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Feeding 10 billion people in 2050

Debunking the digital myths in agriculture

People matter, results count.

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In 2015, Capgemini set up a global team of experts focusing on Agriculture. This is an expert community within Capgemini that focuses on the agribusiness and consist of agronomists, technology experts, data scientists, and researchers in the field of agribusiness. The community tracks the trends and developments within this industry and keeps a close eye on the startups in the agribusiness industry, their offerings, and what can be applied or developed in our Applied Innovation Exchange. Capgemini's Applied Innovation Exchange (AIE) enables organizations to take advantage of a global network of innovation spaces to rapidly and securely gain a competitive advantage in today's fast-paced innovation market landscape. Most importantly, we talk to our clients, and leverage the knowledge we have on how other industries are dealing with these changes.

Introduction

We are happy to present you our first whitepaper on Agriculture. Our goal is to share our point of view on the developments in the agribusiness. The challenges in agriculture are enormous. The biggest challenges include: feeding 10 billion people in 2050, changing climates, changing social systems, and the growth of megacities.

It's not the first time that humanity is faced with these challenges. When (1880-1885) the first steamships brought their grain from the Midwest of the United States towards Europe, the competitive landscape has changed completely and brought the peasants in Europe into poverty: the potatoes crisis in Ireland, costing the lives of more than 1 million people being a prime example. Today, in our dynamic digital world, dealing with millennials, and the fast pace of technological development, the agriculture businesses are being challenged in a new way.

Digital also brings along a plethora of opportunities: new breeding techniques, new crops, and newer concepts like Monsanto's using the mycorrhizal fungi for a better soil life. Given all this, one makes us wonder how the founder of the biodynamic farming movement back in 1924, Rudolf Steiner, would have reacted. Probably, he would have embraced this development. But the bigger question is: how will his followers react?

These are interesting times. Going digital does mean a lot: it offers new service offerings, and farmers can access better and real-time advice. At the same time, the role of the agronomist will change. Robotics and drones can offer the farmers a better life, and they can go to live in the cities and control their farms from a distance. Smart farms will be the new normal.

On the other hand, the biggest groups of farmers are small holders who earn just enough to sustain themselves. They are not rich and do not have access to easy capital. The question is: can they become part of that journey? Can we offer them services that enable them to lead better lives, or become equal trade partners?

This is the global challenge that Capgemini is shaping to service. As a global IT leader with our roots in applications for five decades, we know which technologies are there in the market and how we can use our innovation-as–a-service to share our cross-disciplinary insights. More importantly, using our Applied Innovation Exchange, we can actually demonstrate some of recent and meaningful our developments.

Buzzwords like Big Data, Deep learning, IoT, and Blockchain do not mean anything if we cannot integrate them into everyday operations. We have not yet seen the Uber of agribusiness. Probably it is already there, or probably it is arriving. Combining the capability of ICT with the capability of agriculture to create sustainable business models is a journey we are taking every day with our clients, governments, universities, and our partners. We know for sure that one size does not fit all: you need different approaches, different storylines, depending on the climate and the culture you are living in.

Jacko Obels

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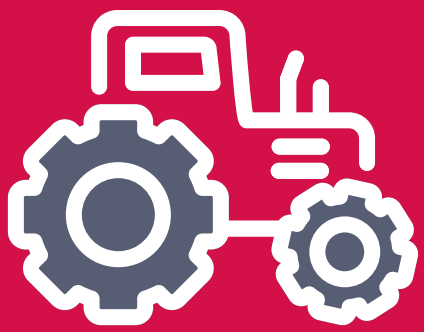


Background

In 30 years, the world will need 70% more food [1], of better quality, and produced in a sustainable way.

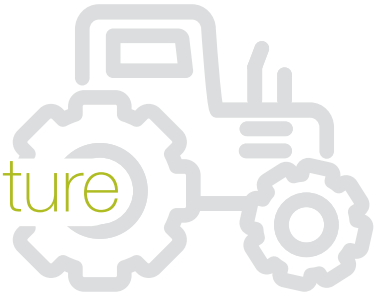
Agriculture must take advantage of the new and effective data-enabled products and services to feed the 9.7 billion people of 2050. But, as a matter of fact, those involved in this industry, farmers or multinationals, have little or no history of convergence. Open innovation and other drivers that have been fueling the digital transformation in other sectors, are still missing in agriculture.

In general, farmers do not trust large companies enough to share their data with them. However, large agribusiness companies have the footprint and expertise to monetize these new products and services. Therefore, this shift is as much technological, as it is social.

As a result of the current scenario in agribusiness, a variety of food companies requested for our insights regarding the ongoing digital revolution in agriculture. Thanks to our strong end-to-end experience from the field to the fork value chain: we as Capgemini are helping players of all sizes, identifying where technology can give them an edge in this dynamically changing and competitive market.

This document is the result of interviews with agriculture leaders, market analysis, and literature reviews. It aims to debunk the myths surrounding digital agriculture and reveals some of the key steps that are necessary for a meaningful and successful digital agriculture transformation.

Moore's law of Agriculture



"Moore's law" of Agriculture is based on the vision that between 2016 and 2050 the world's population is likely to rise to 9.7 billion [1] people. All developments serving this goal are interesting to look into: be it technology like ICT, big data, IoT, LED-Farming, or developments like adding mycorihza to the soil, GMO, or finding new crops. Importantly, all these developments need to go hand in hand.

Today, our planet has enough food to feed all its inhabitants, although about 795 million people do not have enough food to sustain their daily activities and stay healthy. In 2050, being in a position to feed the world population cannot be taken for granted. Meanwhile, the awareness about food safety, quality and health, as well as environmental and social impact, is increasing in both developed and developing countries.

The standards that are guiding the consumer's choices are rising while they are not necessarily ready to pay a fair and realistic price for better foods.

Arable lands have been shrinking over the years due to climate changes, industrialization, and urbanization. Farming is not always considered as an attractive occupation for those who have the choice to move to cities or stay in the countryside. In western countries such as the Netherlands, the average age of the farmer's community is over 55 [1]; and between 2000 and 2016, the number of Dutch agricultural holdings decreased by 30% [3]. Also, children are not keen to follow the food steps of their parents.

Despite these trends in industrialized countries, agriculture and food production still accounts for 40% of the entire global workforce [4]. Most of these people are smallholders or self-employed (See appendix 4). Those employed by companies are a minority. Securing and improving their livelihoods is absolutely critical, especially in countries with large populations like India or China. Disregarding the opinions of farmers or failing to provide food security will certainly trigger political and socio-economic catastrophes.

