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WHITE PAPER

Introduction to IoT in Agriculture

"...every farmer can expect to have about 40 growing seasons, giving them just 40 chances to improve on every harvest."

-Howard G. Buffett



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SMART FARMING AND AGRICULTURE TODAY



In the United States, there are approximately 2.06 million farms currently in operation.¹ This is a drastic contrast to the 1.8 million farms in operation 80 years ago. Interestingly, the total farm output has more than doubled between 1948 and 2015, mostly due to technological developments driving change.

In today's ever-connected world, with broad deployment of Low Power Wide Area Networks (LPWAN) such as LoRaWAN today, and 5G networks expected to roll out nationwide by 2020, the Internet of Things (IoT) is already having a profound effect on many industries that aren't necessarily thought of as "techie." IoT is already a driving force behind predictive and real-time access to agricultural insights, enabling "Smart Farming"—including intelligent assistance in implementation, maintenance and use of the technology—and "Precision Agriculture," defined as everything that makes the practice of farming more accurate and controlled when it comes to the growing of crops and raising livestock.

The next several years will see an increasing use of these and other smart farming technologies, which utilize connectivity to help those in the agricultural space produce more and spend less. In fact, IoT device installations in the agriculture world are projected to experience a compounded annual growth rate of 20 percent.² Some of today's IoT applications in agriculture, which are responsible for increased production at a lower cost, include farm vehicle tracking, livestock monitoring, storage monitoring, and much more.

More than 50 percent of today's farmers use at least one precision farming practice.³ Examples of the way IoT is enabling Smart Farming and Precision Agriculture include:



Livestock sensors that can notify ranchers when animals have roamed from the herd so that ranch hands can round them up.



Soil sensors that can alert farmers to irregular conditions like high acidity, giving the farmer time to reconcile the issue and produce better crops.



Self-driving tractors that can be controlled remotely, providing significant savings in labor costs.

It is widely agreed that increased productivity, arising from innovation and changes in technology, is the main contributor to economic growth in US agriculture.⁴ To better understand the immense opportunities that IoT brings to the agricultural industry we will explore the following fundamental components:

- Connectivity
- Sensors & Hardware
- Big Data & AI
- People & Platforms



CONNECTIVITY

When it comes to connectivity for agricultural IoT usage, there are two options that are viable to implement for Smart Farming and Precision Agriculture activities: LoRaWAN and cellular technologies such as NB-IOT.

LoRaWAN is a low-power, wide-area network that is ideal for this industry.⁵ There are many benefits to this option including:

- Low cost, so it can be mounted close to data sources such as cattle and crops.
- Easy to install networks and sensors.
- Not dependent on telco operator cellular coverage.
- Able to run independently of electricity, with battery life of several years.
- Able to transmit sensor data over long distances.

LoRaWAN works over 915-, 868-, and 433-MHz IMS bands available throughout the world. An edge device costs under \$25 and can last up to 10 years on a single AA battery, transmitting over 12 miles in a clear area.

Cellular technologies, on the other hand, provide ubiquitous communications where electrical power and cellular coverage are available, with emerging NB-IoT protocols featuring similar battery life characteristics as LoRaWAN albeit still dependent on cellular coverage.



SENSORS & HARDWARE



Today, there are sensors available for anything; some are aerial, some satellite, and others ground-based. Within the Smart Farming and Precision Agricultural space, sensors are used to monitor the following: livestock, vehicle tracking, crop/soil, soil moisture, animal location/activity, building temperature, and humidity.

An example of sensor utilization in monitoring plant and soil conditions is a simple use case—but it can lead to a fantastic return on investment for farmers. Several effective uses for agriculture IoT in this space include:

- Sensing for soil moisture and nutrients.
- Controlling water usage for optimal plant growth.
- Determining custom fertilizer profiles based on soil chemistry.
- Determining the optimal time to plant and harvest.
- Reporting weather conditions.⁷

Another example is livestock monitoring, which helps identify sick animals so they can be pulled from the herd, preventing the spread of disease. This practice also lowers labor costs because ranchers can identify where their cattle are located.

WANT TO LEARN MORE ABOUT IoT CONNECTIVITY?

Visit our **Insights** page for additional resources:

www.momenta.partners



BIG DATA & AI



Big Data is defined as massive volumes of data with a wide variety that can be captured, analyzed and used for decision-making. This practice is being used to provide predictive insights into farming operations, drive real-time operational decisions, and redesign business processes for game-changing business models.⁸ As IoT enables data-driven and data-enabled farming practices, both Smart Farming and Precision Agriculture are finding their niche in the big data space.

In Precision Agriculture practices, big data is married to agriculture via data collected from aerial and satellite remote sensing imagery. This is used to assess the current state of fields and manage nutrients, in real time, and also when merged with GIS maps, this data can inform farmers of soil characteristics.⁹ With this insight, farmers are able to quickly assess the amount of fertilizer and pesticide needed for specific areas, instead of treating the field as one homogenous unit. This strategic technique allows farmers to work smarter.

