Digital agriculture:
helping to feed a growing world

Digital (or precision) agriculture and big data hold answers to the problem of how to feed a growing world sustainably. The field-level impact of this next agricultural revolution has been well documented, digital agriculture will, without doubt, change farming. However, research on its effects of agribusinesses has been limited despite the fact it will fundamentally change multiple business functions for agribusinesses across the world. This is the first in a series of articles that will introduce these concepts and foreshadow how agribusinesses will be affected.

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While the current focus on most investment and publications has been on how digital agriculture will change farming, little has been written on how this same data will impact the various agribusiness stakeholders. We have written this article as the first in a series that focuses specifically on the opportunities and challenges that digital agriculture and big data will create for agribusiness and food companies.

Big data and analytics have made headlines across the world for their proven ability to create and transform industries, increase revenue through new products and new customers, and reduce costs and drive efficiencies. As we continue to generate ever more data through the proliferation of IoT and sensors, new technologies and techniques are being employed to turn this data into usable information. Technologies such as machine learning and artificial intelligence (AI) offer users opportunities to harness and transform this data. The growing emphasis on big data has been coined the "big data revolution" and is identified as one of the most transformative technological business strategies of the past decade. LinkedIn and Uber are well-known examples of how big data, industry and disruption go hand in hand. The agriculture industry has been no exception to this trend.
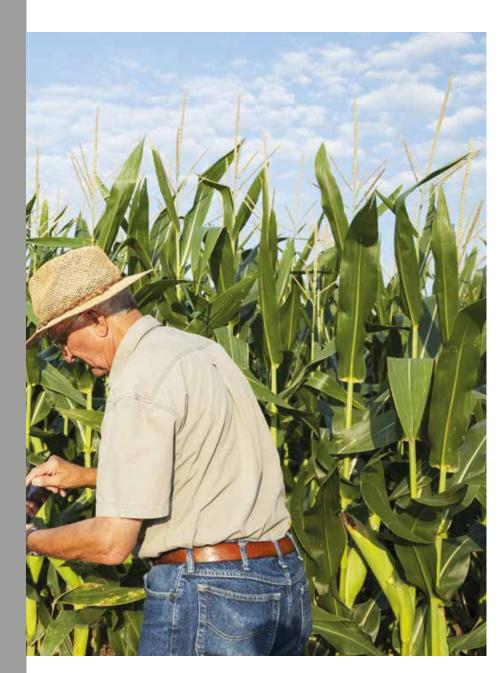
To outsiders, agriculture is often thought of as a low-tech industry. Ask most individuals about farming and they will describe a farmer with an old tractor and plow. They are often surprised to know that modern agriculture is highly technical. For example, the first commercial drone license issued by the US's Federal Aviation Association (FAA) was to a company for agricultural application. Data collection is evolving from hand-written notes and manual field analysis to automatic data capture via equipment, software, remote sensors and aerial drones. The value that this insight can bring to the producer and agribusiness is so significant because it will drive innovation on top of innovation. For example, historical yield, soil, nutrient and weather data can be analyzed to help a producer make a decision on how much fertilizer to apply to a certain soil type in specific climates. An agronomist can analyze field data to recommend the optimal seed that a producer should purchase.

The agriculture industry has begun to harness the power big data can bring to operations. Software and algorithms are being created to leverage data to increase yields, improve farm profitability and increase farm sustainability. Investors are taking note. According to AgFunder, over US$4.6 billion has been invested in agriculture technology during 2015.[1] Much of this investment is in software and technology to enable digital agriculture – a combination of data and algorithms that provides specific recommendations at the sub-field level. For example, whereas today most farmers make a decision to plant one seed variety on an entire 40 acre field, digital agriculture allows farmers to identify and plant the "optimal seed variety" in every square meter of the field.

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Investment
in AgTech in 2015:
more than

US$4.6b

Source: L. Burwood-Taylor, "Agriculture Technology Investment Storms to $4.6bn in 2015 as Global Investors Take Note," *AgFunderNews.*

Digital agriculture and big data hold the promise to feed a growing world sustainably

By 2050, the global population is expected to increase by 40% to 9.6 billion people. In order to feed this drastically increasing population, the agriculture industry will need to produce 70% more food while only using 5% more land.[2] This, coupled with growing environmental and regulatory pressures, poses a daunting challenge for the industry. Current production rates and distribution methods will not be nearly enough to feed the population. It is generally acknowledged that digital agriculture and big data will be needed to meet these demands.