With the compelling need to produce as much as twice the amount of food in the coming 30 years using half the resources that we currently have, agriculture is facing the biggest challenge of all times. To cope with this challenge, the sector is seeking new products, practices, and technologies to increase the yields and quality of our food while using less land, less chemicals, less water, and producing less waste.

According to a 2015 report [1] from the McKinsey Global Institute, agriculture is the least digitalized industry in the USA; far behind construction, hospitality, and Health Care (Appendix 1). Yet, overcoming agriculture challenges will require breaking through the weakest links of the food chain by using technology, with digitization as a keystone.

The food and agribusiness industry accounts for 30 percent of greenhouse-gas emissions and represents 10 percent of global consumer spending [2]. Despite the importance of agriculture, it has been disregarded for a long time by digitization experts. Forecasts and trends made the markets aware that food and water supply will be increasingly important in our societies. As a result, large firms from all horizons as well as private investors are now rushing to what is promised to be the golden age of agriculture (See Appendix 3)

Very few of the new digital players can claim to have the proper experience and knowledge to tackle agriculture. Digital experts that have been successful in industries like finance, automotive, oil and gas or telecoms, are now asked to address agriculture.

The companies that have led digitization of other industries now realize that agriculture will be a tough nut to crack. They are puzzled by dealing with biological assets that live, fall ill, and have a long adoption process before hitting the shelves. Even though the agricultural shift is set to be challenging, most of the industry players are aware that they need to engage their digital strategy right now or run the risk to fall out of the game.

The unusual combination between digital and agricultural players has led to different misunderstandings. Most often they are due to the fact people consider agriculture with the yardstick of other industries they are familiar with, ignoring what is behind their daily meals. Debunking these misconceptions is the first step any company must take if it intends to understand and thrive in the coming digital revolution in agriculture.

Debunking the myths

Interviews combined with literature from leading IT companies, Ag-(agricultural) companies, government, academics, Ag-investment funds, start-ups and farmers have revealed ten myths that need to be addressed in digital agriculture.

Like most myths, they all contain some elements of truth. Discerning these nuances can give players of every size and background, an edge to succeed in this industry.

Myth 1: Digital Agriculture is Digital Farming

There is still a long way to go from Digital Farming, which is farm centric, to actual digital agriculture. Tractors have started being equipped with GPS from 1994. Satellite imagery, sensors, drones and farm management software are now appearing at an unprecedented rate in the fields. Digital farming is about making farming more efficient. Agricultural giants, governments, and IT behemoths alike such as John Deere, Monsanto, Bayer, SAP and IBM all launched their digital initiatives for agriculture.

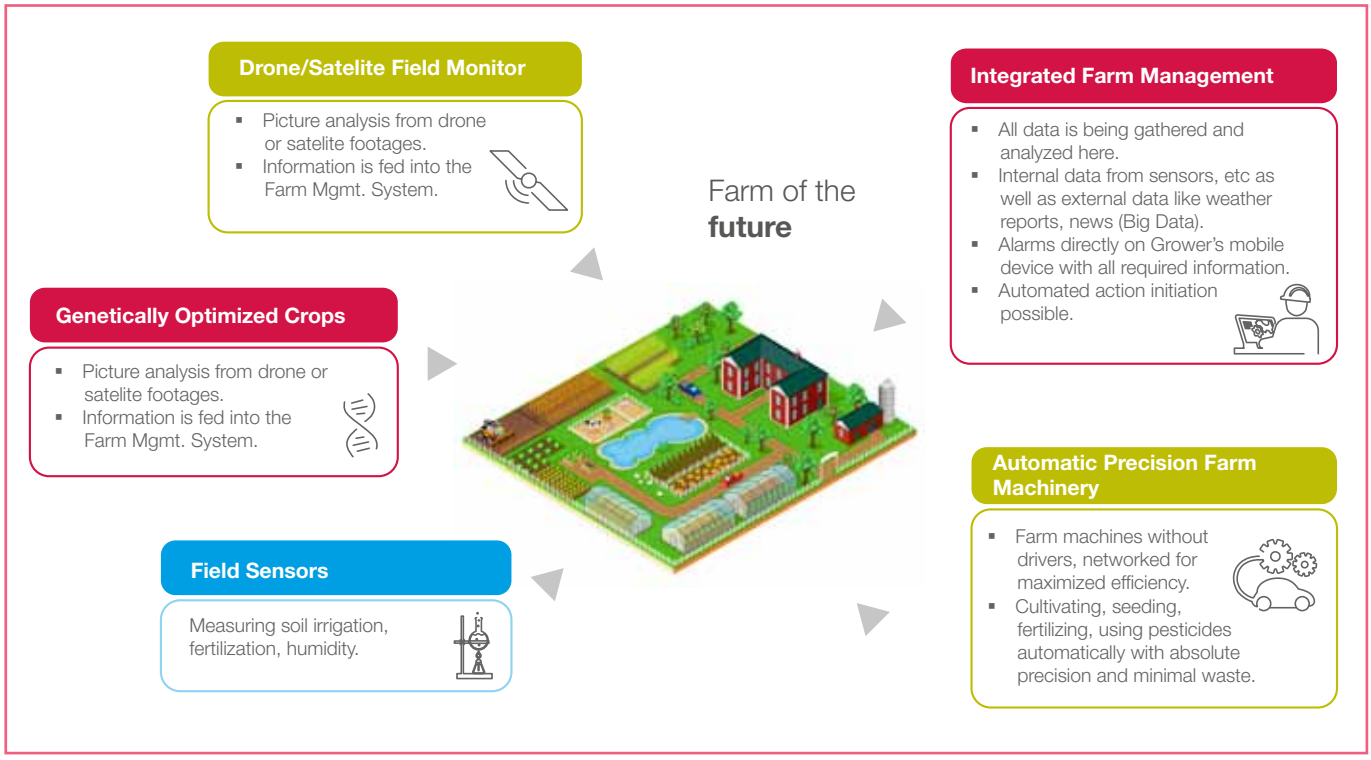
Depending on their background, these initiatives address farming in different ways. Agricultural companies are developing digital services complementing their core business. For example, Bayer offers its clients a web platform enabling them to monitor fields, weather, and manage their spraying. IT/ERP firms usually have a larger scope and try to encompass all farm activities. For example, SAP is creating a connected Agriculture platform based on SAP Cloud Platform. It will act as an App and API marketplace where SAP and their partners can develop collaborative solutions for the Ag-industry. Farmers will be able to pick the most fitting apps and offering for their activities. The increasing variety and number of these initiatives also raises question about how many applications a farmer will need to work with.

