

# Need for Internet of Things in Agriculture for Smart Farming

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## Abstract

*The Internet of Things (IoT) is about making "dumb" things "smart" by connecting them and the internet. It enables physical objects to be sensed and controlled remotely, allowing for more direct integration between the physical world and computer-based systems. IoT enables devices embedded with sensors to connect to and interact via the internet. Devices can be remotely monitored and controlled in real-time, including pumps, sheds, and tractors to weather stations and computers. This paper examines the need for IoT in agriculture and identifies areas of application to transform agriculture into smart farming.*

**Keywords:** Internet of Things, IoT, Smart Farming, Smart Agriculture, Sensors.

## Introduction

Smart farming is a capital-intensive and hi-tech system of growing food cleanly and sustainably for the masses. Application of modern ICT, transform agriculture into smart farming (Information and Communication Technologies) in agriculture. The IoT-based smart farming, which is built to monitor several crop field with the help of sensors light, humidity, temperature, soil moisture, etc. and automate the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach.

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The applications of IoT-based smart farming not only target conventional, large farming operations but could also support trends in agriculture like organic farming, family farming, nutri-sensitive agriculture, climate-resilient agriculture etc.

IoT-based smart farming can provide significant benefits for environmental issues, including more efficient water usage or optimizing inputs and treatments.

## **IoT Opportunities**

IoT is about the power of data. Our world is digitally connected, and data is a critical asset. Data from devices can guide farmer's decisions, helping them farm smarter and safer and adapt more quickly to changing conditions. The ability to monitor farm conditions and infrastructure remotely can free up time, labor, and capital to invest, allowing farmers to focus on other things.

### **Important opportunities of IoT in Agriculture are as follows:**

- Remote monitoring of farm conditions and infrastructure, saving time and labor on routine farm checks
- Improving farmer's decision making through data analytics
- Faster and quicker insights from real-time data across the value chain, helping farmers respond to what the market wants
- Efficiency in how we produce food to ensure less wastage, expediency to market, and enhanced traceability to demonstrate safe and sustainable food to our customers
- Building the capabilities to respond to new and emerging technologies and investing in research and development to contribute to ongoing innovation and improved productivity.

Smart farming based on IoT technologies enables growers and farmers to reduce waste and enhance productivity ranging from the quantity of

fertilizer utilized to the number of journeys the farm vehicles have made and enabling efficient utilization of resources such as water, electricity, etc. IoT innovative farming solutions is a system that is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, crop health, etc.) and automating the irrigation system. The farmers can monitor the field conditions from anywhere. They can also select manual and automated options for taking necessary actions based on this data. For example, the farmer can deploy sensors to start the irrigation if the soil moisture level decreases. Smart farming is highly efficient when compared with the conventional approach. IoT can transform agriculture in many aspects.

**Sensors:** Data collected by smart agriculture sensors are vital component. Sensors, control systems, robotics, autonomous vehicles, automated hardware, variable rate technology, motion detectors, button camera, and wearable devices are used for data collection. This data can be used to track the state of the business in general and staff performance and equipment efficiency. The ability to foresee the output of production allows planning for better product distribution.

**Agricultural Drones:** Ground-based and aerial-based drones are being used in agriculture to enhance various agricultural practices which included crop health assessment, irrigation, crop monitoring, crop spraying, planting, and soil and field analysis.

**Livestock Tracking and Geofencing:** Farm owners can utilize wireless IoT applications to collect data regarding their cattle's location, well-being, and health. This information helps prevent the spread of disease and lowers labor costs.

**Smart Greenhouse:** An innovative greenhouse designed with the help of IoT intelligently monitors and controls the climate, eliminating the need for manual intervention.

**Predictive Analytics for Smart Farming:** Crop prediction plays a key role; it helps the farmer decide crop production, storage, marketing techniques, and risk management plans. This information includes soil, temperature, pressure, rainfall, and humidity parameters. The farmers can get accurate soil data through the dashboard or a customized mobile application.

### **Industrial Internet of Things**

The IoT technology has realized the smart wearable's, connected devices, automated machines, and driverless cars. However, in agriculture, the IoT has brought the most significant impact.

Recent statistics reveal that the global population will reach 9.6 billion by 2050. Moreover, to feed this massive population, the agriculture industry is bounded to adopt the Internet of Things. Amongst the challenges like extreme weather conditions, climatic changes, environmental impact, IoT is addressing these challenges and helping us to meet the demand for more food.

Throughout the world, mechanical innovations such as tractors and harvesters were brought into agriculture operations in the late 20th century. Furthermore, the agriculture industry relies heavily on innovative ideas because of the steadily growing demand for food.

The Industrial IoT has been a driving force behind increased agricultural production at a lower cost. In the next several years, intelligent solutions powered by IoT will increase in agriculture operations. Few recent reports tell that the IoT device installation will see a compound annual growth rate of 20% in the agriculture industry. Furthermore, the number of connected devices in agricultural will grow from 13 million in 2014 to 225 million by 2024.

Due to a lack of constant and reliable communication network infrastructure, IoT solutions providers and business owners have faced implementation challenges in remote or less developed regions. Nevertheless, many network

providers are making it possible by introducing satellite connectivity and expanding cellular networks.

## **IoT in Agriculture**

It has been a long since sensors were introduced in agriculture operations. Nevertheless, the traditional approach to utilizing sensor technology was that we could not get the live data from the sensors. The sensors were used for logging the data into their attached memory, and later on, we were able to use them. With the introduction of Industrial IoT in Agriculture, far more advanced sensors are being utilized. The sensors are now connected to the cloud via a cellular/satellite network. This lets us know the real-time data from the sensors, making decision-making effective.

