

# Project Breakthrough

Disruptive Technology Executive Briefs

## DIGITAL AGRICULTURE

### Feeding the future

Digital agriculture is the use of new and advanced technologies, integrated into one system, to enable farmers and other stakeholders within the agriculture value chain to improve food production.

Most of today's farmers make decisions such as how much fertiliser to apply based on a combination of rough measurements, experience and recommendations. Once a course of action is decided, it is implemented but the results are normally not seen until harvest time.

In contrast, a digital agriculture system gathers data more frequently and accurately, often combined with external sources (such as weather information). The resulting combined data is analysed and interpreted so the farmer can make more informed and appropriate decisions. These decisions can then be quickly implemented with greater accuracy through robotics and advanced machinery, and farmers can get real-time feedback on the impact their actions.

#### The technology

Technologies used include sensors, communication networks, Unmanned Aviation Systems (UAS), Artificial Intelligence (AI), robotics and other advanced machinery and often draws on the principles of the

Internet of Things. Each one of these brings something valuable to farming from data collection, through to management and processing, as well as guidance and direction. This integrated system offers new insights that enhance the ability to make decisions and subsequently implement them.

#### The potential

Digital agriculture has the potential to make agriculture more productive, more consistent and to use time and resources more efficiently. This brings critical advantages for farmers and wider social benefits around the world. It also enables organisations to share information across traditional industry boundaries to open up new, disruptive opportunities.

#### The barriers

Digital agriculture has the potential to transform the way we produce the world's food but the approach is still very new, costs are high and the details of the long term benefits are rarely available. That means to secure its widespread adoption will require collaboration and consensus across the value chain on how to overcome these challenges.



United Nations  
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## Some Example Applications...



### Aquaculture

Factors such as contamination from pollutants (washed from the land into the water by rain) and disease have varying impacts on yield. The farming of oysters is one such example of this. The technology company, The Yield, has partnered with Bosch to help Tasmanian oyster farmers manage these challenges using sensors, predictive analytics and a clear user interface. This enables more accurate predictions about when water contaminants are too high or an outbreak of disease is likely so that farmers are able to take proactive steps to reduce oyster loss.

### Potatoes and reducing water use

PepsiCo has successfully reduced water input to their potato crop by 26% over the past ten years. One way they have done this is through locating sources of waste

water for re-use in irrigation. They also monitor soil moisture, link this to weather forecasts and set more efficient irrigation levels. This can improve sustainability and water availability in countries at risk from drought.

### Lettuces that help kidney disease sufferers

For people with kidney disease, too much potassium in the diet – such as from high-potassium vegetables – is unhealthy. This is a growing issue in countries like Japan where 10% of the population suffer from chronic kidney disease. Fujitsu teamed up with Microsoft and others to grow lettuces with less than 80% of the potassium content of traditionally grown lettuce through carefully controlling growing conditions. This work has both enriched diets and demonstrated how sensors, analytics and data visualisation can create a system to improve agricultural practices.

## Key Numbers

**\$15 bn**

Estimated digital agriculture market size in 2021

Source: Digitising Agriculture, PA Consulting

**80%**

Of agriculture companies surveyed expect a competitive advantage from digitising agriculture

