



# Soil Nutrients Testing Using Internet Of Things

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**Abstract:** Soil nutrients testing with IoT entails using Internet of Things (IoT) sensors to monitor and measure the levels of essential nutrients like nitrogen (N), phosphorus (P), and potassium (K) in soil, providing real-time data that farmers can use to optimize fertilizer application, improve crop yield, and manage their land more efficiently, all through a connected network to a central platform for analysis and decision-making; essentially enabling smart agriculture.

**Index Terms** – Nutrients, Agriculture.

## I INTRODUCTION:

Agriculture is the foundation of the Indian economy. Our country's geographical location has made it ideal for agricultural activity. India's physical characteristics, such as its climate, soil, and relief, have shown to be extremely beneficial to the growth of a wide range of crops. Thus, agriculture has traditionally been the primary source of income for Indians. In the current situation, adopting technology could help agriculturists maximize their yield. In other countries, technology is much more sophisticated. Farmers in India lack knowledge of agricultural technology.

### **Key components of an IoT soil nutrient testing system:**

**Soil sensors monitor** :NPK and other factors like as moisture, pH, and temperature.

**Data acquisition equipment** :Takes soil sensor data and wirelessly delivers it to a hub.

**Wireless networks**: Wi-Fi or cellular data, are commonly used to transmit sensor data to the cloud.

**Cloud platform** : records and analyzes soil data, providing visualization, trend analysis, and fertilizer recommendations.

The soil sample is combined (typically by shaking) with a solution known as a extractant. Following mixing, the liquid part of the sample is filtered and tested for nutrient content. Analytical equipment will vary depending on the nutrients to be assessed as well as the unique lab design and setup. The main goal of this work is to implement an IoT-based, environmentally friendly ecosystem with a sensor network for soil monitoring in agricultural areas. Sensors such as soil moisture, humidity, temperature, and NPK values are used to gather real-time information about soil fertility levels using thing speak platforms.

Agriculture employs the Internet of Things (IoT) for monitoring and controlling farms, greenhouses, and livestock. IoT devices can help farmers make better decisions, save money, and increase agricultural yields.

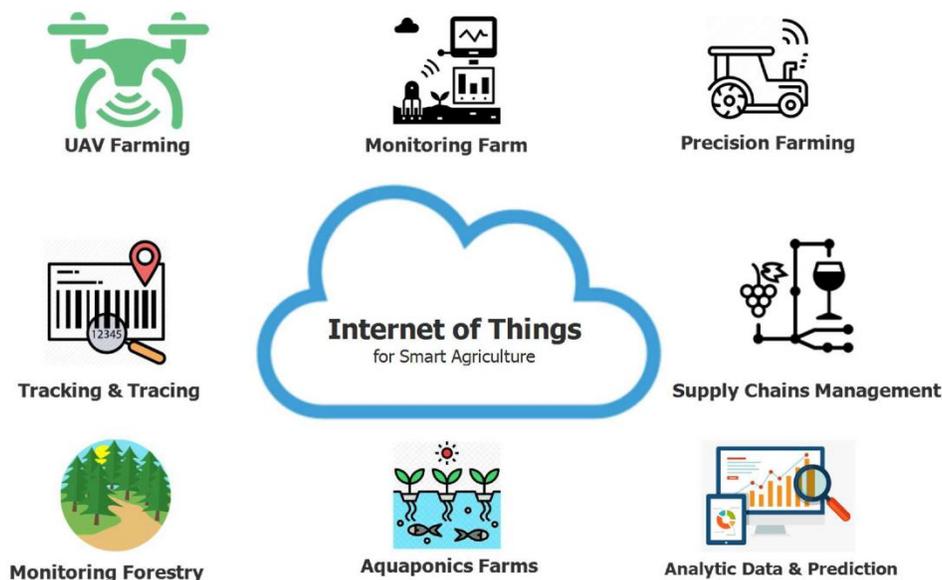


Fig 1: Implementation of IoT for Soil Testing

## Internet of Things

The Internet of Things (IoT) is commonly utilized to link devices and collect data information. The Internet of Things is utilized with IoT frameworks to manage and interact with data and information. Users can use the system to register sensors, produce data streams, and process information. IoT is relevant to a variety of agricultural approaches. Smart cities, smart environments, smart water, smart metering, security and emergency, industrial control, smart agriculture,

## Advantages:

- Through soil testing, we can identify nutrient-deficient soils so farmers can enhance agricultural productivity and ensure a more reliable and diverse food supply by cultivating crops in nutrient-dense soil.
- The Internet of Things (IoT) can benefit farmers in a variety of ways, including increasing crop yields, reducing waste, and managing animals.

## Soil testing system

It is the farmland analysis for numerous criteria such as chemical content, toxicity, pH level, salinity, Earth-dwelling biota.

### Four Easy Do-it-Yourself soil tests



Fig 2: Soil testing method

Nutrients are just elements in the periodic table. According to a recent study, 17 nutrients are required, in varying levels. As a result, a nutritional analysis is required. Farmers must currently travel long distances for testing or rely on one-time testing kits. This study aims to examine the soil using near infrared spectroscopy. Smart agriculture is a revolution in the agriculture industry that guides measures needed to adapt and reorient agricultural systems to successfully promote development and ensure food security in an ever-changing climate. This strategy uses agricultural technology. Using IoT alongside sensors allows us to have data at our fingertips.



