
Are you ready for the future of farming?
How the Internet of Things is transforming agriculture.
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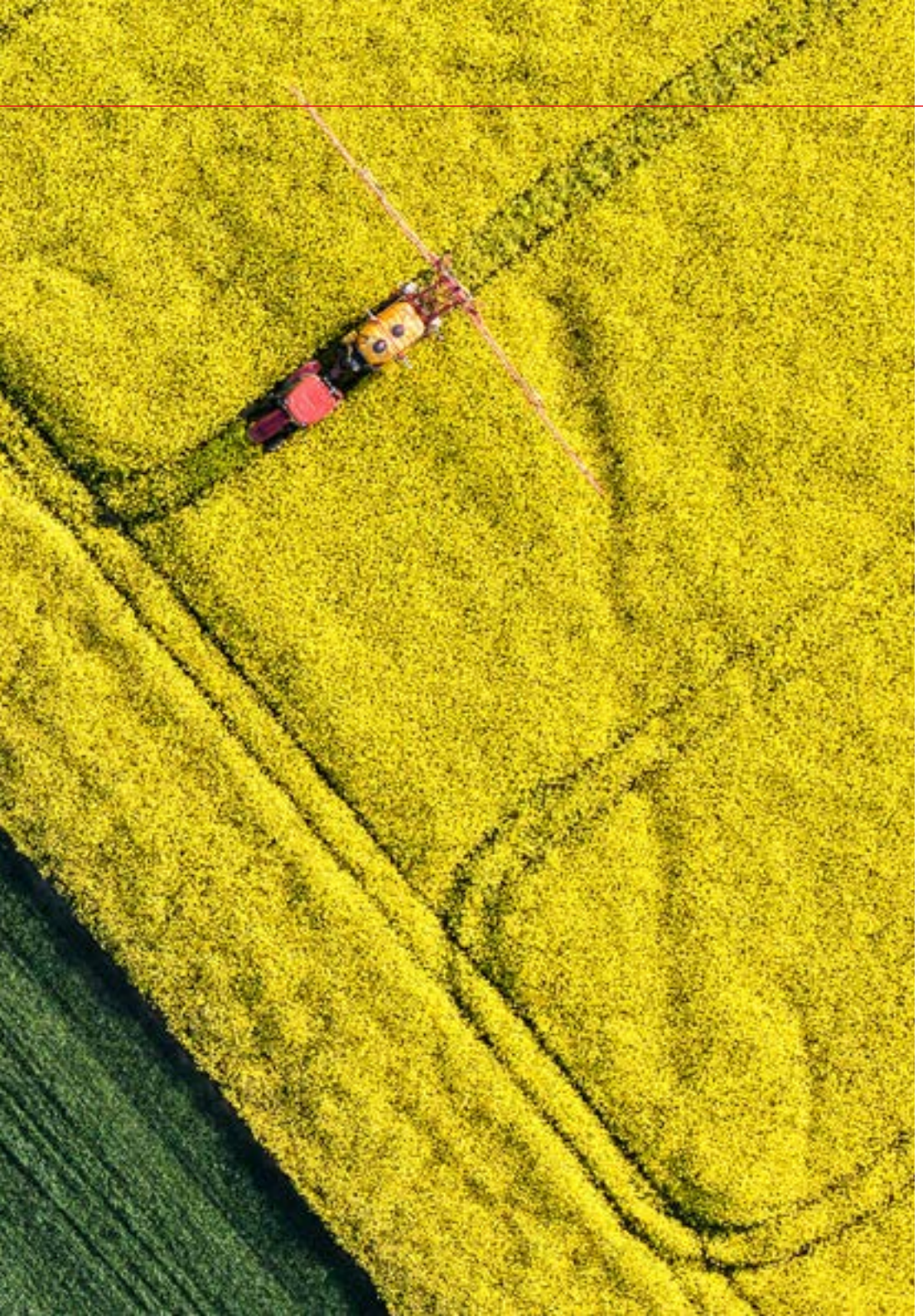
Power to you

"As a field of human activity that was one of the very first to be transformed by technology, agriculture is well versed in taking advantage of new opportunities. The Internet of Things potentially offers another leap forward."

