IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Iot Based Prediction Of Land Degradation

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Abstract: The soil testing device is a user-friendly solution for assessing soil health. This soil testing device consists of sensors such as NPK sensor for detecting the amount of nitrogen, phosphorous, potassium present in the soil and DHT sensor for the measurement of humidity and temperature of the soil. By using Arduino microcontroller processes and collect the data which in turn sends top the ThingSpeak platform for visualizing and monitoring. The execution of this soil testing device helps farmers for agricultural purpose and agricultural scientists. This device helps in improving crop yield and environment friendly practices. This device not only helps in accessible soil testing but also can be improved for future enhancement by adding mobile application connectivity and sensors for soil analysis.

Index Terms **- Soil testing device, ThingSpeak, NPK sensor, DHT sensor.**

I. INTRODUCTION

Soil is a basic resource for agriculture, serving as the foundation on which plants grow and yield crops. The healthiness and fertility of soil directly affect agricultural productivity; thus, soil testing becomes fundamental to farmers and agronomists. Traditional methods for testing soil usually are samples requiring a laboratory, thereby increasing time and costs. To overcome these challenges, the development of portable soil testing devices has begun to help in immediately determining on-site parameters. This portable soil testing device will efficiently measure key soil nutrients, including nitrogen, phosphorus, and potassium (NPK), and also the important environmental parameters like moisture in soil, temperature, and humidity. It integrates an NPK sensor that can rapidly detect the level of nutrients in the soil. DHT is another sensor, which measures temperature and humidity for complete understanding of the soil environment. The central processing unit of the device is an Arduino microcontroller, which collects data from the sensors, processes it, and transmits the information to the ThingSpeak platform via NodeMCU for cloud-based monitoring. This setup not only facilitates real-time data visualization but also enhances data accessibility for users, empowering them to make informed decisions regarding soil management and crop planning. The importance of this project lies in its ability to change soil testing methods so that the soil health monitoring by agricultural stakeholders will be made easy and efficient. The Portable Soil Testing Device allows for the provision of instant soil conditions information, which will result in improved crop management strategies, sustainable agriculture, and consequently, food security. This project will open the door for further development, including the integration of more sensors and mobile connectivity, to further enrich soil analysis capabilities.

II. OBJECTIVE

Develop a portable device that provides immediate measurements of key soil parameters, including nitrogen, phosphorus, potassium, moisture, temperature, and humidity. Design a budget-friendly soil testing device that is accessible to small-scale farmers and agricultural practitioners, promoting widespread use and adoption. Enable farmers to make informed decisions regarding soil management and crop planning based on accurate, up-to-date information, ultimately improving crop yield and sustainability.

III. PROPOSED SYSTEM

The designed system is an Innovative Soil Testing Device that would provide real-time analysis of soil health and fertility parameters. Advanced sensor technology has been combined with microcontroller-based design to provide accurate, timely insights into essential soil characteristics necessary for informed agriculture practices. Real-Time Data Access it immediately provides readings of essential soil parameters, letting users make timely decisions as regards agricultural practices. It is a compact and lightweight design, which makes it transportable and usable in different field conditions, is accessible to farmers. Multi-Parameter Analysis measures the multiple characteristics of soil such as NPK levels, moisture level, temperature, and humidity, therefore giving an all-rounded characteristic of the health of the soil. It is a User-Friendly Interface designed for ease of use and is thereby accessible even to people with minimal technical knowledge. It is Cost-Effective and provides affordable value compared to laboratory testing, which opens the door to soil testing for small-scale farmers. It provides Remote Monitoring and Enables uploading of data to ThingSpeak \ through Wi-Fi connectivity, allowing users to monitor the soil from remote locations. Historical trends can be accessed and analyzed through the ThingSpeak platform, enhancing decision-making. Provides precise data, thus helping the farmers optimize their usage of resources and improve their crop yields for precision agriculture practice for sustainable agriculture. Integration with more sensors or features later, hence offering flexibility to agricultural requirements. It is a practical educational tool for students and professionals in soil management and agriculture practice; summary of the above content in a paragraph.