SmartAgriFood project is part of the Future Internet Public-Private Partnership (FI-PPP) program and addresses farming, agrcultural logistics and food awareness as a use case for this. The intelligence, efficiency, sustainability, and performance of the agricultural food sector can be radically enhanced by using information and decision support systems that are tightly integrated with advanced internet-based networks and services. Concurrently, the sector provides use cases for Future Internet design from physical layer all the way up to the service layer.

SmartAgriFood focuses on three sub systems of the sector:

- smart farming, focusing on sensors and traceability;
- smart agricultural logistics, focusing on real-time virtualization, connectivity, and logistics intelligence;
- smart food awareness, focusing on transparency of data and knowledge representation.

Using a user-centered methodology, the use case specification is developed with a particular focus on transparency and interoperability of data and knowledge across the food supply chain.



Smart farm equipment, drones, and robots are enabling precision agriculture. Big data and algorithms in agriculture will enable insights and optimization in the field. Most of the initiatives are farm-centric, directed towards row crops. However, **Digital farming is just the first step of a long and complex digital food chain in the making.** Food logistics, processors, retailers, and consumers can all benefit from this digital shift.

Using data in food logistics will enable track and trace, quality control, insurance cost reduction, routing, planning and food safety optimization.

Data driven food processors will be able to reduce their stock levels, prevent food fraud, improve food safety, use smart packaging, automatize food handling and planning to reduce costs and waste.

Retailers will be able to use new digital tools to better manage their inventories and product quality with data enabled supply chain and logistics optimization. Using data, they will be able to understand their client's needs, offer food traceability to their customer, display proofs of their sustainable engagement and understand their consumption pattern.

Data can bring a lot to all players along the food chain. However, the challenge is not only implementing data enabled processes and technologies in the fields. It is also about collaboration between the millions of stakeholders involved in the food chain. Farm-input providers, farmers, logistics providers, processors, and retailers need to leverage each other's data to create value.

Myth 2: Food and agriculture are hard sciences

> Food, in the end, in our own tradition, is something holy. It's not about nutrients and calories. It's about sharing. It's about honesty. It's about identity.
>
> **Louise Fresco**
> **2009**

If an energy source was discovered to be 100 times cleaner and cheaper than what we are using now, it is safe to assume the switch will be almost immediate. Animal protein requires 100 times more water than protein from grain, yet the global meat consumption will increase by 76% between 2007 and 2050 [4].

Food and agriculture sciences are not hard sciences and obey much more than logic.

Food tastes are set during our infancy and early childhood. They are influenced by culture, religions and communities. This can lengthen adoption cycles, and possibly impede them by insuperable, and purely irrational hurdles. Asking a Dutch citizen to stop consuming dairy products or a Chinese citizen to stop eating pork is a completely different paradigm shift as compared to switching from Samsung to iPhone.

Meat-based diets for human and animals are probably the lowest hanging fruits that are not so difficult to advocate and are socially acceptable.

The European Commission [5] has identified a clear downward trend with red meat consumption in Western Europe while dairy and poultry segments are both strongly developing. These trends are not only fueled by price evolutions or any supply-related elements. Consumers concerns about environmental impact and sustainability and animal welfare has also contributed to this development.

Our expectations towards food are changing. Food safety used to be a simple target a couple of decades ago, now it is a mandatory license to operate in all developed countries. In the same manner, traceability, sustainability and labeling are also set to become prerequisites demanded by consumers and authorities.

Regardless of scientific breakthroughs with food production, our own biology can impose limitations. We are mammals, omnivores bound by specific needs that cannot be easily overcome.

A vegan diet can leave humans with dietary deficiencies. Genetically modified organisms can be a solution for the future, but they are also raising concerns about their long-term effects on our health. Therefore, only few things are possible whilst it comes to changing our food habits.

Our physiological needs will always be our priority. Without the 2,500 calories per day required for a 75 kg adult male to meet his basic metabolic needs and be active, can have drastic effects on our attention spans and ability to do mundane daily jobs.

Therefore, any promise of what digitalization in agriculture can bring will have to deal with the, slow pace and hardships imposed by nature across our food chain. Digitalization will certainly help to mitigate these uncertainties but optimizing crop or animal farming from field to fork – like it has been done for automotive production – is not going to happen any time soon.

Myth 3: Food is a global game controlled by multinational companies.

Agricultural giants such as Bayer and Monsanto are merging, and cooperatives such as FrieslandCampina are acquiring positions all around the world [7].

Consolidation in some parts of the food chain is in motion. Upstream and downstream successful players are expanding horizontally towards other segments that are complementary to their core business. Larger players take over multiple new activities including farming, or acquiring more farming assets if they are already farmers: for example Olam (Asia & Africa) and Cofco (China). These shifts are giving the inaccurate feeling that food is a global, highly consolidated business.

The reality is that, unlike most of the other industries, food is a very local and extremely fragmented business. Producing food involves millions of stakeholders ranging from multibillion dollar multinationals to local operating smallholders

In regions, such as Asia or Sub-Saharan Africa, smallholders represent 80% of the food producers [6].

Consolidation is taking place – yet not at the same pace and to the same extent across all segments and geographies of the agricultural industry.

There are exceptions such as grain and oilseeds trading, plant genetics or a few niche markets that are controlled by a handful of players but even these companies represent a relatively limited part of the whole value chain.

And yet, the four giant transnationals that dominate the raw materials of the global food system have largely stayed below the radar of European consumers. Known as the ABCD group for the alphabetic convenience of their initials, ADM, Bunge, Cargill and (Louis) Dreyfus, account for between 75% and 90% of the global grain trade, according to estimates. The figures are indicative as because two of the companies are privately owned, and do not give out market shares.

This extraordinary concentration of power and money in the global food trade has been identified by Oxfam in a new report as one of the structural flaws of the system. At each stage a handful of players dominate, not just in primary agriculture but in food manufacturing and retailing. The result, according to Oxfam, is that “they extract much of the value along the chain, while costs and risks cascade down on to the weakest participants, generally the farmers and laborers at the bottom”.

