**Smart IoT Applications for Growing Agriculture Business.**

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## ABSTRACT

With the increasing adoption of the Internet of Things (IoT), connected devices have penetrated [every facet of our life](https://easternpeak.com/blog/6-cool-examples-of-internet-of-things-applications-and-how-to-develop-one/), from fitness and health care, [automotive](https://easternpeak.com/blog/connected-cars-top-5-iot-automotive-apps-and-how-to-develop-one/), home automation, and logistics, to industrial IoT and smart cities. Hence, it is only logical that IoT, connected devices, and automation would find its application in agriculture, and as such, enormously improve nearly every facet of it. Farming has seen a definite quantity of technological transformations in the last decades, seemly more industrialized and technology-driven. Using various smart agriculture gadgets, farmers have advantage of better control over the process of raising livestock and growing cultivate crops, making it much predictable and improving its efficiency. Thus along with the growing consumer demand for agriculture products, has impart to the increased proliferation of smart farming technologies worldwide. In 2020, the market share for IoT in agriculture reached $5.6 billion dollars.

**Keywords**— IoT,AI, ML, GPS, ICT

## INTRODUCTION

Smart farming is an emergent conception that talks about moving aside from traditional farming methods by applying and using technology. It includes the use of AI, robotics, IoT and drones merged with Geo spatial AI techniques to improve the quantity and quality of the harvest. Nowadays smart farming also focuses on optimizing human labor. Smart farming technologies are using AI and IoT which is no longer a remote dream, smart farms are here to stay thanks to amazing advancements in AI and IoT devices. In past few decades, the agriculture sector has undergone through significant changes and in present scenario, it’s possible to grow plants even in the most hostile climatic regions. Cultivation of Crops those are more resistant to insects, weeds, and climate change than ever before. Finally, it’s possible to breed high-yielding farm animals. Even though with all these advancements, a huge population of the world is still malnourished Food insecurity is still a major issue plaguing in the world, especially third-world nations. Due to unpredictable rains, nutrient runoff, new strains of pest and disease, and climate changes. To address these challenges that inhibit food production, scientists are turning to AI and smart farming. Here, we will take an in-depth look at how AI can revolutionize the agriculture industry [1].

## SMART FARMING

Smart farming is a concept that target at making the activity reliable, sustainable, and predictable. Although smart farming remains one of the top objectives for the farming industry, that is achieving that is often not possible with traditional farming methods. But that transform a thing of the past with technologies like IoT, sensors and actuators, robotics, and drones. Smart farming implementation make the use of versatile technologies, including UAVs, Artificial Intelligence, Machine learning, Robotics, and IoT, to supervisor agricultural operations, diminish human labor and increment the quality and quantity of agricultural product. These application provide farmers with full control of the activeness in their farms. It also assistance them to take determination that will demonstration their crops and livestock. Smart farming is interdependent on Internet of Things (IoT). IoT binds all these application together, creating a data-based system that farmers can depend on to manage their farms. The best part is that they can do all of this via their smartphone or tablets. It is not required them to move to their farms regularly. Through this smart agriculture application, farm owners can collect and analyse data to identify problems with their crops. Using the analyzed data, they can resolve the best way to address the challenges. Whether it’s low levels of water or depletion of necessary nutrients, they will know what to do. The end goal of smart agriculture is to increase crop production while reducing the cost of production. It also aid the economical use of resources, ranging from humanlike labor to fertilizer and energy to water consumption. It’s the integrating of modern-day ICT (information and communication technologies) into agriculture to optimize and streamline crops and livestock production.

Today, their various technologies farmers can leverage to manage their farms, including:

GPS Location systems & Geographical Information Systems & Satellite Imagery.

1. For monitoring humidity sensors, water levels, Soil Ph, Sunshine, & temperature.

2. Agriculture specific software that merges agronomy & cybernetic to make farm management

hassle-free.

3.Communication via Cellular IoT solutions & Low-power wide-area networks (LPWANs).