In actual Smart Farming practices, big data involves the entire supply chain. Smart sensors and the data they provide enable unprecedented decision-making capabilities. For example, having access to data and autonomous tractors in real time can help solve critical labor shortages. This is also the first step towards “enabling perfect operation of farm equipment.”¹⁰

PLATFORMS & PEOPLE



US agricultural production occurs in each of the 50 states, with agriculture and related industries providing 11 percent of US employment, equating to 21.4 million full and part-time jobs, with 2.6 million of these being direct, on-farm employment.¹¹

In order to achieve the production needed to feed 9.7 billion people by 2020, the people and platforms that contribute to that growth will be integral factors, especially the adoption of IoT.¹²

More accurate farming techniques for planting and growing crops will need to be employed, including the following:



VARIABLE RATE TECHNOLOGY (VRT)

In Precision Agronomics, this tech enables the variable application of inputs and allows farmers to optimize crop production via fertilizers, chemicals, and seeds. The way in which the materials are applied is based on data that is collected by sensors, maps, and GPS.¹³ There are many forms of technology that are used in variable rate application for precision agriculture. They include everything from drones and satellites to artificial intelligence (AI) and hyperspectral imaging.



AGRICULTURAL DRONES

Agriculture is one of the major industries incorporating drones for crop health assessment, irrigation, crop monitoring, crop spraying, planting, soil and field analysis, and more.¹⁵ The real-time data collection via drone has the potential to increase crop yields.



WIRELESS NETWORKS

These networks such as that provided by LoRaWAN consist of a large number of densely deployed small sensor nodes with sensing, computation, and wireless communication capabilities.¹⁶ Wireless networks are used to measure temperature in greenhouses, in the fields for monitoring humidity, soil moisture, pests and fungal disease, plus on live-stock, measuring everything from pH levels and temperatures to mating cycles and birthing/ labor status.¹⁷

With the risk of climate change reducing crop yields, farmers will need to work smarter and these IoT platforms, along with others, can enable the production increases required to feed 9.7 billion people by 2020.¹⁸ IoT opens doors for Smart Farming solutions to help farmers meet food demands and goals.¹⁹



IOT USE CASES IN AGRICULTURE



RICE FARMING & IoT ²⁰

The U.S. produces over 6 million metric tons of rice every month, across 2.5 million acres of land in seven different states. Traditional rice farming requires 4 inches of water across the fields at all times, using vast amounts of water for irrigation. Additionally, flooding rice fields creates an anaerobic environment, generating methane gas, and contributing to 1.5 percent of global GHG emissions.

CHALLENGE: Alternate Wetting and Drying (AWD)

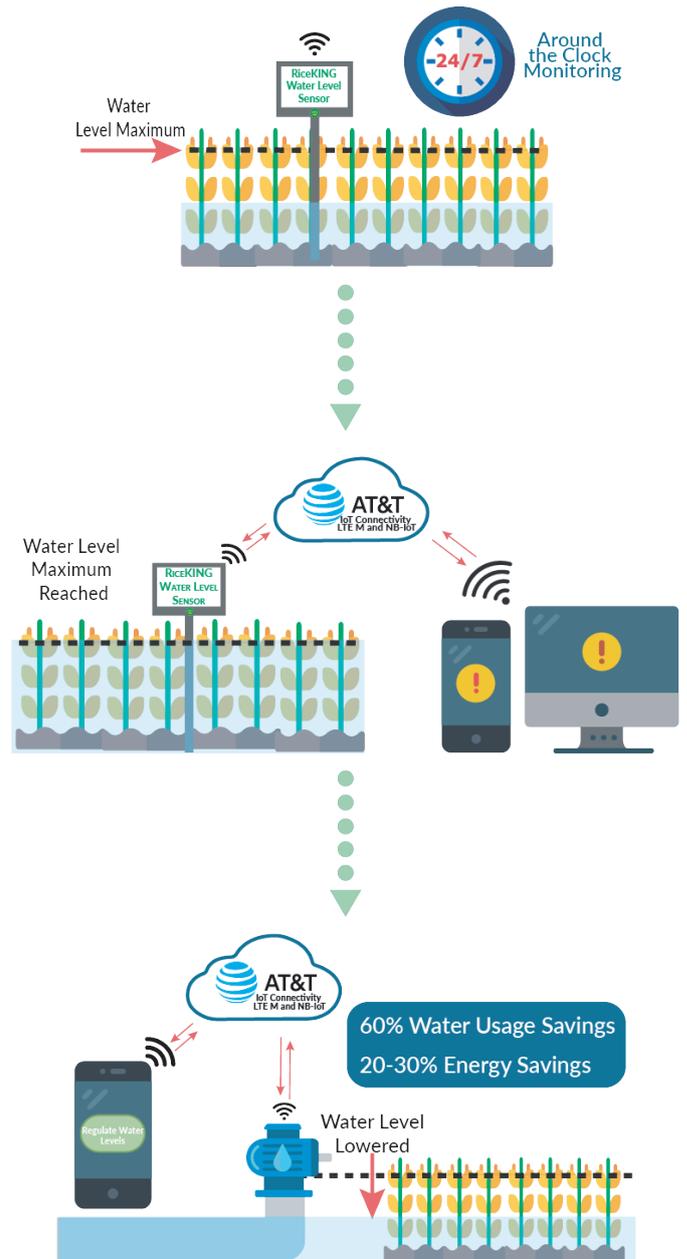
The AWD method of rice farming allows fields to dry down between floods, after establishing the initial flood. This method decreases the time fields remain flooded, reducing water use, slowing anaerobic activity and the need for nitrogen fertilizers. The challenge is that AWD requires farmers to carefully control water levels across large tracts of land and puts the rice crop at risk.

