IOT IN AGRICULTURE: 9 TECHNOLOGY USE CASES FOR SMART FARMING (AND CHALLENGES TO CONSIDER)

With the growing adoption of the Internet of Things (IoT), connected devices have penetrated every aspect of our life, from health and fitness, home automation, automotive and logistics, to smart cities and industrial IoT.

Thus, it is only logical that IoT, connected devices, and automation would find its application in agriculture, and as such, tremendously improve nearly every facet of it. How could one still rely on horses and plows when self-driving cars and virtual reality are no longer a sci-fi fantasy but an everyday occurrence?

Farming has seen a number of technological transformations in the last decades, becoming more industrialized and technology-driven. By using various smart agriculture gadgets, farmers have gained better control over the process of raising livestock and growing crops, making it more predictable and improving its efficiency.

This, along with the growing consumer demand for agriculture products, has contributed to the increased proliferation of smart farming technologies worldwide. In 2022, the market share for IoT in agriculture reached $13.76 billion.

We will explore the IoT use cases in agriculture and examine their benefits.

WHAT IS SMART AGRICULTURE?

Smart agriculture is mostly used to denote the application of IoT solutions in agriculture. So what is smart agriculture using IoT? By using IoT sensors to collect environmental and machine metrics, farmers can make informed decisions, and improve just about every aspect of their work – from livestock to crop farming.

For example, by using smart agriculture sensors to monitor the state of crops, farmers can define exactly how many pesticides and fertilizers they have to use to reach optimal efficiency. The same applies to the smart farming definition.

Although smart agriculture IoT, as well as industrial IoT in general, aren't as popular as consumer connected devices; yet the market is still very dynamic. The adoption of IoT solutions for agriculture is constantly growing.

THE BENEFITS OF SMART FARMING: HOW'S IOT SHAPING AGRICULTURE

- **Data, tons of data, collected by smart agriculture sensors**,

e.g. weather conditions, soil quality, crop's growth progress or cattle's health. This data can be used to track the state of your business in general as well as staff performance, equipment efficiency, etc.

- **Better control over the internal processes and, as a result, lower production risks.**

The ability 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, you can make sure your product won't lie around unsold.

- **Cost management and waste reduction thanks to the increased control over the production.**

Being 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 automate multiple processes across your production cycle, e.g. irrigation, fertilizing, or pest control.

- **Enhanced product quality and volumes.** Achieve better control over the production process and maintain higher standards of crop quality and growth capacity through automation.

- **Reduced environmental footprint.**

Automation also carries environmental benefits. Smart farming technologies can cut down on the use of pesticides and fertilizer by offering more precise coverage, and thus, reduce greenhouse gas emissions.

As a result, all of these factors can eventually lead to higher revenue.

Benefits of Using IoT in Agriculture

Valuable data collected by smart sensors

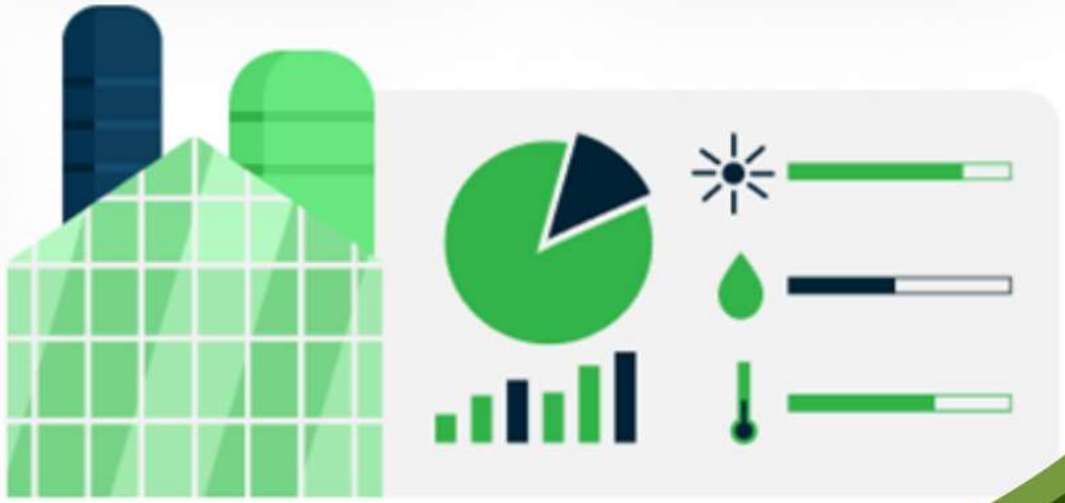
Lower production risks

Cost management & waste reduction

Processes automation across production cycle

Enhanced product quality & volumes

Reduced environmental footprint



IOT USE CASES IN AGRICULTURE

1. Monitoring of climate conditions

Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity (i.e. precision farming).

Some examples of such agriculture IoT devices are allMETEO, Smart Elements, and Pycno.

2. Greenhouse automation

Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.