Fig 3: Collection of Soil Samples

### Objectives of the work:

- Select appropriate sensors to monitor soil moisture and nutrient levels.
- Select required motors, controllers, and equipment.
- To evaluate the performance of the soil nutrient testing

### II.LITERATURE REVIEW:

Yiannis Ampatzidis. stated that the rapid development of new technologies, as well as the changing landscape of the online world (e.g., Internet of Things (IoT), Internet of All, cloud-based solutions), provide a unique opportunity for developing automated and robotic systems for urban farming, agriculture, and forestry. Machine vision, global positioning systems, laser technologies, actuators, and mechatronics advancements have made it possible to build and implement robotic systems and intelligent technologies for precision agriculture. In this paper, we describe and analyze robotic applications in plant pathology and management, as well as developing agricultural technology for intra-urban agriculture. Greenhouse advanced management systems and technologies have improved significantly in recent years, incorporating IoT and WSN (Wireless Sensor Network). Machine learning, machine vision

According to Kavita Sapre , we have evolved in practically every area except one, where technology is still lacking. Agri-bot will eventually become a fully automated system, beginning with the addition of bulk inputs like seeds and water and ending with crop fertilization. Agri-bot aspires to reduce the need for human labor when spreading seeds and doing other tasks. By automating more operations, efficiency can be increased by constant monitoring, optimized decision making, waste and input minimization, and a reduction in the requirement for human labor.

Mihir r bhagat. define a mobile robot as an autonomous system capable of traversing a terrain with natural or artificial barriers. Its chassis is equipped with wheels, tracks, or legs, and perhaps a manipulator setup mounted on the chassis for handling.

of work pieces, tools, or specialized gadgets. Various preplanned procedures are carried out using a preprogrammed navigation strategy that takes into account the present state of the environment. The robot transports devices to diverse terrestrial formations for on-site investigation. The rover's mission is to traverse between places of interest rapidly and safely. To better reflect the planet of interest, the rover must be capable of traveling tens of kilometers.

### III.METHOD AND METHODOLOGY:

Soil nutrient testing system methodology typically includes collecting soil samples, preparing the samples in a lab, extracting nutrients with a chemical solution, analyzing the extracted solution using laboratory techniques (e.g., spectrophotometry, flame photometry), interpreting the results based on crop needs and soil type, and finally making fertilizer recommendations based on the nutrient levels identified.

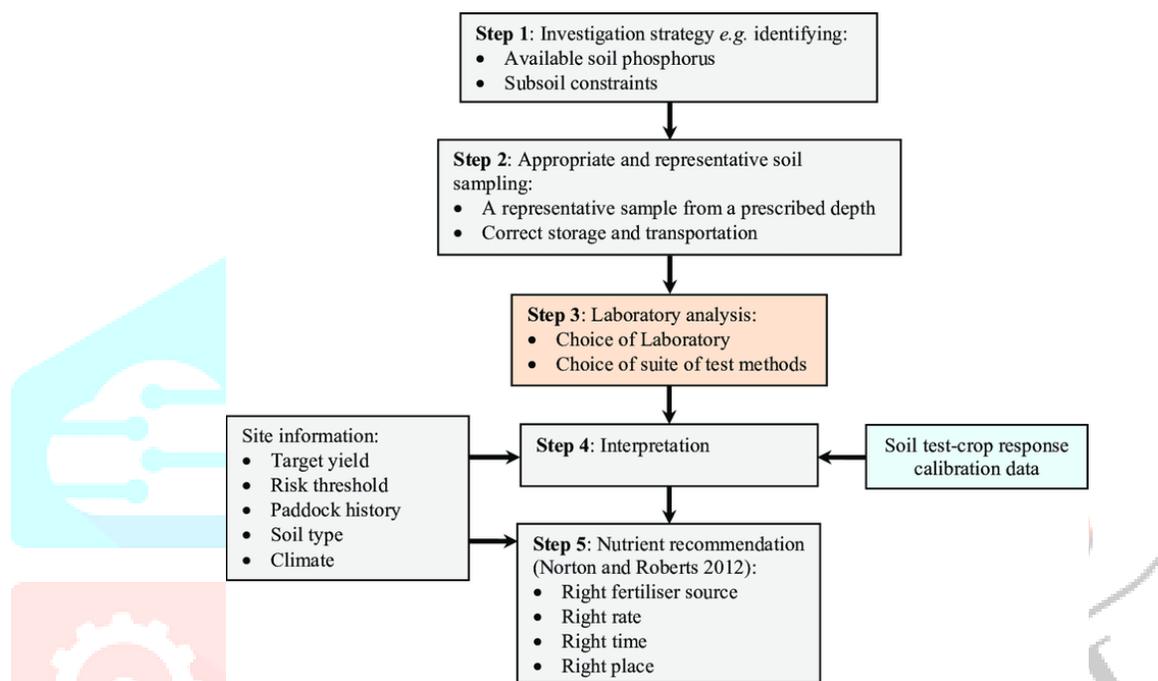


Fig 4: Block Diagram of Soil testing system

Farmers are currently choosing crops based on previous season's trends. Technology can help them make the proper growth decisions by carefully analyzing demand, pricing, and weather swings. This will result in a better balance of supply and demand. Technology-enabled farming instruments can be beneficial for small farms. Large machinery utilized in wealthy countries has little application on most of our tiny farms. The aim is to develop mechanised methods that are acceptable for small farms, reducing reliance on manual labour and increasing output.