IV. METHODOLOGY

System Architecture

The design methodology for the Portable Soil Testing Device is a step-by-step approach, which involves hardware selection, circuit design, programming, and testing. Key components, such as an Arduino microcontroller, NPK sensor, DHT sensor, and NodeMCU for Wi-Fi connectivity, are selected based on the functionalities to be achieved. Hardware components are then integrated into a compact and portable design, which is user-friendly in field conditions. A schematic circuit diagram is drawn for sensors that detail connections with the microcontroller for efficient data collection and processing. After the hardware has been assembled, the source code for the Arduino can be written and uploaded using the Arduino IDE. The structure of the code is to initialize the sensors, read and process the data to increase the accuracy of the reading. By configuring the Node MCU to be in Wi-Fi connection, the data will then automatically be sent to the server side of ThingSpeak for cloud-based monitoring and visualization. This step incorporates proper libraries of communication for sensors and handling data. Following the initial programming, the device undergoes extensive testing and calibration for accuracy and reliability of the sensor readings. Calibration is the process of comparing the sensor output to known standards and making necessary adjustments to enhance precision. Once all the tests are successful, the user interface is developed with an LCD display to provide real-time feedback and to access historical data through ThingSpeak. Field testing of the device will be undertaken to test it in real field conditions, taking feedback from the users and observations from the outcome for iterative improvements and refinements. This thorough design methodology assures that a usable and effective Portable Soil Testing Device is developed.