The Internet of Things: making the most of the second digital revolution, Government Office for Science



Farming gets a boost from the Internet of Things

Smart farming improves your decision making and enables you to increase automation.

Coping with rising demand
Farming is the cornerstone of UK life, with 70% of the land currently used for agriculture. The sector provides jobs for 400,000 people contributes £10.7 billion to the British economy.[1]

But farming is a tough way to make a living. For instance, between 2014 and 2015, UK farmers saw their income drop 29% — largely due to falling prices.[2] And as a result, many UK farmers are in debt.[3]

Farmers also face pressure to increase output. The UK is reliant on the food produced by farmers. And with the population set to reach 77 million by 2050, there will be many more mouths to feed.[4]

That's where smart farming, powered by Internet of Things (IoT) technology, comes in. IoT is already helping businesses across all sectors to achieve dramatic business improvements.

When used in farming, the Internet of Things connects objects such as tractors, spreaders, cattle feeders, and even fields. This gives you:

- New insights into the levels of nutrition your livestock are getting, to increase milk quality or finish animals quicker.
- Better data on soil temperature, moisture content, and pH levels, enabling you to improve yields.
- An opportunity to automate processes and increase productivity.

And all of this needn't be costly — IoT solutions can be affordable and scalable, with minimal capital expenditure.

This guide explores in detail the opportunities IoT can open up for farmers and makers of farm equipment and machinery.

1. www.gov.uk/government/uploads/system/uploads/attachment_data/file/535996/AUK-2015-07jul16.pdf
2. www.gov.uk/government/uploads/system/uploads/attachment_data/file/515048/food-farming-stats-release-07apr16.pdf
3. www.ft.com/content/24b5a304-d98b-11e5-a72f-1e7744c66818
4. www.cityam.com/221125/population-growth-uk-become-biggest-country-european-union-2050

Getting more from your herd

IoT enables you to monitor the health of livestock and maximise the quality of their produce.

Improving animal welfare
Farmers have been using milking machines since the 19th century, so the idea of using automation to reduce workloads is nothing new. Indeed, across the globe, farmers spent $3 billion on agriculture robots in 2015.[5] But thanks to the Internet of Things, today's farming equipment is getting more intelligent. And that's helping deliver radical improvements in productivity and profitability.

IoT solutions are already helping cattle farmers manage calving seasons and reduce the number of animals lost during the birth. Agritech start-up Moocall has developed an IoT-based pregnancy monitor that can alert farmers when it detects that a cow is about to give birth.

"That means the farmer doesn't have to keep a constant watch over his herd, and can carry out other work around the farm," says Emmet Savage, CEO of Moocall.

And so-called 'connected cows' could make it easier for farmers to spot the first signs of disease in their herds, or issues such as mastitis, says Chris Byrne, director of IoT solutions at Vodafone. "Symptoms — such as fever or lameness — can be picked up before the animal suffers seriously," he says.

With each case of lameness costing farmers on average £180,[6] it's easy to see the benefits of an early warning system.

5. www.tractica.com/research/agricultural-robots/
6. dairy.ahdb.org.uk/technical-information/animal-health-welfare/lameness/#.V-kHQ3mECRs

IoT-enabled mixer wagons can increase milk yields by 1.74kg per cow

Better outcomes for farmers

Mixer wagon manufacturer KEENAN uses IoT technology on its connected feeders. These machines monitor animals' performance so nutritionists can adjust the diet to ensure the animal gets exactly the right nutrients it needs to drive performance. And the results are impressive. Dairy farmers see daily milk yields increase by 1.74kg per cow.