Technology-based crop advice services for crop planning, pest control, and disease mitigation can be quite beneficial. Online marketplaces that provide a wide range of legitimate agricultural inputs backed by scientific agri-advisory can also be useful.

Agriculture has been a key component of the Indian economy. Though agriculture provides a primary source of income for the majority of the Indian population, it remains a technologically disadvantaged sector. Despite its significance to the economy, little has been done to revitalize the sector. Indian agriculture faces a number of obstacles, ranging from production constraints to funding inefficiencies. Inadequate farm equipment, a lack of access to reasonably priced loans, and distribution issues caused by intermediaries between farm and fork are just a few of the obstacles that Indian farmers face. Farmers are the sole risk bearers for all of the difficulties that arise throughout the farming cycle. Whether it's a shortage of quality tools, irregular monsoons, or pest outbreaks, farmers have to deal with it all without any risk mitigation.

IV. RESULT AND DISCUSSION:

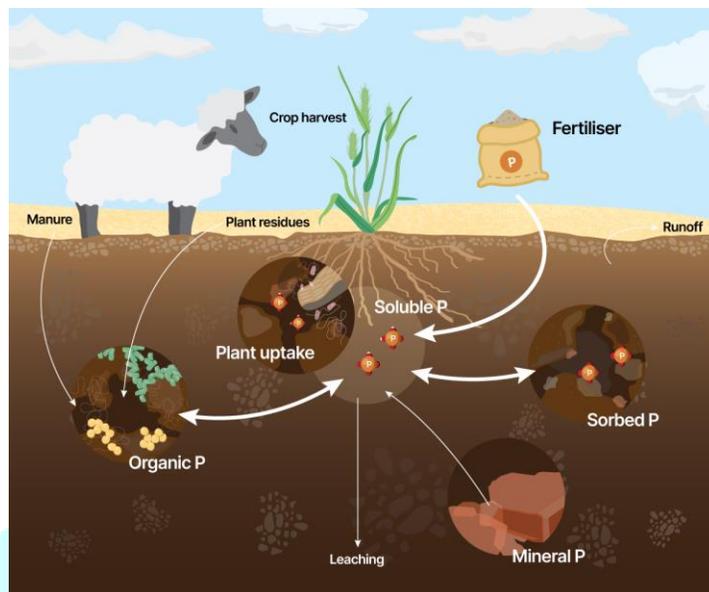


Fig 5: Model of Soil nutrients testing

A "soil nutrient testing figure" typically displays the levels of key nutrients like nitrogen, phosphorus, potassium, as well as soil pH, often presented in a bar graph format where each bar represents a nutrient level categorized as "low," "medium," or "high" based on the tested soil sample, indicating whether additional fertilizer is needed for optimal plant growth; it may also include other important soil characteristics like cation exchange capacity .

Key elements usually included in a soil nutrient testing figure:

**Soil pH:**

A numerical value indicating the acidity or alkalinity of the soil, with 7 being neutral, below 7 acidic, and above 7 alkaline.

**Nutrient levels:**

Nitrogen (N): Essential for plant growth, particularly leaf development.

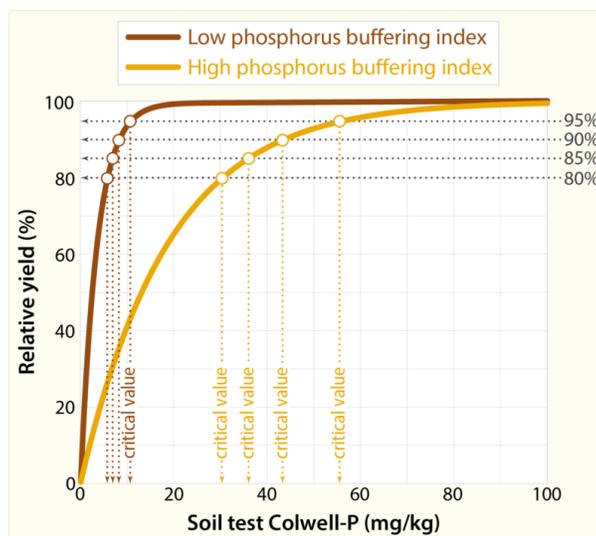


Fig 6: Testing results

**V.CONCLUSION:**

Healthy soils are required for proper plant development, human nourishment, and water filtration. Healthy soil helps to create a landscape that is more resistant to drought, flood, and fire. Soil regulates the Earth's temperature and contains more carbon than all of the world's trees combined.

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