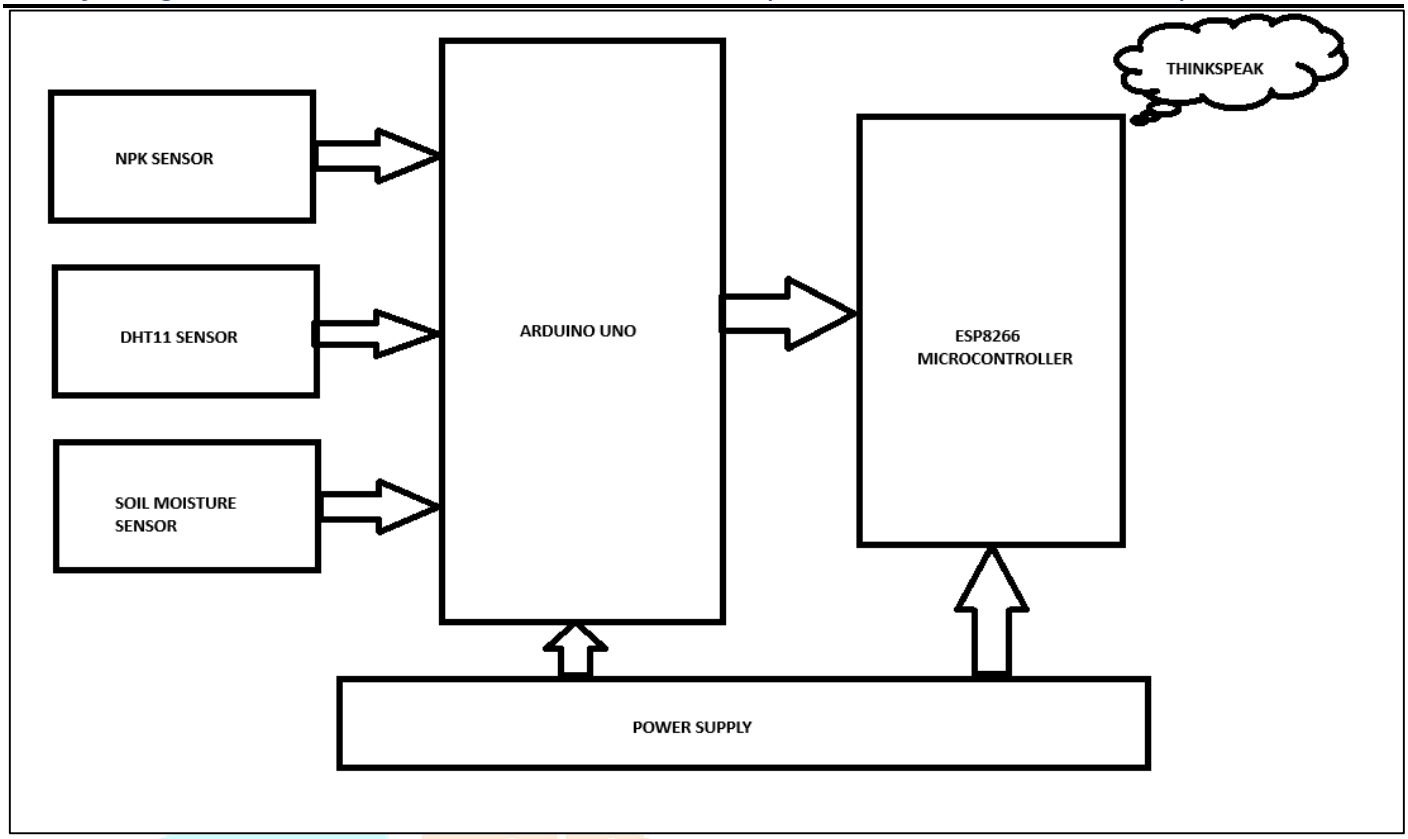

Figure 1: System Architecture

Centralized Architecture

The device is a Soil Testing Device, developed for real-time analysis of soil health and fertility parameters. Using advanced sensor technology and microcontroller-based design, it offers precise and quick insights into crucial soil characteristics that can go a long way to help in making informed agricultural decisions. The centralized architecture of an IoT-based land degradation prediction system integrates sensor nodes, a microcontroller, communication modules, and a centralized server for real-time data monitoring and analysis. Sensors such as soil moisture, temperature, humidity, and pH are deployed to capture critical environmental parameters. An Arduino Uno is used as the central processing unit, collecting and processing sensor data, which is displayed locally on an LCD for on-site monitoring. A communication module, such as Bluetooth or Wi-Fi, transmits the data to a central server or cloud platform, where predictive machine learning models analyze trends and forecast land degradation risks. The system is powered by re-chargeable lithium-ion batteries with an integral power management system that ensures long-running continuous operation. The processed data will be available to end-users using a web or mobile interface for timely decision making and interventions to prevent land degradation.