4. Data Analysis systems provides farmers with real-time data on crop and animal health.

Smart Farming is also called precision agricultural and is one of the deprecative [use cases of spatial data science](https://blog.gramener.com/spatial-data-science-use-cases/). It conceive analyzing the LandSat data & satellite imagery data of fields to make predictions about crop health, production demonstration, and weather forecasting. Artificial Intelligence and Machine Learning are the application for the future, and they can help close this gap. The AgTech industry is devising use of, satellite imagery data, Landsat data, IoT data, and visual image and driving through [spatial analysis](https://gramener.medium.com/spatial-analysis-geoai-overview-cde9b6524e94) techniques for enabling farm management and improve productivity. It will finally amend crop production and agricultural efficiencies, and minify food production costs. There are various AgTech start-ups nowadays that aim at giving benefits to investors in the form of farmland in their investment portfolios. They are also working towards structuring it in the foremost way possible. As smart farming continues to develop, the AgTech industry will proceed to informant newer investment possibility. There is a scope for several assets-based disarrange that can specify the way investors pump in finance in this sector.

1. **Smart Farming vs Traditional Farming Techniques Selecting a Template (Heading 2)**

Smart farming is so much different from conventional farming methods. Let us investigate the conventional farming vs. smart farming debate.

1. **Based on Farming Practices**

Conventional methods involve homogenous practices for crop production across the region. Smart farming methods go a step ahead and examine suitable crops and their water requirements to ensure resource optimization.

1. **Based on Maintenance**

In Conventional farming, the field data gets preserved manually, which could lead to errors. There is no scope for the sensing of soil problems in advance. Smart methods of farming help overwhelm this difficulty and prevent financial losses.

1. **Based on Use of Fertilizers and Pesticides**

Smart methods of farming modify farmers to use fertilizers and pesticides wherever necessary. There is no such scope in Conventional farming. Fertilizer distribution systems give crop recommendations supported on NPK (nitrogen, phosphorus, potassium) values and yield prediction supported on soil samples and farm area.

1. **Based on Satellite imagery**

Smart technique of farming helps in detecting affected areas for fetching corrective steps. Zone detection, geo-tagging, and related techniques are not achievable in traditional farming. When we discussion of the affected areas, satellites and related imagery data can monitor soil conditions like moisture level and ground heat for distinguishing ideal scenarios to grow crops. Moreover, satellite imagery can also help in observance the natural environment of a farm for better targeting of fertilizers and pesticides.

1. **Based on Weather Prediction**

Conventional methods lack in technology, so there is no way farmers can predict the weather. Technology in smart technique helps in the analysis and prediction of weather to prevent crop damage from unseasonal rain or drought. Likewise, pest attack prediction models also enable planning in advance for the expected attack.

1. **Smart Farming Challenges**

Tools like satellite imagery data and Landsat data are specify the farming and food industry landscape. They augur well for sustainable implementation of agriculture, which can guarantee food security. Definite food production will also be manageable without affecting the environment. However, it is not without a impartial set of challenges.

## IOT DEVICE ENABLEMENT

It is possible to enjoy the true performance of IoT only when computational power increases and energy consumption in sensors decreases. Only then will the devices become energy self-reliant. There is further a need for devices to have smart functions accompanying to self-configuration and self-management. Keeping in mind the financial aspect, there is also a demand for these sensors to be cost-effective. Sensors with RFID and NFC tags may not always be executable to incorporate if the cost of the food product is on the lower side. With lower advantage margins, there is also a need to focus on device characteristics.

1. **System Operations**

Devices with proprietary architectures and fixed standards pose a situation for widespread adoption. It is because of issues like compatibility constituent with other systems. There is a situation to find systems with standards that do not require any modifications.

## Network Availability

IoT systems need to have the high-grade connectivity options for their optimal performance. As IoT techniques works in farms situated in rural areas, there is a situation regarding connectivity. It postulate the need for devices that can function even with less power communication.

1. **Advanced Data Capabilities**

IoT devices can generate a heap of data, so extracting meaningful insights from them is essential. However, the level of data generated is still at a emerging stage in the agriculture industry. The existent data largely suits decision-support systems. However, innovative information like production planning and predictive modelling is still a long-distance possibility.

1. **Data Security**

Whenever there is data, concern approximately its security always remains. Critical information accompanying to [predicting crop production](https://blog.gramener.com/crop-yield-prediction/) and soil fertility needs protection. Cloud-based work are ideal for processing and storing such data. When it is likewise about data aggregation from various farms, care needs to be taken to ensure individual farm data remains secure.

