**SMART FARMINF–THE FUTURE OF AGRICULTURE**

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 The spectacular growth of the world population need to produce 70% more food in 2050, but shrinking agricultural lands depletion of finite natural resources, the need to enhance farm yield has become critical, will impede agricultural development as stated by the **UN Food and Agriculture Organization.** The shifting structure of agricultural workforce being a major concern over the farming industry ,the limited availability of natural resources such as fresh water and arable land along with slowing yield trends in several staple crops, have further aggravated the problem. To combat **the declining agricultural workforce, adoption of internet connectivity solutions in farming practices has been triggered, to reduce the need for manual labor.** Agriculture has seen many revolutions, whether the domestication of animals and plants a few thousand years ago, the systematic use of crop rotations and other improvements in farming practice a few hundred years ago, or the “green revolution” with systematic breeding and the widespread use of man-made fertilizers and pesticides a few decades ago. “Smart agriculture “, a fairly new emerging concept, and the majority of farmers need more knowledge of what exactly stands behind it. The instability of future farming demands necessary alternate ,which shed light onto the concept of smart agriculture .The judicious usage of technologies like Internet of Things, sensors, location systems, robots ,drones, artificial intelligence platforms the ultimate goal of increased quality and quantity of the crop produce ,optimizing the human labor used, a manifold utility is feasible . Technologies used by the present agriculture system includes , climate management and control in greenhouses, specialized software platforms, **robotics, connectivity**[cellular](https://www.iotforall.com/what-is-cellular-iot/), [Lo Ra](https://www.iotforall.com/what-is-lpwan-lorawan/), **,** Sensors  for the soil, water, light, moisture, for temperature management, Location systems  GPS, satellite, etc **Data analytics**: standalone analytics solutions, data pipelines for downstream solutions, etc. precision irrigation and precise plant nutrition.

The connection between all these technologies is the Internet of Things, will dive deeper into the benefits of using smart agriculture so farmers can monitor the processes on their farms and take strategic decisions remotely from their tablet, phone or other mobile device without being on the open fields, in their greenhouse, orchard, vineyard, etc. this is a mechanism, for connectivity between sensors and machines, resulting in a complex system that manages your farm based on data received. IoT (Internet of Things) in agriculture involves sensors, drones and robots, connected through internet which function automatically and semi automatically performing operations and gathering data aimed at increasing efficiency and predictability. With increasing demands and shortage of labor across the globe, agriculture automation and robots or commonly known as **Agri bots** are starting to gain attention among farmers. Crop production decreased by an estimated 213 crores approx ($3.1 billion) a year due to labor shortages in the USA alone. Recent advancements in sensors and AI technology that lets machines to train on their surroundings has made agro bots more notable. The world is in the early stages of an ag robotics revolution with most of the products still in trial phases and R&D mode.

In the dawn of the new millennium, agriculture is undergoing a fourth revolution triggered by the exponentially increasing use of information and communication technology (ICT). New technologies, such as unmanned aerial vehicles with powerful, lightweight cameras allowed for farm management improvements, constitute a technical revolution that will generate tremendous changes in agricultural practices. Such profound changes in practice come not only with opportunities but also big challenges. It is minimized or site-specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases. Optimal site-specific weather forecasts, yield projections, and probability maps for diseases and disasters based on a dense network of weather and climate data will allow cultivation of crops in an optimal way.

Till now the [Industrial Internet of Things (IoT)](https://www.biz4intellia.com/industrial-iot/)has disrupted many industries and the Agriculture Industry isn't an exception. Till the end of 2018, the connected agriculture market stood at USD 1.8 billion globally and the change hasn't stopped yet. It is expected to grow to USD 4.3 billion by 2023 at a Compound Annual Growth Rate (CAGR) of 19.3%. The IoT technology has realized the smart wearable's, connected devices, automated machines, and driverless cars. However, in agriculture, the IoT has brought the greatest impact. In fact, few of the recent report tells that the IoT device installation will see a compound annual growth rate of 20% in the agriculture industry. And the no. of connected devices (agricultural) will grow from 13 million in 2014 to 225 million by 2024.

Site-specific information also enable new insurance and business opportunities for the entire value chain, from technology and input suppliers to farmers, processors, and the retail sector in developing and developed societies . The approach of using IoT technology to ensure optimum application of resources to achieve high crop yields and reduce operational costs is called precision agriculture. IoT in agriculture technologies comprise specialized equipment, wireless connectivity, software and IT services. The approach of using IoT technology to ensure optimum application of resources to achieve high crop yields and reduce operational costs is called precision agriculture. IoT in agriculture technologies comprise specialized equipment, wireless connectivity, software and IT services.

## A Way Forward

 Smart farming can provide a concerted path out of locked-in technologies towards sustainable agriculture by diversification of technologies, crop and livestock production systems, and networks across all actors of the agri -food sector. Similar to the debate and conceptualization of “smart cities,” the possibilities of ICT will likely not lead to one globally uniform and rapidly accepted farming system but to a diversity of farming systems. Technical innovations contributing to diversification are facilitated by management advice if given with high reliability and clarity, even if farmers have not produced a certain crop before. However, although the “Internet of Things,” including agricultural machinery, can be used to manage standard farming situations, the farmer still needs to serve as both scientist and watchdog, keeping an eye out for unforeseen situations. Farmers can invest the time freed up by digitalization in treatment of diseases or in monitoring and treating livestock in a more individualized way.