What's more, the milk produced is high quality, containing increased levels of butterfat and proteins, so that farmers can achieve a better price for their milk. With prices having fallen dramatically after the EU ended milk quotas in 2015,[7] increasing quality can provide an extra income for dairy farmers in a challenging market.

Farmers are increasingly confident in their use of technology, says Conan Condon, KEENAN InTouch Director.

"IoT technology is helping our farmers by simply guiding them step-by-step in delivering a consistent ration every day which drives the performance of their herd. The IoT technology allows our KEENAN InTouch nutrition team to monitor the data and proactively provide real-time solutions direct to farm", he says.

7. www.telegraph.co.uk/finance/newsbysector/retailandconsumer/12128033/Dairy-farms-squeezed-even-harder-as-income-halves-due-to-milk-price-war.html

Case study: Moocall

Calving is a stressful time for farmers. Almost one in 14 calves dies during birth. Until now, the only way to improve these odds was to keep watch over the expectant cow around the clock — a real disruption to the running of the farm.

Animal welfare company Moocall has developed a remote monitoring solution for pregnant cows. The ingeniously simple solution is based on the principle that cows move their tails more often the closer they get to delivery.

The Moocall service senses this motion via a battery-powered monitor that is clipped to the cow's tail. The device sends SMS alerts when it detects enough motion to show a cow is about to go into labour. As a result, farmers can carry on with their daily work — or get a good night's sleep — safe in the knowledge that they'll get plenty of warning that the cow will soon give birth. Moocall relies on Vodafone's managed connectivity to ensure coverage in even the most remote farming areas and to help the company expand internationally.

"We're planning to introduce similar devices for horses and have other ideas for new developments, such as flock protection," says Emmet Savage, CEO of Moocall. "Our aim is to become the Fitbit for animals."

Making the most of your land

IoT can improve your crop yields, increase productivity and reduce the impact on the environment.

IoT delivers new levels of insight

Historically, crop farming has relied on farmers' expertise, built up over generations, to identify the best way to work the land and identify the opportune moments to plant and harvest. But even the best farmers can find their hard work undermined by poor weather. And the impact can be severe. For instance, the combination of weak farm gate prices and exceptional levels of rainfall resulted in many crop farmers operating losses in 2014.[8]

Precision farming and the deployment of IoT technology promises to make crop management more predictable, introduce a new level of efficiency and drive up productivity, says Byrne. "Up until now, it's only been big farms that have been able to invest in innovation, but the prices of sensors are coming down quickly," he says.

Soil sensors

Narrow-Band IoT (NB-IoT) is a low-cost technology that's enabling farmers to measure soil conditions such as moisture content, pH levels and temperatures, providing them with better insight into when to plant crops.

"NB-IoT is superior when it comes to precision-farming", says Byrne. "Even deep in the soil, the wireless sensors provide excellent connectivity coverage and the low power consumption means farmers don't need to change a battery for over 10 years."

8. www.fginsight.com/news/farmers-make-a-loss-on-major-uk-arable-crops-3276

Precision farming can increase yields by up to 25%

The technology can also help when it comes to spraying. By monitoring conditions such as temperature, humidity and wind speed, farmers can get a better understanding of the conditions that allow pathogens to take hold, says Byrne. “Using IoT, the farmer knows when to spray and where.”

More precise use of pesticides and fertilisers can save money, deliver better results and lower the impact on the environment — which is good news for everyone.

Towards autonomous vehicles

The combination of GPS and IoT technology has huge implications for machinery such as tractors, harvesters and ploughs, says Byrne. “With autonomous vehicles, you can see the possibility of farmers being able to raise an entire crop — from sowing to harvest — without any part being touched by human hand.”

The implications for workloads are obvious. But the benefits don’t end there. By being able to track vehicles across their fields, farmers can plant seeds with incredible precision — ensuring they’re at the optimum spacing and depth — which can improve yields by up to 25%.[9]

Connected farm vehicles can also use GPS to plot the best route to follow, for instance when harvesting. As these technologies mature, it’s likely that self-driving capabilities will be introduced in tractors, harvesters and diggers, delivering a further boost to farm productivity.