The applications of IoT in the agriculture industry have helped farmers monitor the water tank levels in real-time, which makes the irrigation process more efficient. The advancement of IoT technology in agriculture operations has brought sensors in every step of the farming process, like how much time and resources a seed takes to become a fully-grown vegetable.

Internet of Things in Agriculture has come up as a second wave of the green revolution. The benefits that the farmers are getting by adapting IoT are twofold. It has helped farmers decrease their costs and increase yields simultaneously by improving farmers' decision-making with accurate data.

## **Application of IoT in Agriculture**

Smart Farming is hi-tech and effective and ensures sustainably food system. It is an application of integrating connected devices and innovative technologies in agriculture. Smart Farming majorly depends on IoT, thus eliminating the need for physical work of farmers and growers and thus increasing productivity in every possible manner.

The Internet of Things has brought huge benefits like an efficient use of water, optimization of inputs, and many more.

IoT-based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has saved the farmers' time. However, it has also reduced the extravagant use of water and electricity resources. It keeps various factors like humidity, temperature, soil, etc., under check and gives a crystal precise real-time observation.

The following are the benefits of adopting new technology - Internet of Things in Agriculture:

### **1. Climate Conditions**

Climate plays a very critical role in farming. Furthermore, having improper knowledge about climate heavily deteriorates the quantity and quality of crop production. IoT solutions enable to know the real-time weather conditions. Sensors are placed inside and outside of the agriculture fields. They collect data from the environment used to choose the suitable crops that can grow and sustain in particular climatic conditions. The whole IoT ecosystem is made up of sensors that can detect real-time weather conditions like humidity, rainfall, temperature, and more very accurately. Numerous sensors detect all these parameters and configure them according to your intelligent farming requirements. These sensors monitor the condition of the crops and the weather surrounding them. If any disturbing weather conditions are found, then an alert is sent. What gets eliminated is the need for physical presence during disturbing climatic conditions, which eventually increases productivity and helps farmers to reap more agricultural benefits.

### **2. Precision Farming**

Precision Agriculture/Precision Farming is one of the most famous applications of IoT in Agriculture. It makes the farming practice more precise and controlled by realizing innovative farming applications such as livestock monitoring, vehicle tracking, field observation, and inventory monitoring. Precision farming aims to analyze the data generated via sensors

to react accordingly. Precision farming helps farmers to generate data with the help of sensors and analyze that information to make intelligent and quick decisions. There are numerous precision farming techniques like irrigation management, livestock management, vehicle tracking, and many more which play a vital role in increasing efficiency and effectiveness. With the help of precision farming, one can analyze soil conditions and other related parameters to increase operational efficiency. It can also detect the real-time working conditions of the connected devices to detect water and nutrient levels.

### **3. Smart Greenhouse**

IoT has enabled weather stations to automatically adjust the climate conditions according to a particular set of instructions to make our greenhouses smart. The adoption of IoT in Greenhouses has eliminated human intervention, thus making the entire process cost-effective and increasing accuracy at the same time. For example, using solar-powered IoT sensors builds modern and inexpensive greenhouses. These sensors collect and transmit real-time data, which helps monitor the greenhouse state very precisely in real-time. With the help of the sensors, the water consumption and greenhouse state can be monitored via emails or SMS alerts. Automatic and smart irrigation is carried out with the help of IoT. These sensors help provide information on the pressure, humidity, temperature, and light levels.

### **4. Data Analytics**

The conventional database system does not have enough storage for the data collected from the IoT sensors. Cloud-based data storage and an end-to-end IoT Platform plays a vital role in the smart agriculture system. These systems are estimated to play an essential role in performing better activities. In the IoT world, sensors are the primary source of collecting data on a large scale. The data is analyzed and transformed into meaningful information using analytics tools. Data analytics helps analyze weather conditions, livestock conditions, and crop conditions. The data collected



leverages technological innovations and thus makes better decisions. With the help of IoT devices, one can know the real-time status of the crops by capturing the data from sensors. Using predictive analytics, you can get an insight to make better decisions related to harvesting. The trend analysis helps the farmers to know upcoming weather conditions and harvesting of crops. IoT in the Agriculture Industry has helped the farmers to maintain the quality of crops and fertility of the land, thus enhancing the product volume and quality.

## **5. Agricultural Drones**

Technological advancements have almost revolutionized agricultural operations, and the introduction of agricultural drones is a trending disruption. The Ground and Aerial drones are used to assess crop health, crop monitoring, planting, crop spraying, and field analysis. With proper strategy and planning based on real-time data, drone technology has given the agriculture industry a high rise and makeover. Drones with thermal or multispectral sensors identify the areas that require changes in irrigation. Once the crops start growing, sensors indicate their health and calculate their vegetation index. Eventually, smart drones have reduced the environmental impact. The results have been such that there has been a massive reduction and much lower chemicals reaching the groundwater.

## **Conclusion**

IoT-enabled agriculture has helped implement modern technological solutions to time-tested knowledge. This has helped bridge the gap between production and quality and quantity yield. Data ingestion by obtaining and importing information from the multiple sensors for real-time use or storage in a database ensures swift action and minor damage to the crops. With seamless end-to-end intelligent operations and improved business process execution, produce gets processed faster and reaches supermarkets in the fastest time possible.



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