Source: Digitising Agriculture, PA Consulting

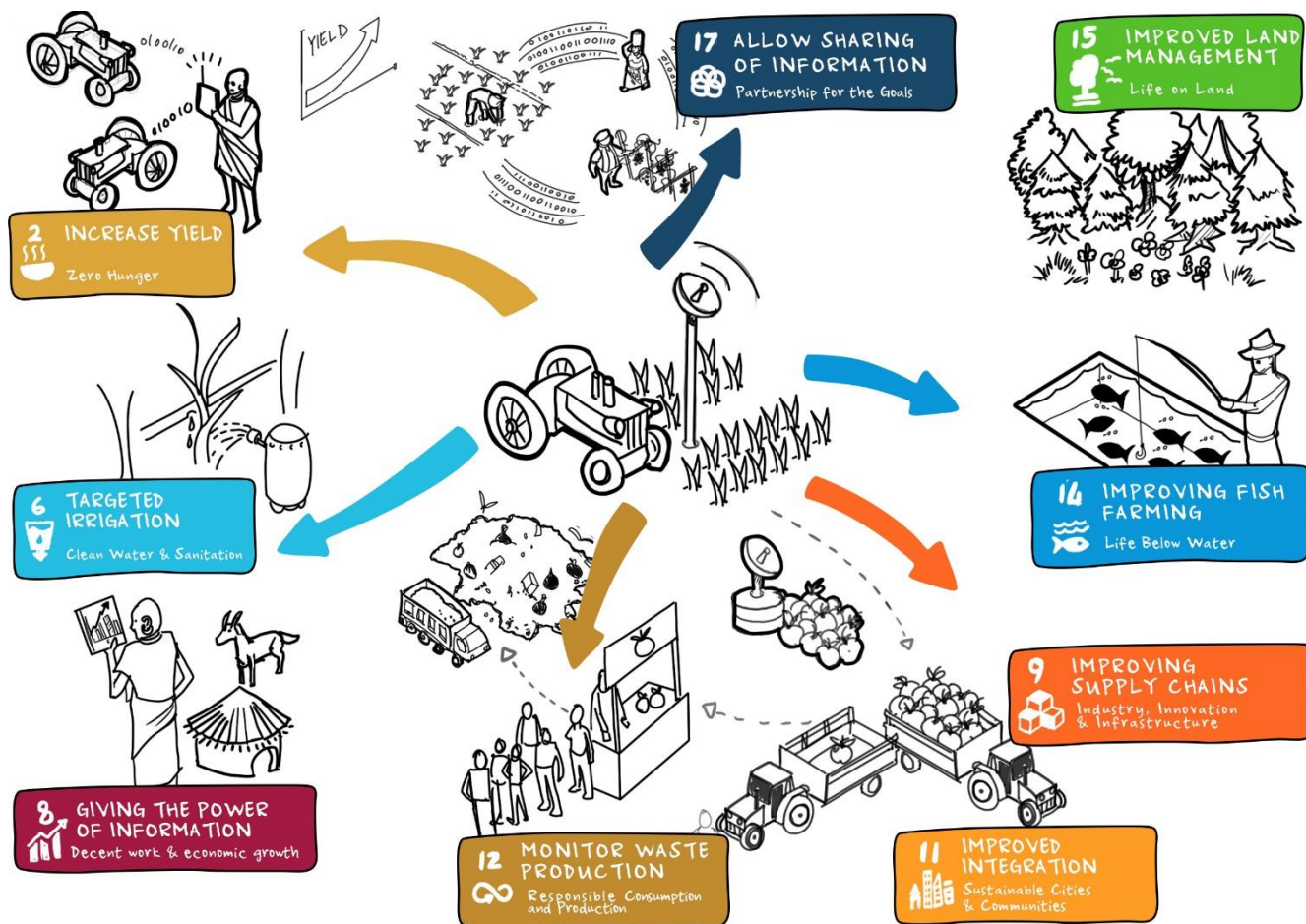
**60%**

Increase in food supply required to feed the predicted world population in 2050

Source: Food and Agriculture Organisation (FAO), UN



# Advancing the Sustainable Development Goals (SDGs)



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Digital agriculture has the potential to advance many of the SDGs. Below are some examples of areas of application across a wide variety of sectors.

## ■ SDG 2 Zero hunger

- Make better farming decisions by supplementing local knowledge developed over generations with real-time, detailed, environmental data.
- Increase yield per acre and reduce production loss to help improve food security and increase the food output, required to keep up with population growth.
- Improve transparency and sharing of information. By providing quantitative data on factors that have been difficult until now to measure and interpret, farmers will be able to improve their economic models. Financiers and insurers can also better understand risk to protect farmers financially.

## ■ SDG 6 Availability and sustainable management of water

- Waste less water through a better understanding of soil moisture, crop health and weather forecasting – provide only as much water to the plants as needed.
- Reduce chemical use and run-off into local water supplies.