In addition to sourcing environmental data, weather stations can automatically adjust the conditions to match the given parameters. Specifically, greenhouse automation systems use a similar principle. For instance, Farmapp and Growlink are also IoT agriculture products offering such capabilities among others.

3. Crop management

One more type of IoT product in agriculture and another element of precision farming are crop management devices. Just like weather stations, they should be placed in the field to collect data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health.

Thus, you can monitor your crop growth and any anomalies to effectively prevent any diseases or infestations that can harm your yield. Arable and Semios can serve as good representations of how this use case can be applied in real life.

4. Cattle monitoring and management

Just like crop monitoring, there are IoT agriculture sensors that can be attached to the animals on a farm to monitor their health and log performance. Livestock tracking and monitoring help collect data on stock health, well-being, and physical location.

For example, such sensors can identify sick animals so that farmers can separate them from the herd and avoid contamination. Using drones for real-time cattle tracking also helps farmers reduce staffing expenses. This works similarly to IoT devices for petcare.

For example, SCR by Allflex and Cowlar use smart agriculture sensors (collar tags) to deliver temperature, health, activity, and nutrition insights on each individual cow as well as collective information about the herd.

5. Precision farming

Also known as precision agriculture, precision farming is all about 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 vast array of metrics on every facet of the field microclimate and ecosystem: lighting, temperature, soil condition, humidity, CO2 levels, and pest infections. This data enables farmers to estimate optimal amounts of water, fertilizers, and pesticides that their crops need, reduce expenses, and raise better and healthier crops.

For example, CropX 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 offers similar services, helping farmers reduce waste, improve yields, and increase farm sustainability.

6. Agricultural drones

Perhaps one of the most promising agritech advancements is the use of agricultural drones in smart farming. Also known as UAVs (unmanned aerial vehicles), drones are better equipped than airplanes and satellites to collect agricultural data. Apart 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.

DroneSeed, for example, builds drones for planting trees in deforested areas. The use of such drones is 6 times more effective than human labor. A Sense Fly agriculture drone eBee SQ uses multispectral image analyses to estimate the health of crops and comes at an affordable price.

7. Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-time data, the use of data analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc. Data analytics tools help make farming, which is inherently highly dependent on weather conditions, more manageable, and predictable.

8. End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in-built accounting/reporting features.

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by FarmLogs and Cropio.

In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking (or even automation), storage management, logistics, etc.

8. End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in-built accounting/reporting features.

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by FarmLogs and Cropio.

In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking (or even automation), storage management, logistics, etc.

7. Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-time data, the use of data analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc. Data analytics tools help make farming, which is inherently highly dependent on weather conditions, more manageable, and predictable.

For example, the Crop Performance platform helps farmers access the volume and quality of yields in advance, as well as their vulnerability to unfavorable weather conditions, such as floods and drought. It also enables farmers to optimize the supply of water and nutrients for each crop and even select yield traits to improve quality.

Applied in agriculture, solutions like SoilScout enable farmers to save up to 50% irrigation water, reduce the loss of fertilizers caused by overwatering, and deliver actionable insights regardless of season or weather conditions.

8. End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in-built accounting/reporting features.

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by FarmLogs and Cropio.

In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking (or even automation), storage management, logistics, etc.

7. Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-time data, the use of data analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc. Data analytics tools help make farming, which is inherently highly dependent on weather conditions, more manageable, and predictable.

For example, the Crop Performance platform helps farmers access the volume and quality of yields in advance, as well as their vulnerability to unfavorable weather conditions, such as floods and drought. It also enables farmers to optimize the supply of water and nutrients for each crop and even select yield traits to improve quality.