## GROW AGRICULTURE BUSINESS WITH SMART IOT SOLUTIONS FROM EASTERN PEAK

According to [the UN Food and Agriculture Organization (FAO)](http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf), the global population is supposed to surpass 9 billion people by 2050. To make enough food for the given population, agriculture production volumes have to increase by 50%. As the resources for agricultural operations are restricted (most of the lands suitable for farming are already in use), the only way to increase volume is to improve production efficiency. There is no uncertainty as to the level with which smart farming can help tackle this demand; in fact, it seems that it is not possible without it. Here at Easterly Peak we produce custom IoT solutions for agriculture, tailored to your particular needs.

**Top of Form**

**Bottom of Form**

### How to get started?

From cattle tracking to advanced field mapping, IoT utilize in smart agriculture vary from farm to farm depending on your market segment, climate, and region. In many position, out-of-the-box tools won’t be under consideration, and you may need a tailored smart farming IoT solution. At Eastern Peak we approaching each customer individually to meet their unique needs.

The product discovery phase is the best first step you can take to lay a solid foundation for the development of your application. It includes a functional specification, UX/UI design, and a visual prototype that will give you a broad vision of the end product. On average, this phase takes 4-6 weeks.

The product discovery phase can help you:

* define a full range of work and develop a roadmap for the project
* set a vivid budget for your MVP and plan your resources
* test the waters with your audience using a sensory system prototype
* craft a convincing investment pitch
* get to know your team [2]

1. **Devices Used for Smart Farming**

Here is a list of diverse devices that are generally used for analyzing data for smart farming.

1. Soil testing sensors: They test the moisture and water content of the soil to test its suitability for crop production.
2. Humidity sensors: It helps farmers to monitor crop health by checking the moisture content of the soil.
3. Permafrost testers: Farmers check and confirm the presence of permafrost surfaces in soil.
4. Nutrient sensors: It helps in identifying the nutrient level of soil for better crop production.
5. Precision harvesters: It makes harvesting activity more efficient and economical.
6. Water sprinklers: It helps in irrigating crops most optimally.
7. Drones: Farmers can monitor crop growth and optimize agriculture operations with the help of drones.[3]

For example, by using smart farming technique sensors are used to supervisor the state of crops, farmers can determine exactly how many amount of pesticides and fertilizers they have to use to reach optimal efficiency. The same techniques applies to the smart farming definition.

Although smart farming IoT, as well as industrial IoT in general, aren’t as popular as consumer related devices; so far the market is still very impulsive. The adoption of IoT technique for agriculture is growing constantly. Namely, in COVID-19 has had a positive impact on IoT in the farming market share. Interruption in the supply chain, and the deficiency of qualified workers, has propel its CAGR to 99%. In fact, [as per recent farming reports](https://www.marketsandmarkets.com/Market-Reports/covid-19-impact-on-digital-agriculture-market-222616344.html), the smart framing market share is set to reach $6.2 billion by 2021.

At the same time, the world-wide smart farming market size is [expected](https://globenewswire.com/news-release/2018/03/22/1444017/0/en/Global-Smart-Agriculture-Market-Will-Reach-USD-15-344-million-by-2025-Zion-Market-Research.html) to ternary by 2025, reaching $15.3 billion (compared to being slightly over $5 billion back in 2016).

Because the market is still developing, there is still ample possibility for businesses willing to join in. Building IoT products for agriculture within the coming years can set you apart as an early adopter, and as such, help you pave the way to success. [3]

1. **The Benefits of smart farming**

IoT technologies have the potential to modify agriculture industries in many aspects. Namely, there are 5 ways to improve IoT agriculture:

* **Data, tons of data, collected by smart farming sensors,** Example: weather conditions, soil quality, crop’s growth progress or cattle’s health. This data can be used to trace the state of your business in general as well as staff performance, equipment efficiency, etc.
* **Improved control over the internal processes and, as a result, lower production risks**. The knowledge to foresee the output of your production allows you to plan for better product distribution. If you know exactly how much crops you are going to harvest yearly then you can make sure your product won’t lie around unsold.
* **Cost management & waste diminution thanks to the increased control over the production**. Existence able to see any anomalies in the crop growth or livestock health, you will be able to mitigate the risks of losing your yield.
* **Increased business efficiency through process automation**. By using smart devices, you can modify multiple processes across your production cycle, e.g. irrigation, fertilizing, or pest control.
* **Enhanced product quality and volumes**. To achieve better control over the production process and maintain higher standards of crop quality and growth capacity through automation [2].

As a outcome, all of these factors can finally lead to higher revenue.

Now that we have defined how IoT can be advantageously applied in the domain of agriculture, let’s take a look at how the listed benefits can find their application in real life.