1. L. Burwood-Taylor, "Agriculture Technology Investment Storms to $4.6bn in 2015 as Global Investors Take Note," *AgFunderNews,* 2016, https://agfundernews.com/agriculture-technology-investment-storms-to-4-6bn-in-2015-as-global-investors-take-note5380.html, accessed November 2016.

2. *How to feed the world in 2050,* Food and Agriculture Organization of the United Nations, 2009, http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf, accessed November 2016.

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The third agricultural revolution

Digital agriculture is widely recognized as the third great revolution of modern agricultural. The introduction and implementation of mechanization (1900 to 1930) and genetic modification (1990 to 2005) are referred to as Ag 1.0 and Ag 2.0 respectively. Both revolutions drove efficiency, yield and profitability to levels previously unattainable, and are now conventional in developed countries across the world.

While Ag 1.0 and Ag 2.0 definitely drove significant changes in agriculture, we believe the Ag 3.0 will be the most transformative and disruptive, not only on the farm, but across the entire agriculture and food value chain.

Digital agriculture will change farming

The impact of digital agriculture on the field is well documented and researched. From variable rate application to real-time NDVI visualization (i.e., the index for visualizing vegetation health), farming will forever be changed. In the future, data creation, analysis and decision-making will almost certainly increase at the field level. Farming operations will have the opportunity to prosper from targeted field solutions, data-driven agronomic advice and smarter inputs. Software is being developed to help propel developing countries toward modern farming practices. Farms are consolidating at an increasing rate as technology supports automation and economies of scale. Input applications are based on factual data and investments into farming tech are funded by profit saved by data-driven efficiency.

While the benefits of digital agriculture are compelling, it has been met by significant challenges, for example, difficulty using software, data usage concerns, disparate and propriety data formats and an unclear return on investment. Agribusiness has struggled to provide immediate, tangible results from digital agriculture equipment and software. Challenges around gathering and standardizing data make adoption difficult across all stakeholder groups. Undeveloped countries lag in adoption with weak network infrastructure and limited capital. The gap between modern, advanced farming and subsistence farming is growing at an alarming rate. All of these factors raise important questions for the industry. Producers face problems and decisions every day, both on and off the field. These decisions are projected and magnified up and down the entire value chain — from field to fork. What does this mean for the various stakeholders in that value chain?

In 1960,
a farmer fed
26 people:
a machine
revolution

Today,
a farmer feeds
155 people:
a biotech revolution

By 2050,
a farmer will need to feed
more than **265 people**:
a digital agriculture
revolution

Digital agriculture is creating competition among both traditional and nontraditional competitors.

Digital agriculture will fundamentally change agribusiness

While the first two revolutions in agriculture – mechanization and biotech – had a major impact for farmers and select agribusinesses, digital agriculture will fundamentally transform every part of the agribusiness value chain. Seed companies were not drastically changed from the bottom up to accommodate advanced machinery. While significant innovation occurred in equipment design, it was not altered to specifically accommodate genetically modified seeds. However Ag 3.0 will affect producer buying behavior and seed and equipment product design, and could enable dynamic pricing at the consumer retail level. These implications will gradually affect multiple business functions across a single company. For example, digital agriculture and big data will change the way seed and agrichemical companies market, price and sell products, select and invest in their R&D pipeline, recommend and technically support product sales, manufacture and distribute products, and manage credit and financial risk. Business strategy, product design, customer preferences and even organizational structure will change as more digital agriculture data is available.

As technological advancements in equipment and inputs slow, companies will need increasingly to compete on digital strategy. Being able to support digital agriculture becomes ever more important. This revolution will also challenge traditional company roles, intercompany relationships, reward systems and, potentially, entire business models. Digital agriculture is creating competition among both traditional and nontraditional competitors. The industry is in a storming phase and agribusinesses are working to solidify their place in Ag 3.0. Several companies are investing heavily in internal data activities such as standardization, storage, software and analytics. Others are focusing on outsourcing strategies or licensing software from other companies. Still others are taking a wait-and-see approach. As the industry evolves, disruption will follow. It is essential for agribusinesses to transform their business and themselves to differentiate and provide more value to customers.

How will digital agriculture and big data impact agribusiness?

Although the challenges are concerning, they present thought-provoking opportunities to all stakeholder groups. How do agribusinesses begin to explore

these opportunities, understand the goals of other stakeholders and collectively move the industry forward in Ag 3.0?

Our goal is to provide insights and help the industry ask the right questions to spur conversations that develop strategies for their businesses. The next few articles will focus on how a particular stakeholder group's business functions, challenges and opportunities may be impacted. The series will wrap up by examining some big-picture ideas facing the industry and presenting our thoughts and conclusions on these issues. ∎

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