## ■ SDG 8 Decent work and economic growth

- Give more power to those working in agriculture and support related innovations such as up-to-date agricultural pricing and trading – particularly the ability to facilitate trade without using intermediaries.

## ■ SDG 9 Industry, innovation and infrastructure

- Improve resilience and effectiveness of food / farming supply chains through better integrated systems and information sharing.

## ■ SDG 11 Sustainable cities and communities

- Enable more sustainable city growth through better waste management as a result of improved integration across the food value chain.

## ■ SDG 12 Responsible consumption and production

- Provide information which allows consumers to be more responsible.
- Reduce waste through better decision making across the supply chain, using predictions of harvest yields and quality to improve planning.
- Reduce waste in storage through improved planning and by linking agricultural sensors with transport management systems to reduce food spoilage.
- Reduce the chemicals used, and improve long-term soil management through better planned crop rotations.

## ■ ■ SDG 14/15 Life on land/below water

- Allow increased freshwater fishing by improving water quality with aquaculture technology.
- Reduce chemical run-off contaminating oceans.
- Promote more sustainable land ecosystems through a more considered use of farming land and approach to forestry.

## ■ SDG 17 Partnerships for the goals

- Allow companies to partner to increase the impact on all the SDGs through improved availability of information.

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# Potential Negative Impacts and Barriers

As digital agriculture develops, it will be critical to make the technology available to as many farmers as possible and to implement it in ways that minimises negative impacts on those who work in the sector:

## Data and Intellectual Property (IP)

The more collaborative, such as sharing of data, the more sophisticated and beneficial the solutions will become. However, there is no clear consensus on how to protect data or IP rights and there is less incentive for already successful parties to develop collaborative technologies that might help their competitors.

Access to data could evolve so that it reinforces inequalities rather than drives collaboration. It is possible that closed platforms and data (rather than open source technology and open data) could create economic barriers that prevent competition and potentially stop the benefits being available to developing markets. Ensuring that information is used in a positive way will be a significant challenge in an area that is not yet widely understood.

## Employment impacts

Agriculture and its associated industries remain one of the world's largest sources of employment. Due to the potential of this technology to reduce labour intensity and generate labour savings on farms, the implementation of digital agriculture could cause economic disruption in areas where many people work in the industry.

## Security

As with other industries that are becoming increasingly reliant on digital systems, there exists a key security challenge. If agricultural systems are reliant on technology that is not secure enough, an opportunity for large-scale, coordinated agricultural warfare could arise. Hacking control systems to damage crop growth, contaminating feed and water supplies, and manipulating data to conceal issues could all be used to damage yields and threaten the ability of people to feed themselves.

## Case for change

Case studies showing the effects of digital approaches on mainstream crops are still uncommon – especially those showing the long term benefits. This makes it difficult to develop business cases that show consistent benefits. Although this is changing, in the short term it may inhibit farmers' willingness to deploy technologies and possibly restrict the ability of individuals to secure investment.

## Development costs

Despite falling costs, the initial outlay for development and adoption in large agricultural settings could be prohibitively high, and discourage usage and innovation. Technology must be understood, sourced, deployed, connected and monitored to create an effective system and this one-time cost, especially in an area that is not yet widely understood or proven, may be a significant barrier for some years to come.

# Technical Considerations

As digital agriculture is a complex system of technologies, it is essential to clearly define the design and manage the integration of the disruptive technologies that underpin it.

## User centric design

It is often difficult for technology companies to understand the farmers' exact needs and to assess how good is 'good enough' for everyday use. In the short term, this may lead to advances which fail to address the key areas of need or deliver over-performing systems which are unnecessarily expensive. Closer links to farmers and other key stakeholders and continuous communication with end-users will help to ensure that the most value is gained from innovation.

## Technology integration

The integrated systems of digital agriculture often rely on a number of early-stage, emerging technologies – for example autonomous robotics. The progress in implementing digital agriculture solutions in many areas will be heavily linked to the development of these underpinning technologies.