SOLUTION: AT&T IoT Creates Visibility & Control

By utilizing AT&T's IoT solution to connect water-level sensors and pumps, farmers have better control over their operations. Working with tech company PrecisionKing, AT&T connects their RiceKing sensors, which read water levels every hour, 24/7, to the PumpKing, which farmers can control remotely, turning pumps on and off as needed. The connectivity between these devices enables the collection of data and automation, optimizing AWD.

EXAMPLE: Helped Whitaker Farms Save Water & Reduce Emissions

Early adopters of AWD, Jim and Sam Whitaker of Arkansas have collaborated with PrecisionKing, using AT&T IoT, to optimize their rice fields. The water-depth monitoring and remote pump-control has reduced water usage by up to 60 percent and have reduced pump energy by 20-30 percent.





WHY INVEST IN IOT FOR AGRICULTURE?



HOW MOMENTA PARTNERS CAN HELP YOU SUCCEED

THE BENEFIT

IoT agricultural applications already exist in the marketplace which are enabling farmers and ranchers to virtually connect their operations, collect meaningful data, reduce costs, and increase production.

Utilizing connectivity networks like LoRaWAN and cellular, low-cost options with durability and longevity, farmers are able to stay connected to their crops, fields, livestock and more. New technology like sensors require these wireless networks to operate, enabling farmers to collect data and analyze it to operate more efficiently and effectively. Additionally, drones are being deployed to assess fields and crop, collecting and transmitting additional data, in real time.

With agriculture accounting for 70 percent of water use, plus generating unsustainable levels of pollution and waste, advances in IoT are enabling Precision Agriculture.²¹ The case study example explored showcases the exceptional opportunities collaboration and IoT advancements can produce, not just where farmers and production are concerned, but also on the environment.

In short, technology has become an indispensable part of doing business for every farmer. Farmers, agriculturalists, and industrial food producers alike are looking at IoT solutions to increase efficiencies and yields and reduce loss and theft. In other words, they're looking to optimize resources and lower costs.²²

In 2019, the estimated U.S. Gross Cash Farm Income (GCFI) is forecast at \$69.4 billion, a 10 percent increase year-over-year.²³ Investing in IoT for Smart Farming and Precision Agriculture will help maximize food production, plus enable farmers to work more efficiently and effectively; it may be the most effective path to realizing continued gains in GCFI.

At Momenta Partners, we understand the amazing advances IoT has already brought to Smart Farming and Precision Agriculture and the incredible potential yet to come. We want to help farmers, agricultural retailers, and agronomists implement successful strategies to meet production and revenue goals. We understand how imperative it is for the industry to access and implement IoT technology to leverage Smart Farming and Precision Agriculture advances now for the future of farming.

Our team of IoT experts can help you navigate the IoT ecosystem successfully:

- **Do you want to know what adopting IoT means to your bottom line?**
- **How it will cut costs and by how much?**
- **Where will it help you create new revenue?**
- **How much business value can you expect to attribute to IoT-related initiatives?**

Let us help you get the answers and monetize with IoT in today. Contact Momenta Partners to learn more about our IoT experts and IoT Strategy and Execution program or visit www.momenta-partners/iot-advisory



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ABOUT MOMENTA PARTNERS

As Digital Growth Partners, we help drive digital transformation within and assist with organic or inorganic growth. We place key talent and professional teams and invest in Connected Industry leaders and challengers to accelerate time-to-value, for companies in Energy, Manufacturing, Smart Spaces and Supply Chain/Logistics.

Schedule a free consultation to learn more about our Connected Industry practice. Learn more about our team, capabilities, and experience at www.momenta.partners

CONTACT US

U.S. OFFICE: +1 917 765 3600
EU OFFICE: +41 (0) 43 430 7516

EMAIL: Info@Momenta.partners
TWITTER: [@MomentaPartners](https://twitter.com/MomentaPartners)
LINKEDIN: [Momenta Partners](https://www.linkedin.com/company/momenta-partners)

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