1. **IoT use cases in agriculture (with examples)**

There are numerous types of IoT sensors for agriculture as well as IoT applications in agriculture in general:

1. **Monitoring of climate conditions**

Probably the fewest popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect several data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the suitable crops, and take the required measures to improve their capacity (i.e. precision farming). Several examples of such agriculture IoT devices are [allMETEO](https://www.allmeteo.com/), [Smart Elements](https://smartelements.io/), and [Pycno](https://www.pycno.co/).

### Greenhouse automation

Typically, farmers use manual participation to control the greenhouse environment. The usage of IoT sensors change them to get high-fidelity real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity. In addition to sourcing environmental data, weather stations can automatically modify the conditions to match the given parameters. Generally, greenhouse automation systems use a similar principle. For instance, [Farmapp](https://farmappweb.com/) & [Growlink](http://growlink.com/) are also IoT agriculture products offering such capabilities among others. [GreenIQ](https://easternpeak.com/works/iot/) is also an interesting product that usage smart agriculture sensors. It is a smart sprinklers controller that allows you to succeed your irrigation and lighting systems remotely.

### Crop management

One more type of IoT product in agriculture and some other element of precision farming are crop management devices. Just like weather stations, they should be placed in the field to accumulate data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health. Hence, you can monitor your crop growth and any individual to effectively prevent any diseases or infestations that can harm your yield. [Arable](https://arable.com/) and [Semios](http://semios.com/) can serve as good correspond of how this use case can be applied in real life.

### D. Cattle monitoring and management

Just like crop monitoring, there are IoT agriculture sensors that can be connected to the animals on a farm to monitor their health and log performance. Live stock trailing & monitoring help collect data on stock health, welfare, and physical location. For example, such sensing element can find ill animals so that farmers can separate them from the herd and avoid contamination. Using drones for real-time cattle trailing also helps farmers reduce staffing expenses. This works likewise to [IoT devices for petcare](https://easternpeak.com/blog/how-to-develop-an-internet-of-things-application-for-pet-care-a-go-to-market-guide/). For example, [SCR by Allflex](http://www.scrdairy.com/) and [Cowlar](https://cowlar.com/) use smart agriculture sensors (collar tags) to present temperature, health, activity, and nutrition insights on each individual cow as well as collective information about the herd.

### E. Precision farming

Also known as precision agriculture, precision farming is all approximately efficiency and making accurate data-driven decisions. It’s also one of the most widespread and effective applications of IoT in agriculture. By using IoT sensors, farmers can collect a immense array of metrics on every facet of the field microclimate and ecosystem: lighting, temperature, soil condition, humidity, CO2 levels, and pest infections. This data modify farmers to approximation optimal amounts of water, fertilizers, and pesticides that their crops need, reduce expenses, and raise better and healthier crops. For example, [CropX](https://www.cropx.com/) builds IoT soil sensors that measure soil moisture, temperature, and electric conductivity enabling farmers to approach each crop’s unique needs individually. Combined with geospatial data, this technology helps create precise soil maps for each field. [**Mothive**](https://www.mothive.com/) offers similar services, helping farmers reduce waste, improve yields, and increment farm sustainability.

### F. Agricultural drones

Perhaps one of the most likely agritech advancements is the use of agricultural drones in smart farming. Likewise it is known as UAVs (unmanned aerial vehicles), drones are better equipped than airplanes and satellites to accumulate agricultural data. Isolated from surveillance capabilities, drones can also perform a vast number of tasks that previously required human labor: planting crops, fighting pests and infections, agriculture spraying, crop monitoring, etc.

### G. Predictive analytics for smart farming

Precision agriculture & predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly applicable real-time data, the use of data analytics aid farmers make sense of it and come up with essential predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc. Data analytics tools assist make farming, which is inherently highly dependent on weather conditions, more controllable, and predictable. For example, the [Crop Demonstration](https://crop-performance.com/) platform helps farmers to access the volume and quality of yields in advance, as well as their vulnerability to admonishing weather conditions, such as floods and drought. It also modify farmers to modify the supply of water and nutrients for each crop and even select yield attribute to improve quality.

Applied in agriculture, solutions like [SoilScout](https://soilscout.com/applications/agriculture/) alter farmers to save up to 50% irrigation water, decrease the loss of fertilizers caused by overwatering, and present actionable insights regardless of season or weather conditions.