## Connectivity

Integration of digital agriculture systems will require reliable connectivity between fields, data centres, end users and other parts of the supply chain. Reliable connectivity of some form will be necessary to aid ease of adoption but is often lacking in many parts of the rural world.

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# Enabling New Business Models

Digital agriculture can vastly increase efficiency as well as create new markets and opportunities.

Unlike much of today's farm equipment that is both large and expensive, the continued decline in technology costs and the reduction in the size of devices means that digital agriculture should be substantially more accessible to populations in developing economies. This means the benefits can be felt across the globe and in countries that are simultaneously the most reliant on agriculture yet the most challenging to farm.

Digital agriculture will empower customers by providing information on food history and safety at the point of purchase. It will transform farming through better decision making, more precise management, and automated action through the use of robots and advanced machinery. At its most disruptive, digital agriculture will integrate systems across the supply chain to allow better information sharing between providers, distributors, retailers, consumers and supporting industries.

New companies are already offering products and services based on digital agriculture technologies. However, it is recognised that hardware alone is no longer enough; the key is to integrate this hardware into systems which capture the right data, use algorithms to make that data usable, and direct the use of agricultural hardware. While currently many individual solutions exist, in the future businesses will join these up to create new disruptive approaches.

Digital agriculture will both affect existing business models in the sector and create new opportunities. The greater focus on the end user enabled by some of the technologies, and a continued reduction in price will allow experimentation and enable small-scale local providers to be more innovative and explore new applications. Existing businesses are likely to be disrupted by the desire of consumers to be closer to the farmer and in doing so, remove cost in the process of getting food from farm to fork.

However, no single company seems to have all the capabilities across digital agriculture. This means successful companies will be able to identify their core capabilities and work to build relationships in those areas where they do not have the right skills.

Digital agriculture will enable a number of the disruptive business model levers identified on the Project Breakthrough website, specifically:

## A more personalised product or service

Digital agriculture technologies may create demand for personalised services where products are tailored to the requirements of individual farms.

## A closed-loop process

Digital agriculture technologies will enable a reduction in chemical usage, a reduction in waste and spoilage, and better matching of demand to supply.

## A collaborative ecosystem

Digital agriculture will enable better collaboration across the food supply chain. It will also create opportunities for providers of digital agriculture products and services to the industry.



## More Examples...

Fujitsu enrich diets of kidney disease patients by reducing potassium in lettuces

<http://www.iotjournal.com/articles/view?12992>

PepsiCo significantly reduces water use by recycling waste water and only irrigating when needed

<https://www.environmentalleader.com/2016/09/how-pepsico-saved-80-million-by-cutting-water-use-26/>

Urban Farmers are using technology to bring farming to where people live

<http://www.dutchnews.nl/features/2016/04/89233/>



### United Nations Global Compact

The United Nations Global Compact is a call to companies everywhere to align their operations and strategies with ten universally accepted principles in the areas of human rights, labour, environment and anti-corruption, and to take action in support of UN goals and issues embodied in the Sustainable Development Goals.

The UN Global Compact is a leadership platform for the development, implementation and disclosure of responsible corporate practices. It is the largest corporate sustainability initiative in the world, with more than 9,000 companies and 3,000 non-business signatories globally.



## Project Breakthrough

Project Breakthrough is a collaboration between UN Global Compact, Volans and partners that spotlights the best thinking in sustainable innovation. It showcases innovators across mainstream companies and next generation entrepreneurs who are developing solutions with the potential to achieve exponential impact. It features analysis and resources designed to help leaders understand the new business models and technologies that will be crucial in achieving the SDGs, catalysing action amongst today's businesses to meet the needs of tomorrow's world.



The Disruptive Technology Executive Briefs are produced in collaboration with PA Consulting Group, combining cross sector technology, innovation and business design expertise. The briefs are intended as an easy to digest introduction to disruptive technologies, to help organisations understand how they could advance the Sustainable Development Goals and business performance. These overviews explore key features, examples of applications, potential positive and negative impacts, and how they may enable the new business models.

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