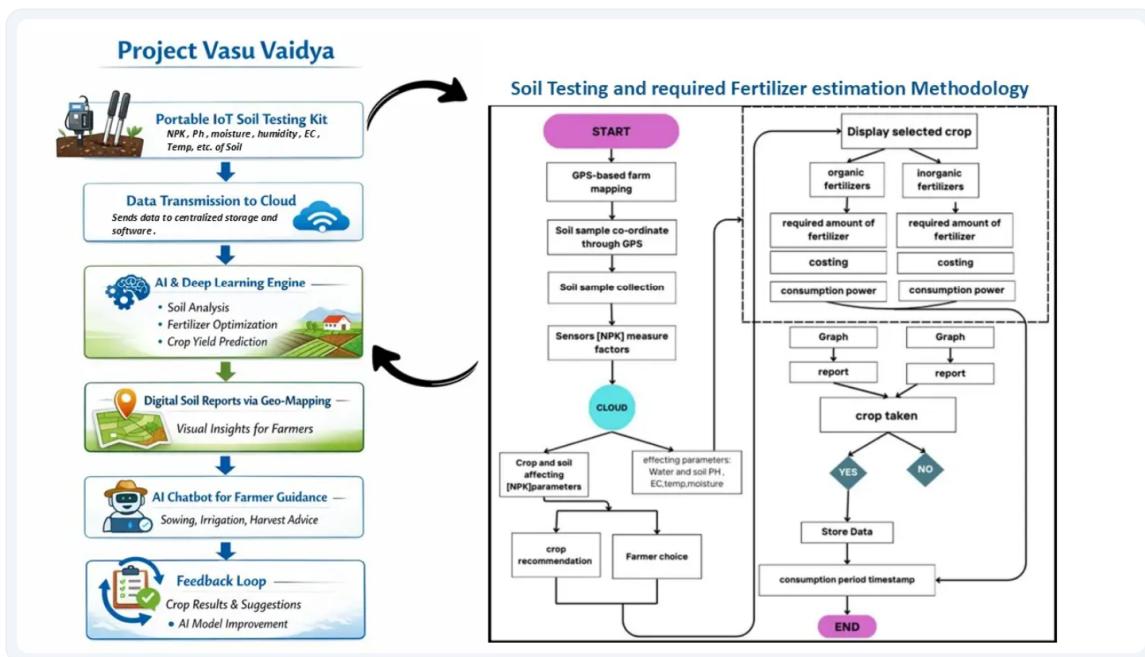
The data is processed by the AI engine for the preparation of digital soil maps, suggesting the suitable fertilizer type, quantity, timing, and cost, along with predicting crop yields based on soil health, weather, and past data.

4. Agriculture An AI-based chatbot allows farmers to get area-specific guidance on sowing, plantation, irrigation, fertilization, and harvesting, depending on the soil and crop type.

5. Feedback & Continuous Learning: Farmers can now enter their crop growth and yield patterns, which will enable the learning algorithm to improve its predictions over time, thus creating an efficient agricultural environment.

Conclusion 6. Sustainability and Efficiency Through better utilization of fertilizers, avoiding overuse, better soil properties, and proper suggestions,

SYSTEM FLOWCHART



KEY FEATURES

- Portable IoT Soil Testing Kit: On-field, real-time soil testing measuring NPK, pH, EC, moisture, and temperature, eliminating lab dependency with a low-cost, farmer-friendly design.
- AI-Powered Soil Intelligence: Incorporates AI and deep learning to evaluate soil health, identify nutrient imbalances, and transform raw sensor data into actionable insights.
- Smart Geo-Mapping: GPS-tagged soil sampling allowing for location-specific digital reports and region-wise soil health analysis.
- Precision Fertilizer Optimization: Suggests the most suitable fertilizer type, quantity, timing, and cost, balances organic and inorganic inputs, and cuts down overuse by 30 TO 40%
- Instant Digital Soil Reports: Delivers mail-based, visual, simple reports with graphs, charts, and soil health scores, available through mobile and web apps.
- Sustainability & Health Focus: Limits soil degradation, reduces the

EXPECTED OUTCOMES

- Better Soil Quality: Mitigated deficiencies and problems regarding nutrient imbalance and soil deterioration, as well as enhanced fertility and soil structure.
- Optimized Fertilizer Use: It ensures a cutback in overuse by applying the right amount and type of fertilizer at the right time, thus reducing the costs incurred by the farmer. The cutback in use achieved
- Real-Time Soil Intelligence: Offers immediate access to health information on soils, ending the waiting periods for lab tests and exorbitant costs associated with such tests.
- Whole Chain Farmer Support: Provides farmers with elaborate assistance via an AI chat service, thereby making them less reliant on so-called middleman pieces and lessening guesswork.
- Economic Impact: Helps cut fertilizer costs, improve farmer earnings, and facilitate the creation of a viable and affordable farming business model.