### H. End-to-end farm management systems

A more than complex approach to IoT production in agriculture can be represented by the so-called farm productiveness management systems. They usually include a amount of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical ability and in-built accounting/reporting characteristic. This offers distant farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are depicted by [FarmLogs](https://farmlogs.com/) and [Cropio](file:///C:\Users\priti\Desktop\Driving%20Smart%20Farming%20with%20Advanced%20AI.docx#agro). In addition to the listed IoT agriculture use cases, some outstanding opportunities include vehicle tracking (or even automation), storage management, logistics, etc.

## 1. Things to conceive before developing your smart farming solution

As we can perceive, the use cases for IoT in agriculture are endless. There are numerous ways smart devices can help you increment your farm’s performance and revenue. However, agriculture IoT apps improvement is no easy task.

There are definite challenges you need to be aware of if you are considering investing into smart farming.

### 2. The hardware

To build an IoT solution for agriculture, you demand to select the sensors for your device (or create a custom one). Your choice will depend on the types of information you want to accumulate and the intent of your solution in general. In any case, the quality of your sensors is essential to the success of your product: it will depend on the accuracy of the collected data and its reliability.

### 3. The brain

Data analytics should be at the core of all smart agriculture solution. The collected data itself will be of diminutive aid if you cannot make sense of it. Therefore, you necessity to have powerful data analytics capabilities and apply predictive algorithms and machine learning in order to obtain actionable insights based on the collected data.

### 4. The Maintenance

Maintenance of your hardware component is a challenge that is of primary importance for IoT production in farming, as the sensing element are typically used in the field and can be easily damaged. Thus, you demand to make sure your hardware is imperishable and easy to maintain. Otherwise you will need to regenerate your sensors more often than you would like.

### 5. The mobility

Smart agricultural applications should be customized for use in the field. A commercialism capitalist or farm manager should be able to access the information on site or remotely via a smartphone or desktop computer. Plus, each connected device should be autonomous and have enough wireless range to communicate with the different devices and send data to the central server.[ 2] [3]

1. **Smart Farming Techniques**

Some of the leading techniques concerned in smart farming with AI.

**V. MONITORING OF REMOTE EQUIPMENT**

The tool has a communications controller or computer related to the agricultural machine. There is a link provided to data buses and other controllers of the machine. The connection between controllers and data bus ensures that alerts from sensors get communicated to the controller. It additional generates snapshots and summary information that go to central information servers. The information finally reaches the user on the application.

1. **Resource and Field Mapping**

Sensor-based mapping has made remote sensing an perfect data source for applications and their revise. The sensors that make available information to the application on a smartphone prove a lot beneficial for farmers. In the past, there was no such opportunity to get advanced data or assistance from agricultural experts.

1. **Predictive Analytics**

It is credible to analyze chronological as well as existing farming data to prepare for future yield. Satellite imagery helps in appreciative and managing the natural environment of farms, which gives them cues for sustainable agricultural practices. Yield maps further allow for better targeting of fertilizers for improved crop production standards. Data-driven decision-making is essential to improving the bottom line. So predictive analytics helps farmers make informed decisions for better profits.

1. **Crop Monitoring**

It is possible to monitor crops remotely through remote sense data and field data. It helps check vital parameters like crop condition, yield, and productivity, cropping intensity, planting status, and drought prediction.

1. **Weather Prediction**

The production of crops gets affected by uneven weather patterns. Statistical weather forecasts make use of historical climate data to show the relationship between different periods. So, it is possible to predict winter temperatures based on the data of summer temperatures. Any fluctuation in the former will likely hold true for the latter.

1. **Using Predictive Analytics in Smart Farming**

Smart farming makes use of data analytics to collect information from various farming activities. It helps in creating algorithms for better and sustainable farming. Here are the various components of predictive analytics in smart methods of farming.

**F. Data Collection**

Cloud software in farming supports large-scale gathering and retrieving of data from multiple sources. Data can be of various types like soil conditions, crop mapping, crop environment monitoring, satellite images, yield information management, and much more. They offer insights with excellent speed and accuracy. As the data remains stored in the cloud, it is accessible at any time. Farmers can use historic data to overcome problems related to crop production.

**G. Data Analysis**

The analysis of data helps in gathering insights that aid better decision-making. Data related to water availability, soil moisture content, and GIS are some examples. This information can help the AgTech industry understand the optimal water requirements, soil moisture levels, and much more. If there are any discrepancies, the system will also alert the concerned person to take corrective actions. The system will also alert about the possibility of a pest attack.