The fragmentation of the agricultural industry is the result of multiple constraints, such as food security. Countries have been welcoming foreign companies coming to exploit natural resources, build factories, or deploy telecom networks. However, this will not happen easily with agriculture because food security and control over the land is at stake.

Governments will not allow foreign or corporate interests to gain control over its food supply, to rule over any significant part of its territory or to push its farmers, often in large numbers, out of their jobs. This will trigger coups and political disturbances.

Like issuing currencies, food security and land ownership are sovereign functions leaving little room for corporate involvement. Even the grain and oilseeds trading giants and the increasingly consolidated seed companies need farmers more than the opposite. Big or small, a farm is firstly a plot of land embedded in a national territory. Even soil-less farming requires inputs like water that are local and strictly regulated by the states.

Multinationals cannot disregard these elements; else embargos, registration rules, anti-monopoly regulations and public outcry will exclude them from these markets.

Considering these market realities, food production is unlikely to become a highly consolidated industry. At least not as much as those industries that have already enjoyed the lowest hanging fruits of digitalization like telecommunications, healthcare, or energy.

For these reasons, the agricultural industries space is not set to be “owned” or disrupted by the “few”, but will remain a complex arena orchestrated by digitization, in which all players must position themselves where they can create value.

Myth 4: "The retailers are killing the farmers"

Food retailers are commonly blamed for having squeezed the profit margins of farmers by taking advantage of the intense competition across the food chain. This is inaccurate. In fact, retailers are struggling with their assets and are now under-performing in the major stock indexes [9].

It is actually the Western consumers who have greatly profited at the expense of the farmers. In countries such as The Netherlands, only 15 % of the household spending goes to food while it used to be up to 30% in the 1960s [10]. **The part of the income that was intended for buying food has shifted to other expenses such as entertainment or traveling.**

Farm income in developed countries has been shrinking over the past years [5]. According to the European Commission, the agricultural labor force is expected to drop from 9.9 million in 2014 to 7.3 million in 2025. Agriculture income should increase by 10% by 2025. However, rise of production costs will negate any benefits for farmers [5].

Over the past decades, the volatile food prices spiraling down has left little room for making the food production more efficient. As investments are growing, agriculture must now seize the opportunity to catch up using available technologies.

Myth 5: Farmers are not ready for digital

The increasing age of the farmer's community and their difficult (See myth 4) situation has led to the misconception that they are not ready to use digital tools in their daily work [5].

However, according to a French IPSOS-Agriavis survey in 2016 [7], **65% of French farmers are willing to continue investing in technology/digital.** They are expecting to gain time, reduce work nuisance, and improve their margins.

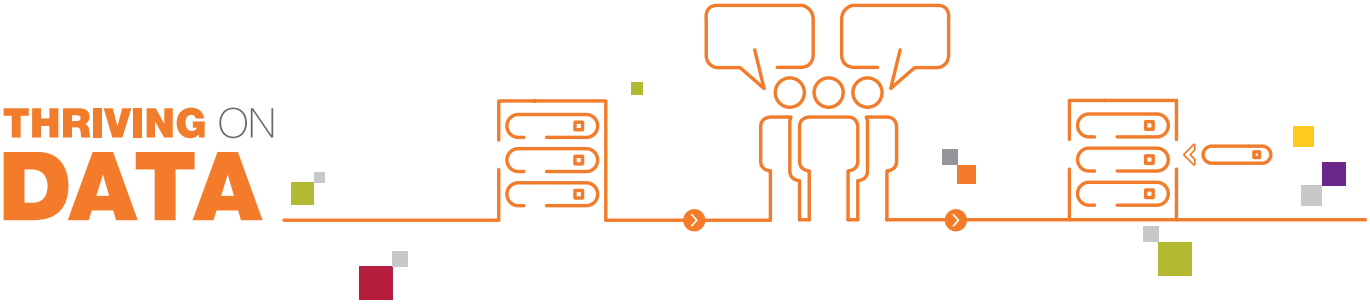
Markets such as row crops in the USA are showing increasing costs for lower crop value (See Appendix 2). Consequently, farm management solutions enabled by big data and precision farming (observing, measuring and responding to variability in crops) are being adopted as they can provide higher yield with little investments.

Large agricultural firms are also adapting and starting to offer more than just seeds, chemicals, or farm equipments. These companies are all developing farm management software using data from the farms. The data from weather conditions, soil conditions, fertilizer use, farm history, crop performance, etc, are being interpreted and provided to farmers resulting in higher yields with accurate information on its content and features. Soon farmers might not buy farm inputs anymore but will buy "yield", as mix of service and products with precise expected performance. This can result in increased revenue thanks to dynamic pricing based on the product quality.

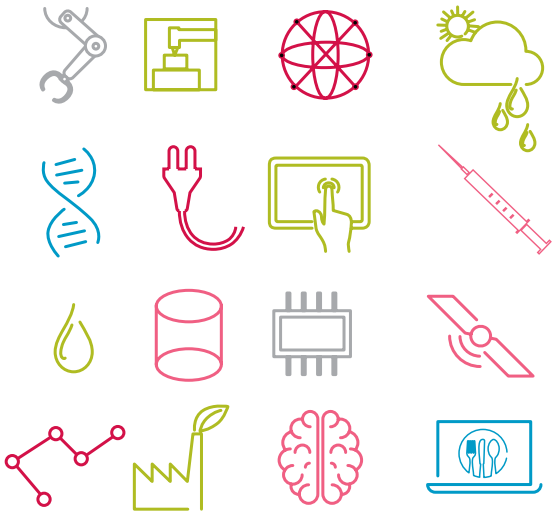
The real challenge is making technology available to the numerous and scattered farmers around the world. In this quest, the agricultural-industries can count on multiple initiatives to connect rural areas such as the World Bank's project in India or even Facebook's internet drone.

Even though farmers are ready to go digital, they will need guidance to select the most fitting technologies as well as financial support to use these new tools. Farmers are also aware that their data will be valuable, hence expect material return on investments.

Capgemini Insight and Data is using Predictive Analytics, delivered in real time to redefine business models and create new ones. "Combining data from all across the food chain will make it more valuable. It is Capgemini's objective to help every member of the food chain harvest the fruits of this digital revolution."