Sustainability & Healthy Soil: Limits soil degradation, reduces the chance of groundwater pollution, lessens health risks caused by fertilizers, and ensures long, term soil fertility.

- Health & Social Benefits: Reduces exposure to toxic fertilizers, minimizes health risks caused by pollution, and positively affects rural livelihoods.

TECH STACK

Hardware

SOFTWARE USED

HARDWARE

BLUEPRINT / DESIGN ASPECT

Vasudha uses portable, field-ready hardware combined with low-power, energy-efficient operation that includes rechargeable and solar options, as well as a dust- and moisture-resistant casing. Its sensor suite assures reliable real-time, GPS-tagged data for accurate location-specific soil analysis. Insights are AI-driven to provide fertilizer recommendations and yield predictions, while farmer-friendly digital reports and an AI chatbot offer end-to-end crop guidance. This design of the Vasudha is scalable and modular, hence supports multiple crops and sensors. It is designed to be sustainable-reducing fertilizer overuse, protecting soil and groundwater, while also making sure the data management keeps security and privacy in focus.

TECHNICAL DOCUMENTS



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Impact & Classification

VALUE ADDITION

- Real- Time Soil perceptivity :- The capability to know the status of the soil's health without the pause that comes with laboratory
- Precision Fertilization :- It aims at maximizing the correct variety and quantum of toxin at the right time
- Enhanced Crop Yield :- AI- grounded suggestions ameliorate yield and gains.
- Cost effectiveness :- Reduces the cost of input factors and increases the profit of the planter.
- Geo- Specific Analysis :- With GPS- enabled slice, recommendations grounded on geographical position come
- Farmer- Friendly Reports :- Reports that use filmland, original languages, and QR canons
- End- to- End backing :- The chatbot helps with sowing, fertilization, and harvesting.
- Sustainable & Safe :- Reduces soil declination, conserves ground water, and promotes good health.

APPLICATION AREAS

- Government & Research systems
- Farmer Education & Guidance
- Government FPOs
- Agricultural Fields
- Fertilizer Management
- Crop Yield prophecy AI
- Soil Health Monitoring Recording
- Sustainability Programs

SOCIAL IMPACT

VASUDHA enhances the quality of the soil by correcting nutrient deficiencies, increasing fertility, and improving soil texture. It increases crop output using artificial intelligence-based knowledge and optimal fertilizer application, thereby reducing fertilizer expenditure, which ultimately increases the revenue of the farmers. VASUDHA encourages sustainable agricultural practices by ensuring less degradation of the soil and conservation of groundwater. Real-time analyses based on the soil properties enable quick and intelligent decision-making, and on top of that, it offers services from start to finish using the artificial intelligence chatbot for agricultural farming.

COMMERCIAL VIABILITY

VASUDHA is highly commercially viable as it satisfies the key needs in contemporary agriculture such as inefficient fertilizer application, reduced fertility in soils, and the need for data-driven agricultural solutions. With its low-cost, portable IoT-based soil testing kit, VASUDHA helps agricultural farms, agricultural cooperatives, and agricultural business units implement precision agriculture without the need for substantial expenditure on laboratory equipment. With its AI-powered analytics and digital reporting solution, VASUDHA also provides immense value in terms of optimizing fertilizer application, yield estimation, and reducing costs, which is extremely appealing to agricultural farms irrespective of their scale. Additionally, the cloud-storing capabilities and scalability also help VASUDHA integrate itself seamlessly with government initiatives, agricultural technology, and agricultural research initiatives, leading to immense additional market opportunities. In addition, VASUDHA also provides multiple revenue streams in terms of subscription-based access to its digital reports, AI, and predictive analytics services, which is yet another immediate source of revenue streams for VASUDHA.



Institute, District & Team

INSTITUTE DETAILS

Annasaheb Dange College of Engineering and Technology, Ashta, Sangli

Program: Degree & PG Degree

LOCATION

Sangli

District Registered

PROJECT GUIDE / MENTOR

Rohan Bhupal Waghmare

rbw_iot@adcet.in

9637431966

TEAM MEMBERS (6)

1 Tanmay Dhanaji Patil

Artificial Intelligence and Data Science

pdhanaji482@gmail.com

9022976013

2 Amit Ramesh Yedage

Artificial Intelligence and Data Science

amityedage58@gmail.com

9529365375

3 Shruti Vrushabhanath Talande

CSE (Iot , Cyber Security and Blockchain)

talandageshruti26@gmail.com

8484932004

4 Prathamesh Bharat Shinde

CSE (Iot , Cyber Security and Blockchain)

prathamps8666@gmail.com

8767473895

5 Dhanashri Mahendra Tandale

CSE (Iot , Cyber Security and Blockchain)

dhanashritandale9@gmail.com

9022239537

6 Aditya Vilas Borse

Aeronautical Engineering

adityaborde03@gmail.com

9823856646



Support Requirements

Incubation Support Needed

YES

Industry Sponsored

NO



Project Gallery



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