# Smart Farming: The Future of Agriculture

"Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production.

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The Internet of Things (IoT) has provided not only a way to better measure and control growth factors, like irrigation and fertilizer, on a farm, it will change how we view agriculture in its entirely. In this article, I'll explain what exactly a smart farm is and IoT will impact the future of farming.

## What is a Smart Farm?

**Smart Farming** is an emerging concept that refers to managing farms using modern Information and Communication Technologies to increase the quantity and quality of products while optimizing the human labor required.

Among the technologies available for present-day farmers are:

- **Sensors**: soil, water, light, humidity, temperature management
- **Software**: specialized software solutions that target specific farm types or use case agnostic IoT platforms
- **Connectivity**: cellular, LoRa, *etc.*
- **Location**: GPS, Satellite, *etc.*
- **Robotics**: Autonomous tractors, processing facilities, *etc.*
- **Data analytics**: standalone analytics solutions, data pipelines for downstream solutions, *etc.*
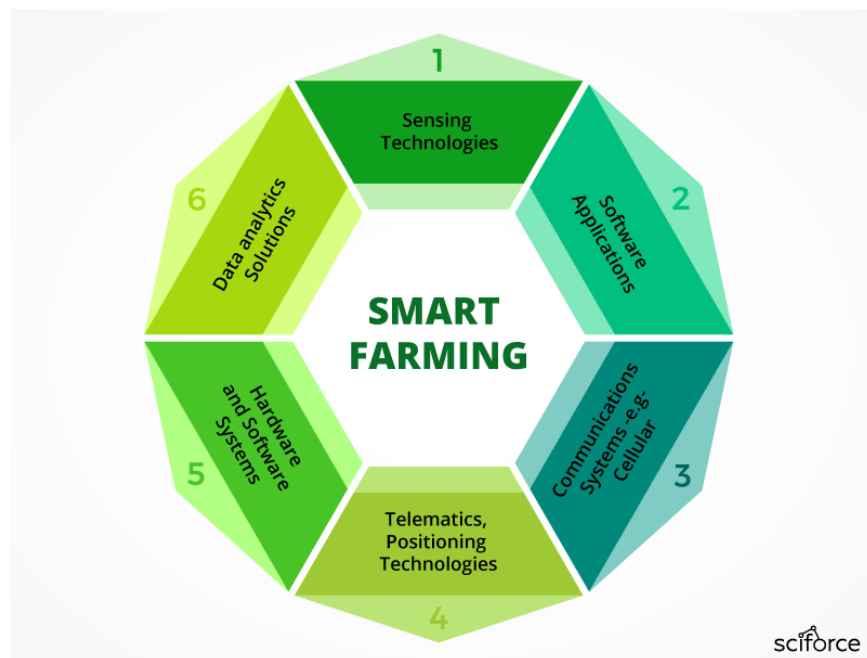


Image Credit: Beecham Research

Armed with such tools, farmers can monitor field conditions without even going to the field and make strategic decisions for the whole farm or for a single plant.

The driving force of smart farming is IoT—connecting smart machines and sensors integrated on farms to make farming processes data-driven and data-enabled.

# The IoT-Based Smart Farming Cycle

The core of IoT is the data you can draw from things ("T") and transmit over the Internet ("I"). To optimize the farming process, IoT devices installed on a farm should collect and process data in a repetitive cycle that enables farmers to react quickly to emerging issues and changes in ambient conditions. Smart farming follows a cycle like this one:

### 1. Observation

Sensors record observational data from the crops, livestock, soil, or atmosphere.

### 2. Diagnostics

The sensor values are fed to a cloud-hosted IoT platform with predefined decision rules and models—also called "business logic"—that ascertain the condition of the examined object and identify any deficiencies or needs.

### 3. Decisions

After issues are revealed, the user, and/or machine learning-driven components of the IoT platform determine whether location-specific treatment is necessary and if so, which.

### 4. Action

After end-user evaluation and action, the cycle repeats from the beginning.

# IoT Solutions to Agricultural Problems

Many believe that IoT can add value to all areas of farming, from growing crops to forestry. In this article, we'll talk about two major areas of agriculture that IoT can revolutionize:

1. Precision farming
2. Farming automation/robotization

# 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.

# 2. Precision Livestock Farming

As in 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.

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# 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.

# 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 *etc.*, and enhance highly transparent farming to consumers, society and market consciousness.



Image Credit: unsplash.com

# Internet of Food, or Farm 2020

If we have the Internet of Things (IoT) and the Internet of Medical Things (IoMT), why not have one for food? The European Commission project Internet of Food and Farm 2020 (IoF2020), a part of Horizon 2020 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.

# 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, 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.