Myth 6: Technology is the bottleneck



Plant and animal sciences, robotics, cheaper sensors, precision farming, transition to sustainable protein sources, vertical agriculture, aquaculture, biotechnologies, bioinformatics, genotyping, phenotyping, smart water and irrigation management, alternative crop protection, satellite imagery, drones, nanotechnologies, and Blockchain are already here to serve the future of food [12]. No matter the field of technology, it will benefit from valuable data further processed into new generations of products and solutions.

At this stage, technology is no longer the bottleneck. Most of those necessary technologies to feed the billions are already available, being developed, or have their building blocks already existing somewhere.

Breakthroughs are not only enabled by new technologies as such, but also by cheaper devices, faster feedbacks across the value chain or better engagement with the consumers. Combining these applications to create the most suited offer for each segment of the food chain will be the fundamental step to turn technology into market reality.

In food and agriculture, the forward thinkers, possibly disruptors, are the need seekers instead of those delivering technologies.

To quote Henry Ford: "If I had asked people what they wanted, they would have said faster horses."

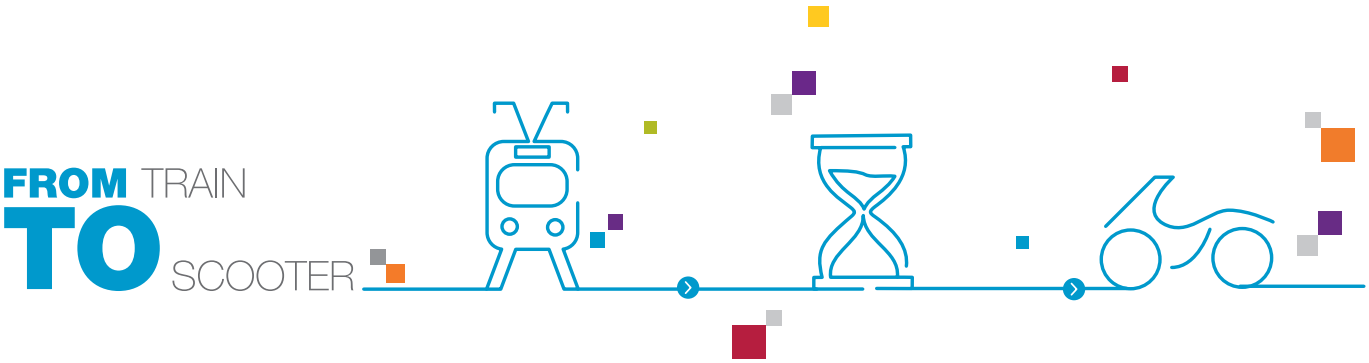
Interestingly, Henry Ford's factories manufactured 10,000 cars in 1908, 472,350 cars in 1915 and 933,720 cars in 1920.

While technology is getting cheaper, data and analytics are getting more valuable and effective. Manual processes are rapidly being taken over by new automatic tools and big data will speed up this trend.

One example is the SCiO, an affordable and portable molecular sensor that could replace expensive and heavy equipment in the years to come. However, SCiO is yet to convince users to take the plunge with specific, meaningful, and commercially viable applications.

In this new digital industry where the technology is not the bottleneck, Waze's (community-based traffic and navigation app) co-founder Uri Levine's quote sounds like the keystone that can make agriculture go forward: "Fall in love with the problem not the solution."

Ron Tolido, Capgemini expert in IT strategy transformation, is building platforms to support multi-speed IT and explore new solutions with agile approach like Scrum and DevOps. Says Ron: "This way of working is a perfect fit for agriculture where large companies and smallholders alike are still lagging behind in their digital journey. No one can pretend to know which technology will disrupt digital agriculture. Thanks to a broad catalog of expertise and technologies, Capgemini can make its client identify where value is to be made, and integrate a tailored solution."



Myth 7: Analytics and Big Data are safe bets

Big Data and analytics are by far the investment priority of the Ag-tech revolution [8]. These services have made their proofs in other industries, bringing cheap and scalable solutions combined with transparent added value. These features seem perfectly fit for the agriculture challenges.

However, unlike other service-based business areas where analytics companies are just one click away from the end user, food production cannot be easily disrupted.

Food and agriculture involves biological assets like plants and animals. Not everything is lab-grown but instead subjected to unforeseen chances of natural events and economic downturns. Most of what the world produces has its own biological requirements, its own way of processing, its own geographies, and markets. This extreme segmentation is a large obstacle for data-enabled agriculture as scalability might be hard to achieve. On the other hand, this large segmentation can be solved by using the technologies in a proper way.

One of the key factors in analytics successes has been their ability to offer transparent performance. With food, this transparency is much harder to achieve. For example: How do you account which part of the income is generated by a farm management system and which is due to different weather or fluctuating market prices? Such questions become even more relevant when multiple companies, with different KPIs, need to collaborate.

Mamatha Updhyaya, Capgemini expert in business analytics, states that the secret of actionable insights is data visualization. Says Mamatha: "In Agriculture, more than in any industry, Capgemini puts an imperative in delivering the right insights, in the most meaningful way to each participant in the food chain. By giving a strong attention to visualization, Capgemini aims to make every player realize the benefits they can receive from collaborating in this new digital food world."

Myth 8: Farmers are ready to share data with the value chain stakeholders

Overall, farmers have been treated harshly by their clients and suppliers along the past decades and have not capitalized on the benefits from agricultural innovation. Likewise, the image of those dealing with them is now bad: plant genetic companies suing farmers for saving GMO seeds, GMO seeds that do not produce viable offspring seeds; animal feed companies having spread BSE (Bovine Spongiform Encephalopathy); farmers demonstrating against dairy or meat giants to get better prices; or large retailers putting unbearable pressure on prices.

Consequently, trust between farmers and corporations is just non-existent. In the meantime, farmers, big or small, cannot afford to work in silos if they want to take advantage of the digital revolution based on big data and sharing platforms.

Therefore, mistrust and unwillingness to collaborate will be a major setback to any digital agriculture initiative.