**H. Data Storage**

It is a vital aspect of predictive analytics. In earlier times, when storage required physical infrastructure, it was tough to maintain it. Any fault with the hardware meant that data can easily get compromised. However, cloud systems eliminate this problem in a modern agriculture scenario. There is no need to invest in costly hardware now. The data additionally remains accessible to anyone at any time on their smartphones. When quality data is available in large amounts, it gives better insights for improved decision-making. [2][3]

**VI. BENEFITS OF SMART FARMING USING SAAS SOLUTIONS?**

Here are some advantages of using SaaS solutions in smart methods of farming.

1. It is a flexible and comprehensive system for farm management
2. Data remains accessible to anyone at anytime
3. Alerts to overcome problems like pest attacks
4. Weather-related guidance
5. Better yield possibilities through constant monitoring of farm activities
6. Predictability of results
7. Comprehensive reports and insights
8. Improved accountability and efficiency in operations
9. Geo-tagging for easy tracking
10. Better resource utilization leading to reduced production costs
11. Adherence to compliances and norms
12. **How to Utilize AI For Yield Prediction and Optimization**

Crop yield prediction is difficult because many factors come into play, like environment and genotype. We can only attain accurate yield prediction after understanding how these factors influence crop yields. That’s where artificial intelligence comes in.

By feeding machines with the right datasets, it’s possible to predict crop yield. AI systems can use historical crop yield data and compare with recent data, and over time, accurately determine crop yield.

Accurate yield prediction will allow growers to make data-driven decisions about farm management. Let’s not forget about their finances.

1. **IoT Smart Plant Monitoring**

AI system can help farmers identify the amount of light received by their crop’s foliage. If some plants are not receiving enough sunlight, they can alter crop spacing to create enough space for sunlight penetration. Manual observation of the foliage gap is costly and time-consuming.

Visual-enabled AI systems can also observe and analyze the changes of plants daily to determine their growth rate. Such systems can make use of data from infrared sensors, satellite imagery, and thermal cameras.

1. **Role of Artifical Intelligence in Agriculture**

When farmers apply fertilizers and pesticides, the system can record and measure the response of the crops. Growers can use the data to identify underperforming crops and take the right steps to address the cause of the problem.

IoT and AI solutions can get integrated into autonomous tractors to help collect real-time data about soil health, including water levels, temperature, and PH. Farmers can also use drone cameras, satellite captured images, and other sensors to track crop health. When analyzed, the results can help growers identify nutrient deficits in the soil and crop pests & diseases.

**VII. AI AND AUTOMATION ARE TRANSFORMING FARMING**

Big companies are already leveraging the power of AI to develop autonomous tractors that a farmer can control remotely. Self-driving tractors will not only reduce labor costs but also increase the efficiency of farm operations and crop yield.

1. **Automated Robotic Farming**

Autonomous drones will allow farmers to capture images of crops and monitor their conditions remotely. Using the UAVs, growers can apply crop treatments like pesticides and fertilizers from the air. AI-powered cameras can get mounted on drones and deployed to large-scale farms. The cameras will help growers detect issues with crops, count fruits, and even forecast crop yield.

AI also allows the automation of other farming activities, like harvesting, seeding, weeding, and crop sorting. In fact, [a farm in Australia](https://www.businessinsider.com/farming-agriculture-robotics-artificial-intelligence-smart-innovation-automation-food-production-2021-8?r=US&IR=T) leverages the power of AI and robots to conduct hands-free farming.

To manage all the data coming in, farmers can make use of powerful and efficient AI platforms. The power of data can help reduce the cost of labor, increase yield production, and reduce the environmental footprint of farming.

Furthermore, it can help farmers evaluate their farming strategies and resource management for maximum productivity and profits [2] [3]

1. **IoT Solutions to Agricultural Problems**

Many believe that IoT can add value to all areas of farming, from growing crops to forestry. While there are several ways that IoT can improve farming, two of the major ways IoT can revolutionize agriculture are precision farming and farming automation.[3]

1. **Precision Farming**

Precision farming, or precision agriculture, is an umbrella concept for IoT-based approaches that make farming more controlled and accurate. In simple words, plants and cattle get precisely the treatment they need, determined by machines with superhuman accuracy. The biggest difference from the classical approach is that precision farming allows decisions to be made per square meter or even per plant/animal rather than for a field.