9. www.mckinsey.com/business-functions/business-technology/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

A new level of efficiency

IoT can smooth the day-to-day running of the farm.

Keep a close eye on your buildings
It's not just the management of crops and herds that's changing. IoT introduces new ways to work that can dramatically improve the day-to-day running of your farm — for instance, improving how you manage your buildings.

Modern farms consume significant energy. Heating, lighting and ventilation systems are critical components of livestock agriculture. Feed delivery systems, milking machines and manure pumps add to the toll. Smart lighting and heating systems can help you gain control over your energy use — and cut your bills, says Byrne.

"IoT has applications across the farm," he adds. Using IoT building sensors, you can ensure chicken coops are adequately heated and ventilated, or that grain silos are kept dry. You can use IoT to monitor fuel levels in your tanks, or to ensure the integrity of slurry containers — saving you the time and effort of conducting manual checks.

Predictive maintenance
When it comes to harvesting crops or birthing calves, speed is of the essence. Downtime during harvest means spoilage. And given British farmers spend on average £85 per hectare on machinery in 2015,[10] you want to know your equipment is perfect working order when it's needed.

Increasingly, we are seeing equipment makers fit maintenance sensors into their machinery, which look out for signs of wear or impending failure. This information ensures engineers are only sent out when needed — thereby cutting maintenance bills — and giving farmers peace of mind that their equipment will be ready when needed.

These kind of savings all contribute to excellent ROI on a typical project.

10. pdf.euro.savills.co.uk/uk/rural---other/spotlight-arable-benchmarking-survey-2016.pdf

In 2015, the value of property stolen from British farms topped £42.5 million.[12]

Safe and secure farming

Agriculture has always been a risky profession. Working with heavy machinery or large animals, and often carrying out tasks on your own, means there's always an element of danger. As a result, the number of fatalities per 1,000 workers is higher in agriculture than in any other sector.[11]

IoT can help make farms a safer working environment. For instance, you can protect lone workers by providing them with IoT-enabled panic alarms or fall sensors, which will alert you to their location in the event of an incident.

As well as improving safety for workers, IoT can increase the security of your machinery. In 2015, the value of property stolen from British farms topped £42.5 million.[12] And it's not just the cost of replacing stolen assets: thefts disrupt the entire working day.

Cable-free smart cameras are easy to install in locations that lack power, and can incorporate night vision, motion detection and automatic number plate recognition, to improve your chances of catching thieves. IoT-powered trackers can also help you recover stolen machinery — or even livestock — helping keep your insurance premiums to a minimum.

11. www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf
12. www.nfumutual.co.uk/farming/initiatives/rural-crime/

Lifestyle changes

IoT can help end the long-hour culture in farming

Sleep well tonight

"When I speak to our customers about why they bought our product, they nearly all tell me that it was for animal welfare reasons," says Moocall's Savage. "But when I ask them about the benefits they get, number one is always the same: a good night's sleep."

Because the Moocall sensor only issues alerts when cows are close to giving birth, farmers don't have to stay up half the night to monitor the animals. This is indicative of the lifestyle changes that IoT will bring on the farm.

"I can see sensors and cloud technology effectively taking the farmer out of the farm and the need to be on site less of a necessity, when anything critical happens you'll be made aware by your monitoring system," says Savage.

That promises to be a sea-change for an industry associated with notoriously long hours. Today, farm-based workers average more than 50-hour working weeks — compared to a national average of just 43 hours.[13]

By using IoT and cloud-based technologies, farmers can keep up with the running of the farm without having to be physically present, says Savage. "Most farmers I speak to struggle to take a holiday, because they have to be on the farm. IoT can really change that," he adds.