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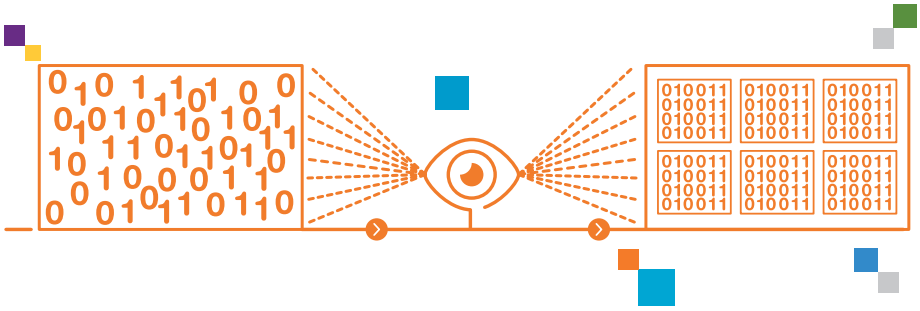


Myth 9: Start-ups are the new overlords

Large corporations, academies, and public institutes are no longer the only or even the most effective innovation engines. Smaller players, such as start-ups, are rising with new ways to extract value out of agricultural data.

A growing number of start-up incubators, grants, investors, as well as governmental institutions like the EU are allowing young companies to develop with unprecedented ease.

Start-ups might be delivering most of the groundbreaking technology and ideas for Ag-tech. However, with food and agriculture, validation is key. And this is where start-ups usually fail. Validation is about turning proof of concepts into value-adding, scalable products, services, or integrated solutions.

Being on the right go-to-market with the right pricing will be crucial for any digital food initiative aiming for success. This is a difficult task in a variable and segmented industry dealing with low margins.

With agriculture, validation does not take place in commercial farms where various interactions are taking place simultaneously. Neither laboratories nor startups are suited to figure out whether their findings are of any commercial value.

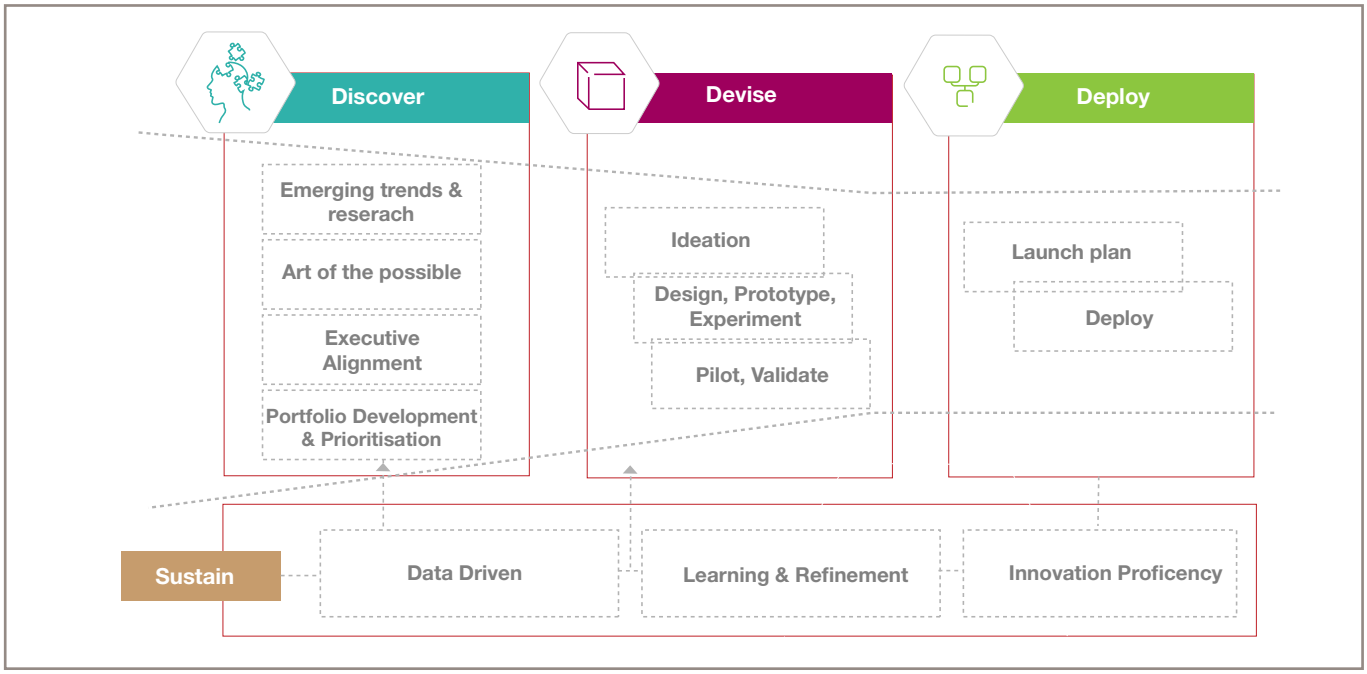
Validating any food industry innovation requires large facilities to run. These are difficult to obtain by start-ups because they require highly skilled specialists employed by multinationals, relying on intellectual properties developed over decades.

Considering these challenges, it is not a coincidence that most of the private investments in food recently have been on food-delivery startups who are indeed one click away from their clients with direct benefits from data [9].

Start-ups are key to the digital revolution in agriculture, but to deliver the real validation, most will need to partner with, or become part of larger players.

Hybrid models involving startups and larger corporations are a fitting combination for digital agriculture. This mix of expertise will be needed to turn (farm) data into measurable achievements acknowledged by the users. Agricultural multinationals, especially the largest ones, will push for open-innovation and implement new organizational models.

Developing these new models is only possible with structures where all the stakeholders can gather. The Applied Innovation Exchange (AIE) is Capgemini's global platform that leverages a framework for action, a network of exchange, locations, and a high performance engagement experience. Together with a broad community of designers, technologists, sector experts, business and technology partners, academics, research organizations and start-ups to enable organizations to proactively plan for and respond to the various technology and business shifts which are confronting them on a daily basis. This approach is well suited for the agricultural business digital shift as it engages players from all parts of the food supply chain around common issues they encounter.



Myth 10: Farmers will pay

Food multinational companies are well positioned to develop new revenue streams alongside or instead of products supply, taking advantage of their technical expertise empowered by digital innovations. Engaging end-users more directly also creates new opportunities (through farm management apps, web interfaces, customer feedback etc.), bypassing middlemen for both startups and large companies.

Such new service-based businesses are fueled by data generated across the food value chain with the farmers at the center. Having this central position, farmers can provide valuable data for seed, chemical, food processing companies, and retailers alike. Farmers cannot afford, for their own good, to keep their data for themselves.

Even though farmer's data can benefit every stakeholder, in the current setup, farmers often are the one asked to pay to share their data. This is a strong obstacle to digital agriculture as a lot of farmers do not have enough resources to invest in new technologies.