By precisely measuring variations within a field, farmers can boost the effectiveness of pesticides and fertilizers, or use them selectively.

1. **Precision Livestock Farming**

As is the case of precision agriculture, smart farming techniques enable farmers better to monitor the needs of individual animals and to adjust their nutrition accordingly, thereby preventing disease and enhancing herd health.

Large farm owners can use wireless IoT applications to monitor the location, well-being, and health of their cattle. With this information, they can identify sick animals, so that they can be separated from the herd to prevent the spread of disease.

1. **Automation in Smart Greenhouses**

Traditional greenhouses control the environmental parameters through manual intervention or a proportional control mechanism, which often results in production loss, energy loss, and increased labor cost.

IoT-driven smart greenhouses can intelligently monitor as well as control the climate, eliminating the need for manual intervention. Various sensors are deployed to measure the environmental parameters according to the specific requirements of the crop. That data is stored in a cloud-based platform for further processing and control with minimal manual intervention.

**VIII. AGRICULTURAL DRONES**

Agriculture is one of the major verticals to incorporate both ground-based and aerial drones for crop health assessment, irrigation, crop monitoring, crop spraying, planting, soil and field analysis, and other spheres.

Since drones collect multispectral, thermal, and visual imagery while flying, the data they gather provide farmers with insights into a whole array of metrics: plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, field water pond mapping, scouting reports, stockpile measuring, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping, and so on.

Importantly, IoT-based smart farming doesn’t only target large-scale farming operations; it can add value to emerging trends in agriculture like organic farming, family farming, including breeding particular cattle and/or growing specific cultures, preservation of particular or high-quality varieties, and enhance highly transparent farming to consumers, society and market consciousness.

**A. What’s Next in Smart Farming**

Of course, all of these innovations are useless if they are not providing solutions to global problems. Here are two ways that smart farming is going to impact the future for the better.

**1. Internet of Food, or Farm 2020**

If we have the Internet of Things (IoT) and [the Internet of Medical Things (IoMT)](https://www.iotforall.com/ai-healthcare-turning-data-into-action/), why not have one for food? The European Commission project Internet of Food and [Farm 2020](https://www.iof2020.eu/about) (IoF2020), a part of [Horizon 2020 Industrial Leadership](https://ec.europa.eu/programmes/horizon2020/en/h2020-section/industrial-leadership), explores through research and regular conferences the potential of IoT technologies for the European food and farming industry.

IoT has fostered the belief that a smart network of sensors, actuators, cameras, robots, drones, and other connected devices will bring an unprecedented level of control and automated decision-making to agriculture, making possible an enduring ecosystem of innovation in this eldest of industries.

**2. Third Green Revolution**

Smart farming and IoT-driven agriculture are paving the way for what can be called a Third Green Revolution.

Following the plant breeding and genetics revolutions, the Third Green Revolution is taking over agriculture. That revolution draws upon the combined application of data-driven analytics technologies, such as precision farming equipment, IoT, big data analytics, Unmanned Aerial Vehicles (UAVs or drones), robotics, etc.

In the future, this smart farming revolution depicts, pesticide and fertilizer use will drop while overall efficiency will rise. IoT technologies will enable [better food traceability](https://www.iotforall.com/iot-solution-food-waste-supply-chain/), which in turn will lead to increased food safety. It will also be beneficial for the environment, through, for example, more efficient use of water, or optimization of treatments and inputs.

Therefore, smart farming has a real potential to deliver a more productive and sustainable form of agricultural production, based on a more precise and resource-efficient approach. New farms will finally realize the eternal dream of mankind. It’ll feed our population, which may explode to [9.6 billion by 2050](http://www.computerweekly.com/news/2240239484/IoT-could-be-key-to-farming-says-Beecham-Research)[3]

**REFERENCES**

[1] Smart Farming using AI and IoT, Sanksshep Mahendra, May 6th 2022.

[2] Smart Farming: How AgTech Industry Can Reap the Benefits of Advanced Agriculture Data

Analysis, [Gramener Inc](https://blog.gramener.com/author/gramener/), July 6th 2021.

[3] Article IoT in Agriculture by Alexey Chalimov, CEO at Eastern Peak.

[4] Article Smart Farming: The Future of Agriculture, Published on June 22, 2020 and updated

December 23, 2021.