13. www.fwi.co.uk/business/pay-survey-who-gets-what-in-the-farm-industry.htm

Case study: KEENAN

KEENAN, now part of the Alltech family of companies, is one of the world's foremost livestock feeding businesses, combining manufacturing, science and technology to maximise milk and beef production yields for thousands of farmers around the globe.

The KEENAN In-Touch system is a world first. The KEENAN feeder produces a fibre mix that is highly digestible, but it is the combination of the KEENAN machine and the KEENAN InTouch data that is proving to be a winning formula. The real synergy comes from the association with Alltech, which has access to more than 120 offices around the world, as well as to thousands of farms and nutritionists. Alltech's natural feed additives combined with the KEENAN feeder delivers a fully integrated system.

To complete its comprehensive support service for customers, KEENAN needed its livestock feed control centre to be in permanent contact with its mixing machinery on farms.

By building in Vodafone managed IoT connectivity to each feeder, KEENAN can provide unprecedented levels of data analysis to improve the performance of dairy and beef herds.

"Getting that insight provides a huge boost to farmers' income — through finishing cows quicker or increasing milk yields and quality" says Conan Condon, KEENAN InTouch Director.

The availability of technology on farms varies greatly, so KEENAN makes it easy for farmers to connect — either via a smartphone app, a cloud-based web system, or through its partnerships with the Irish Co-operative Organisation Society.

"Farmers are starting to see how technology can provide a new level of insight into the performance of their herds," says Condon.

Plan your journey

Smart farming can seem a world away from today's farms. Here are three simple steps you can take today.

1

Look for the quick wins

IoT will deliver the most compelling benefits where it can provide you with insight that you lack today. That may be on the nutrition in the feed given to cattle, the level of nutrients in your soil, or the security of your barns. Before committing to a radical overhaul of your farm, it makes sense to test the water. Many IoT solutions can be delivered as standalone projects, which deliver a return on investment that you can use to fund more ambitious ventures.

2

Plan for interoperability

As your farm gets smarter, you're going to see far more technology around you — whether you start with IoT-enabled pregnancy monitors for cows, or soil sensors, or wearables for your workers. These assets may be provided by multiple suppliers, but if they're to make your farm more efficient and productive, you don't want to be spending your time managing your smart devices.

Plan for interoperability at the outset. Look for partners that understand your business and can see the big picture of where you're going.

3

Change your business, not your technology

The IoT paves the way for a new way to farm. But you shouldn't approach it as a technology change — it's all about how it affects your business. For instance, IoT is enabling equipment makers to stop selling their products and start leasing them on 'pay for use' basis. So instead of buying a new tractor or cultivator, you might rent it instead — only paying when you use it and freeing you from the large up-front costs. This opens up the possibility of creating a new wave of equipment-sharing co-operatives.

The IoT will also enable you to automate many parts of your operations — such as harvesting or milking — freeing you from routine tasks and enabling you to focus on what matters.

Contact us

Want to find out more about the Internet of Things and what it can do for your business? Speak to the experts. Vodafone has been highly rated by prominent technology analysts including Analysys Mason, Current Analysis and Machina Research. We're a trusted partner to some of the world's leading companies, including IBM, Philips and Amazon as well as a host of small and medium-sized companies across the globe.

And whether you're a farm owner, equipment manufacturer or agricultural services business, you need an IoT partner that has in-depth experience and can provide end-to-end solutions including a range of connectivity. We have delivered groundbreaking IoT solutions for the farming sector and have proven experience in delivering vehicle and asset tracking solutions, animal welfare systems and sustainability projects.

We can help you to manage your business more effectively, reduce operating costs and boost productivity.

Find out more by visiting **www.vodafone.com/iot** or emailing **iot@vodafone.com.**

Thanks to our contributors

Chris Byrne is a IoT solutions architect at Vodafone, specialising in agriculture.

Conan Condon is the InTouch Director at mixer wagon manufacturer KEENAN.

Emmet Savage is the CEO of agri-tech start-up Moocall.

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