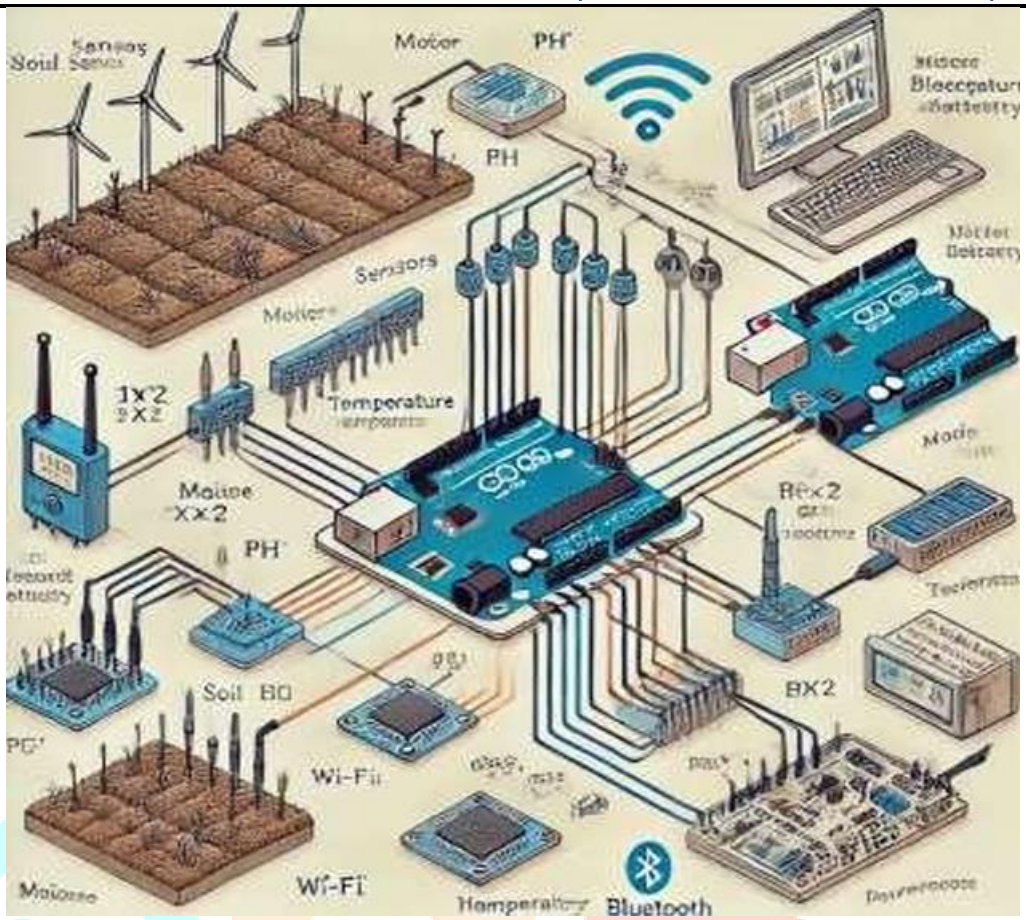

Figure 2: Centralized Architecture.

V. RESULTS

The IoT-based land degradation prediction system tested successfully, which proves its functionality, reliability, and efficiency. All sensors-NPK, soil moisture, temperature, and humidity-were accurate, and the integration with the Arduino microcontroller, LCD display, and Wi-Fi module performed without any glitches. Data transmission to the ThingSpeak platform was consistent with minimal latency, and the real-time visualization on the dashboard matched the sensor outputs. The system showed stability during long time operation, secure data transmission, and good performance under varied environmental conditions. Such results show that the system is ready for deployment with minor optimizations for extended scalability and operational efficiency.

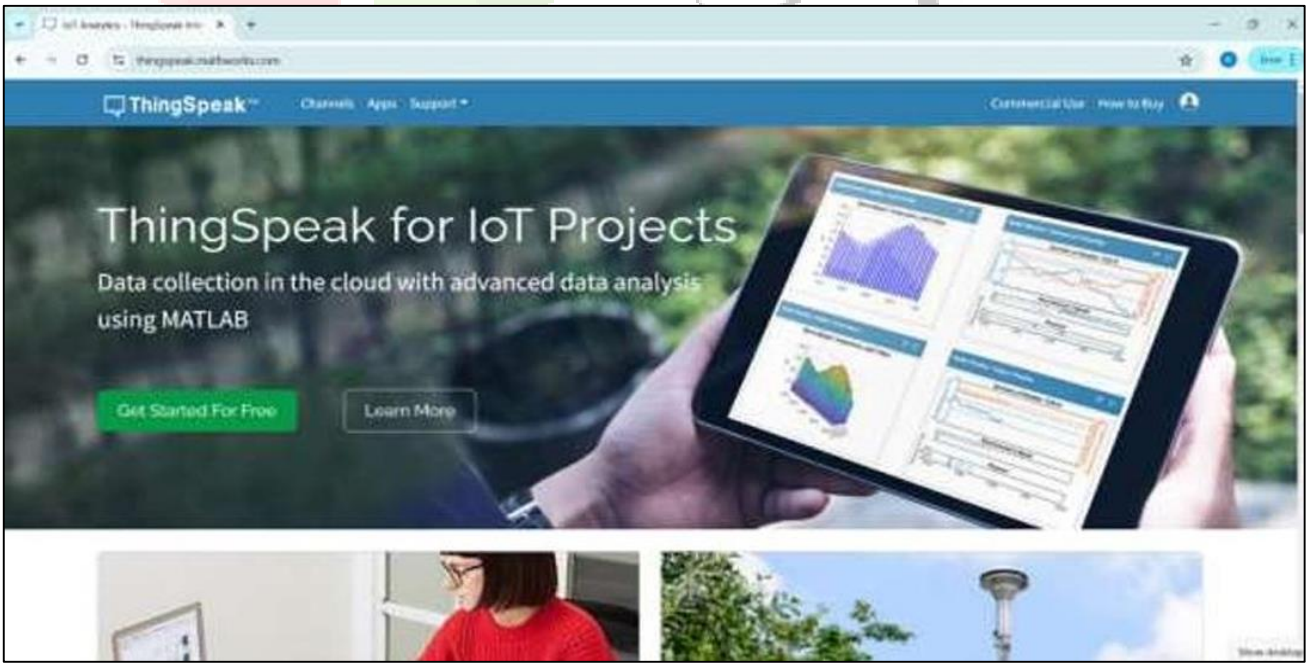

Figure 3: Home page of soil testing device.