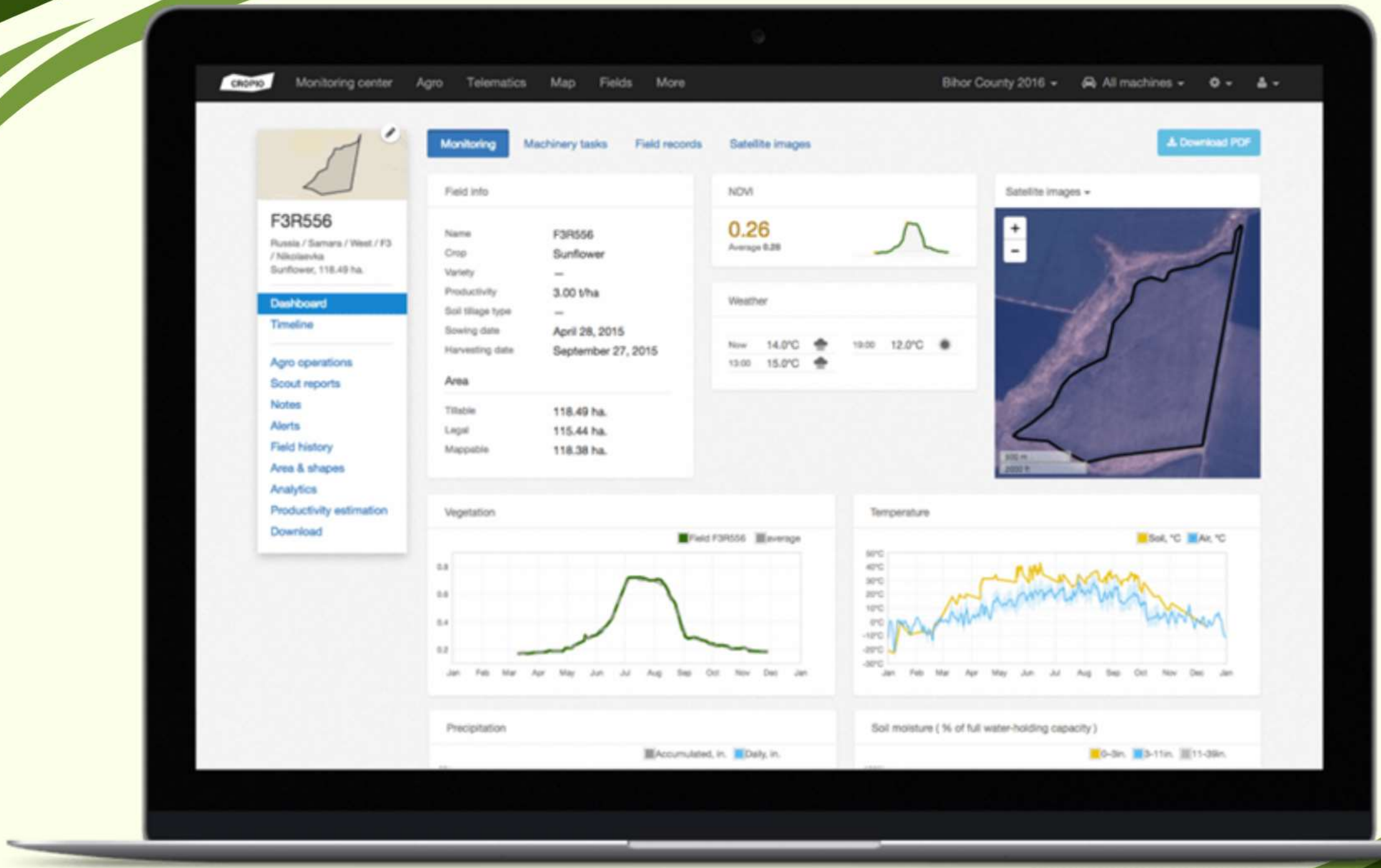
Applied in agriculture, solutions like SoilScout enable farmers to save up to 50% irrigation water, reduce the loss of fertilizers caused by overwatering, and deliver actionable insights regardless of season or weather conditions.

8. End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analytical capabilities and in-built accounting/reporting features.

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by FarmLogs and Cropio.

In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking (or even automation), storage management, logistics, etc.


CROPIO
Monitoring center
Agro
Telematics
Map
Fields
More
Bihor County 2016
All machines
F3R556
Russia / Samara / West / F3 / Nikolaevka
Sunflower, 118.49 ha.
Dashboard
Timeline
Agro operations
Scout reports
Notes
Alerts
Field history
Area & shapes
Analytics
Productivity estimation
Download
Monitoring
Machinery tasks
Field records
Satellite images
Download PDF
Field info
Name F3R556
Crop Sunflower
Variety —
Productivity 3.00 t/ha
Soil tillage type —
Sowing date April 28, 2015
Harvesting date September 27, 2015
Area
Tillable 118.49 ha.
Legal 115.44 ha.
Mappable 118.38 ha.
NDVI
0.26
Average 0.28
Weather
Now 14.0°C
13:00 15.0°C
19:00 12.0°C
Satellite images
Vegetation
Field F3R556
average
Temperature
Soil, °C
Air, °C
Precipitation
Accumulated, in.
Daily, in.
Soil moisture (% of full water-holding capacity)
0–3in.
3–11in.
11–39in.

9. Robots and autonomous machines

Robotic innovations also offer a promising future in the field of autonomous machines for agricultural purposes. Some farmers already use automated harvesters, tractors, and other machines and vehicles that can operate without a human controlling it. Such robots can complete repetitive, challenging, and labor-intensive tasks.

For instance, modern agrobots include automated tractors that can work on assigned routes, send notifications, start work at planned hours, etc. Such tractors are driverless and cut farmers' labor costs. Bear Flag Robotics is one company that works on such technology at the moment.

In addition, smart farming also uses robots for planting seeds, weeding, and watering. The given jobs are very demanding and labor-intensive. Yet, robots, such as ones from Eco Robotics, can detect weeds or plant seeds using computer vision and AI technology. These agricultural robots work delicately, drastically reducing harm to the plants and the environment.

Things to Consider in Agriculture IoT Apps Development

1

The hardware

2

The brain

3

The maintenance

4

The mobility

5

The infrastructure

6

Connectivity

7

Data collection frequency

8

Data security

THANK YOU