Getting farmers or their representatives like co-ops to pay for services will require proving continuously the relevance and upside of such services.
For every single batch, harvest and fiscal year, farmers will want the right metrics so that the savings or premium can be shared between farmers and service providers on a pre-agreed basis.

Those processing farm data must prove they add value, otherwise technology providers might have to pay for the data logs generated by the farms.

Turning data into meaningful, money-making advices to farmers is set to become the new license to operate. This is especially true for agriculture-inputs companies such as seeds, chemicals, or equipment. This will form a new competitive arena beside the price and the quality of their product.

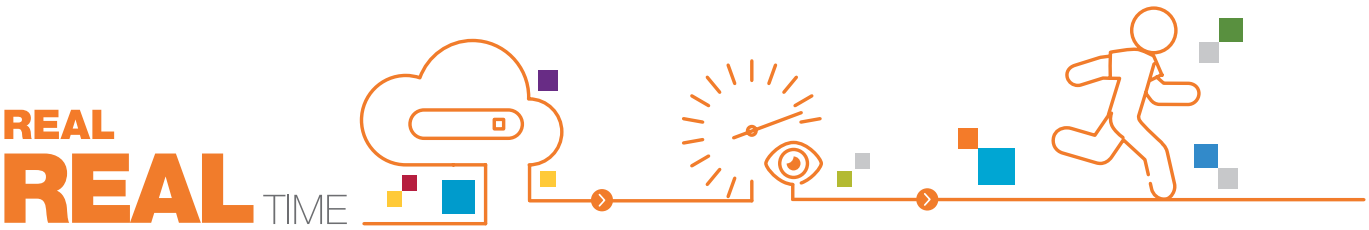
No matter who is offering services to farmers, the challenge is to make them recognize the issues they must solve to generate value. Then, and only then, can they consider choosing relevant technologies.

Food used to be a buyer's market at the cost of farmers, with overproduction and competition dropping the food prices. It is all set to become a sellers' market to the farmer's benefit with the consumers having to spend more on quality food. Higher demand for food both in quantity and quality will result in a shift of power benefiting farmers.

Shorter circuits for food, where farmers sell directly to consumers, are multiplying [10]. Addressing consumers more directly, thanks to the digital platforms, will allow those successful farmers to improve their profitability. By cutting out middlemen, they can secure higher margins. This can be a strong incentive to drive digitization in farmer's operations.

However, concerns regarding data handling, privacy and traceability will decelerate further digitization of farmer's operations. Fintech-originated innovations like Blockchain or other such evolutions may be the way forward.

Rüdiger Eberlein, Capgemini Insights and Data expert stresses the importance of creating ultra-fast insights: "Time is of the primary essence when it comes to food. Thanks to multiple partners like SAP with their HANA data technology and solutions of Big Data and analytics, Capgemini can deliver the right and just-in-time insights that are aligned to our client's needs."



Solving the puzzle

Despite the obvious upside of digitization, even the largest agricultural players are struggling with deploying the proper digital approach. To streamline an unconsolidated industry requires solving many conflicts of interests. To get all stakeholders, including fierce competitors, willing to share data and develop proper governance and infrastructure will take lots of effort.

Several initiatives of various importance, backgrounds, and origins have the ambition to reshape the agriculture scene. To understand how all these different pieces can fit together in a consistent picture, it is possible to examine Walmart's latest move with the Chinese pork chain.

In October 2016, Walmart and IBM announced their plans of using a Blockchain technology to trace the supply chain for pork in China. Food safety is extremely critical in China where melamine in milk killed six children and hospitalized hundreds of thousands in 2008 [11].

Using this type of distributed ledger in the food industry offers multiple advantages. Immutability makes it impossible for the users to cheat on the product information. Traceability provides insight on the meat's origin but can as well indicate what treatment it has undergone. This solution will be a considerable improvement from the current paper-based or RFID tracking that are vulnerable to inaccuracies and fraud. This initiative might save billions of dollars and many lives in the future.

However, more than what it brings, it is important to see what it took for such a project to begin: a 10 year old technology, a country that consumes half of the world's pork supply (EOCD, 2009) and an expensive and vulnerable product. Above all, it took a powerful government that was willing to push collaboration from all members of the supply chain with the help of large foreign companies.

This proves that technology and even crucial challenges such as food security, waste, or quality are not the only keystones of digitalized agriculture. In fact, **the enablers are the integrators that are capable of identifying and tackling challenges in real time and adding value in the food chain.**

Steve Jones, Capgemini expert in Big Data, implements Meta-Data-Management and smarter ways to make data from different sources come together in a meaningful way. These features are key to digital agriculture. It can only take place with new levels of collaboration. In China, various parties, worked together to solve a common problem. Capgemini has a footprint in every part of the food chain, making it the right partner for any Ag-digital projects.

The bigger picture

The Blockchain example in China's pork industry is the result of an unprecedented collaboration between different players. To gain a better understanding of how the millions of stakeholders comprising the food industry can position themselves in the world of digital agriculture, they should be subdivided into three categories.

Green section: Agricultural companies

Agricultural companies such as large retailers, chemicals, feed, seed companies, and large farmers are or will become some of the major players in this Ag-digital field.

In 2013, Monsanto acquired "The Climate Corporation" [12] to combine crop science with field data. Two years later, the Climate Corporation and John Deere partnered up to offer new hardware to farmers to gain insights and derive value from farm data [13]. Meanwhile, Bayer, a life sciences behemoth, has developed its own digital farming tool combining machine data, web interfaces, and weather data so farmers can better manage their chemicals. In 2016, Bayer acquired Monsanto to leverage more synergies by merging their digital platforms [14].

Such mergers, acquisitions, and partnerships are technically very promising for digital farming since these companies already have a major footprint in specific production systems. Having a deep farmer client base, they can either sell their services to these large farmers who can afford it or simply offer data services alongside their usual seeds or chemical products. This can allow them to secure their business and protect their margins against competitors.

Agricultural segments, such as animal protein, that are not traditionally addressed by these companies might also indirectly be affected from these consolidated platforms. For example: plant-based raw materials make up to 80% of meat prices [15].

Meanwhile, farmers are raising concerns about their data ownership and the power play of companies such as Bayer and Monsanto enforcing their technology. The trust issues can lead to a major slowdown in the development of digital agriculture, as it is already the case for other data driven initiatives.