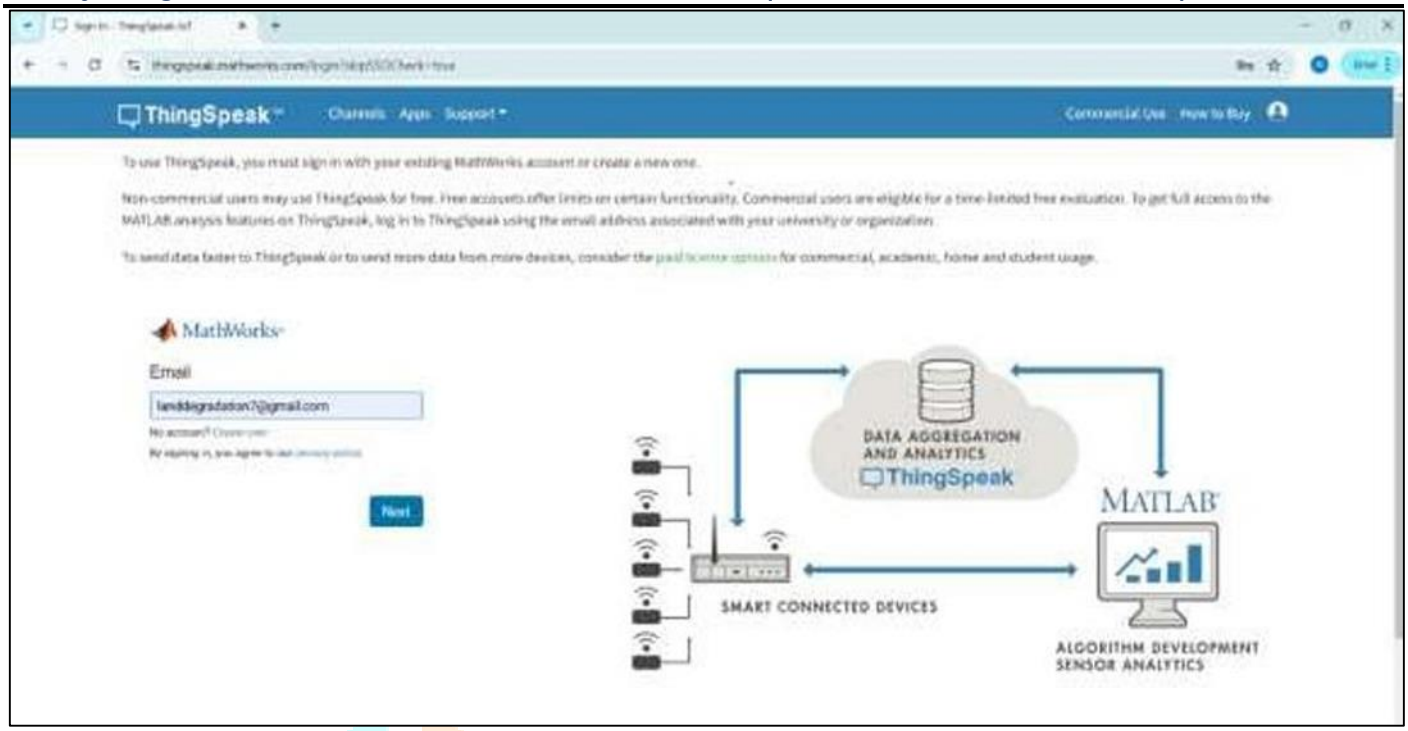

Figure 4: Login page of soil testing device.