Crop pests and diseases need only be tackled when certain thresholds, determined with new ICT applications are reached. Smart Farming is focused on the use of data acquired through various sources (historical, geographical and instrumental) in the management of farm activities.. Smart systems differentiate themselves through their ability to record the data and make sense out of it. Smart farming employs hardware (IoT) and software (SaaS**)** to capture the data and give actionable insights to manage all the operations on the farm, both pre and post harvest. The data is organized, accessible all the time and full of data on every aspect of finance and field operations that can be monitored from anywhere in the world. IoT have the potential to transform agriculture in many aspects and these are the main ones.

**Data collected by smart agriculture sensors**

In this approach of farm management, a key component is sensors, control systems, robotics, autonomous vehicles, automated hardware, variable rate technology, motion detectors, button camera, and wearable devices. This data can be used to track the state of the business in general as well as staff performance, equipment efficiency. The ability to foresee the output of production allows to plan for better product distribution.

 **Agricultural Drones**

Ground-based and aerial-based drones are being used in agriculture in order to enhance various agricultural practices: 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 the location, well-being, and health of their cattle. This information helps to prevent the spread of disease and also lowers labour costs.

**Smart Greenhouses**

A smart greenhouse designed with the help of IoT intelligently monitors as well as controls the climate, eliminating the need for manual intervention.

**Predictive analytics for smart farming**

Crop predication plays a key role, it helps the farmer to decide future plan regarding the production of the crop, its storage, marketing techniques and risk management. To predict production rate of the crop artificial network use information collected by sensors from the farm. This information includes parameters such as soil, temperature, pressure, rainfall, and humidity. The farmers can get an accurate soil data either by the dashboard or a customized mobile application.

## Internet of Things in Agriculture:

### Precision Farming

Climate plays a very critical role for farming. And having improper knowledge about climate heavily deteriorates the quantity and quality of the crop production. But IoT solutions enable you to know the real-time weather conditions. Sensors are placed inside and outside of the agriculture fields. They collect data from the environment which is used to choose the right crops which can grow and sustain in the 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. There are numerous no. of sensors available to detect all these parameters and configure accordingly to suit your smart 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 send. What gets eliminated is the need of the physical presence during disturbing climatic conditions which eventually increases the productivity and help farmers to reap more agriculture benefits.

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 smart farming applications such as livestock monitoring, [vehicle tracking](https://www.biz4intellia.com/gps-fleet-tracking-solution/), field observation, and inventory monitoring. The goal of precision farming is 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 take 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 the efficiency and effectiveness. With the help of Precision farming, you can analyze soil conditions and other related parameters to increase the operational efficiency. Not only has this you can also detect the real-time working conditioned of the connected devices to detect water and nutrient level.

### Smart Greenhouse

To make our greenhouses smart, IoT has enabled weather stations to automatically adjust the climate conditions according to a particular set of instructions. Adoption of IoT in Greenhouses has eliminated the human intervention, thus making 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 the real-time data which helps in monitoring 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 to provide information on the pressure, humidity, temperature and light levels.

 **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 an important role in the smart agriculture system. These systems are estimated to play an important role such that better activities can be performed. In the IoT world, sensors are the primary source of collecting data on a large scale. The data is analyzed and transformed to meaningful information using analytics tools. The data analytics helps in the analysis of weather conditions, livestock conditions, and crop conditions. The data collected leverages the technological innovations and thus making better decisions. With the help of the IoT devices, you 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.

**Drones in Agriculture**

Technological advancements has almost revolutionized the agricultural operations and the introduction of agricultural drones is the trending disruption. The Ground and Aerial drones are used for assessment of crop health, crop monitoring, planting, crop spraying, and field analysis. With proper strategy and planning based on real-time data, drone technology has given a high rise and makeover to the agriculture industry. 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 chemical reaching the groundwater.

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| DJI MG-1S - Agricultural Wonder Drone - YouTube | DJI Agricultural UAV |

### 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 ingested by obtaining and importing information from the multiple sensors for real time use or storage in a database ensures swift action and less damage to the crops. With seamless end to end intelligent operations and improved business process execution, produce gets processed faster and reaches supermarkets in fastest time possible. Smart Farming focuses on application of acquired data and combining it from various data sources to show the bigger picture to manage all the activities of the farm. Smart farming is a big leap from traditional farming as it brings certainty and predictability to table. Robotics, automation and cloud software systems are tools for smart farming. Robotics, drones and sensor equipment placed throughout the farms can collect data and this data is processed to produce farm insightsFarmers have started to realize that the IoT is a driving force for increasing agricultural production in a cost-effective way.Because the market is still developing, there is still ample opportunity for businesses willing to join in. Perhaps in future ,smart farming characterize the drop in the use of pesticide and fertilizer but rise in the overall efficiency is certain .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, 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)

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