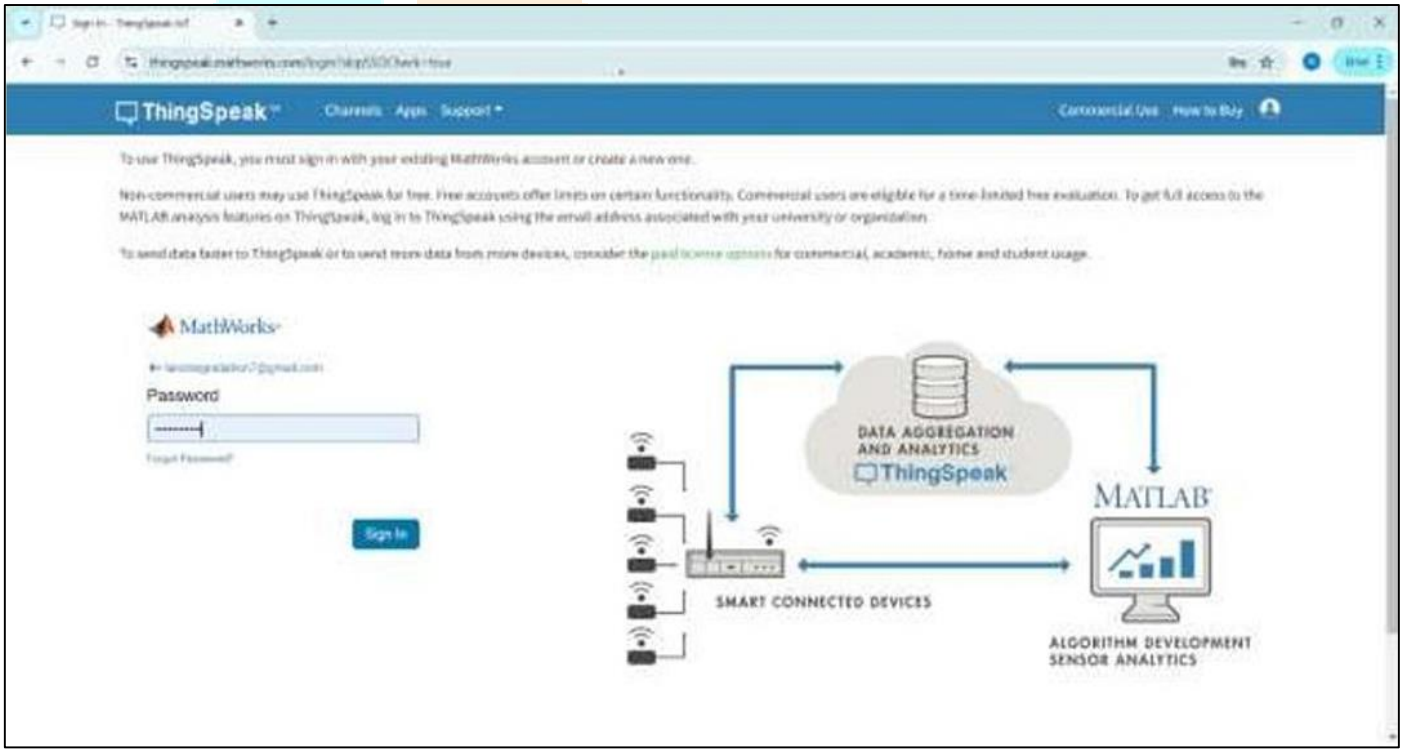

Figure 5: Password of soil testing device.

Figure 6: Nitrogen present in the soil.

Figure 7: Phosphorous present in soil.

Figure 8: Potassium present in soil.

Figure 9: Temperature of the soil.

Figure 10: Humidity of the soil.

Figure11: Moisture of the soil.

VI. CONCLUSION

The Portable Soil Testing Device represents a new wave in agricultural technology, giving the farmer and the agricultural practitioner the practical and efficient tool for measuring soil health on the spot. With essential sensors for nitrogen, phosphorus, potassium, moisture, temperature, and humidity, the device is able to help users make proper decisions on the management of soils and planning for crops. This makes it possible to transmit data through Wi-Fi connectivity using the NodeMCU module to the ThingSpeak platform for remote monitoring and historical data analysis. With agriculture moving toward precision farming and sustainability, the search for available and reliable soil testing will be more important than ever. Not only will this device fulfill such needs, but it will further engage the user with its user-friendly interface and data visualization options. Portability, cost-effectiveness, and comprehensive soil analysis make the Portable Soil Testing Device an essential resource for farmers, researchers, and educators. With these future improvements such as

additional sensors, advanced data analytics, and mobile applications in the pipeline, the potential of this device for further enhancements into the future promises to take the device to unprecedented heights and impacts. By improving soil health, this project further contributes to the overarching goal of sustainable food production and environmental stewardship. This means that the Portable Soil Testing Device is a technological innovation that speaks to the crossing of technology with agriculture, providing a basis for better farming practice and higher yields in crops amid the changing climate.

VII. REFERENCE

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