Disregarding these monopoly concerns, the same companies had to write-off billions with the banning of GMO seeds from many regions. This has forced them to rely on alternative technologies like CRISPR-CAS9 to take over and access these markets. Moreover, these giant clusters may disregard any new, and more efficient technologies that do not fit their platforms.

Yellow section: IT Players

Companies such as IBM, Oracle, SAP or Microsoft are now developing their own digital platforms. Their strong experience of working with data will give them an edge to develop value added applications and interfaces. While they do not have direct ties or experience with agriculture, they have been offering Enterprise Resource Planning and other services to large agricultural firms for years. The packaged solutions they deliver to agricultural business are adapted to the agricultural supply chain, commodity trading, and contract management. Moving to farm data may implicate a major leap with different resources and expertise.

These companies tend to partner with startups to quickly develop applications on their existing digital platforms. Unlike the players within the green section, these companies are inexperienced with farmers and might face large issues to implement and secure revenue from those applications. It will be hard for them to compete with the large agricultural players that can offer those services alongside other products. On the other hand, their strong experience with digital platforms and data science makes them the corner stone for one of the most important but often ignored bottlenecks, collaboration.

The platforms IT companies can set up might be the neutral, trusted third party platforms that are needed to make every element of the chain work together. From crop and chemical providers, to farmers, processors and retailers, the dream of a data driven and efficient food chain can only succeed with collaboration. This requires a global, secure, trustworthy, versatile and competent platform that the yellow section players can create.

Yellow zone's ERP footprint in all steps of the food chain will be their key advantage. They will be able to orchestrate the digital shift while solving trust and collaboration issues that would otherwise destroy a large part of the value that data can bring to this industry.

Blue section: The Science space

These are small-scale, technology-driven startup companies will outpace any large initiative when it comes to developing next generation digital agriculture tools or applications. Private investments are taking place at a fast pace for food and agro-technology, giving a new generation of scientists and apps developers the right tools and funding to create new technologies.

USA (Silicon Valley, Boston area), the Netherlands (WUR) and Israel are the hot-spots where these competencies meet with less than 20 dedicated investment funds involved.

These newcomers have diverse areas of expertise, putting them in a good position to address niche markets that are very suitable for proof of concepts that might be ignored by larger initiatives.

However, these innovations are hard to market in this unconsolidated local and global industry with players very diverse in size, interest, and geographical position. As a result, the most promising technologies will probably end up being partnered or acquired by large green or yellow zones corporations.

The missing piece

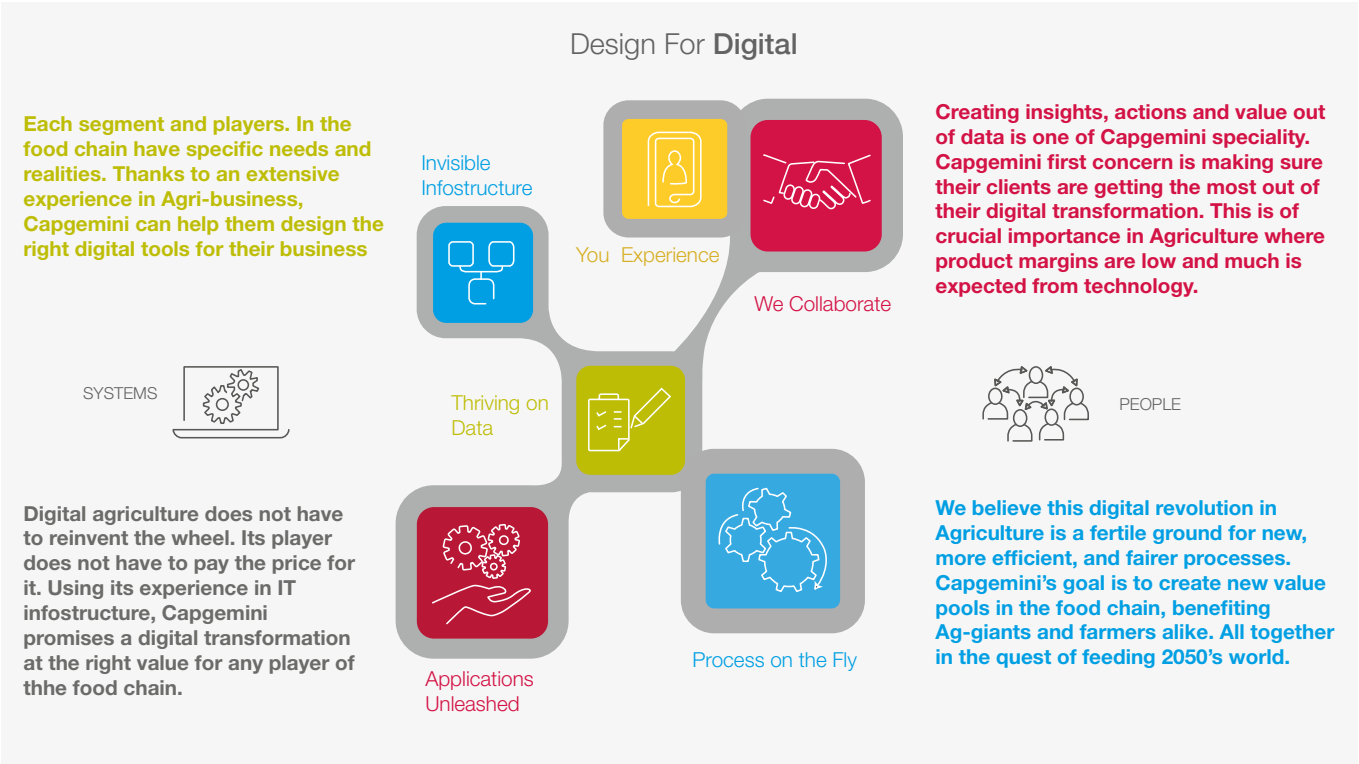
The three sections have three different approaches for a same goal. Due to fierce competition, lack of consolidation, competition, absence of meaningful collaboration, the three zones are missing a key component to make digital agriculture work: integrators.

Integrators can come in different forms. They can be a mix of consultants, with knowledge on specific parts of the food chain as well as technology. More often, they have some experience with in the supply chain: crop, animal protein, logistics, or food sciences. Nowadays, they are scattered between all industries, which makes them scarce and coveted consultants.

Integrators such as Capgemini are the necessary middlemen in this paradigm shift of digitalization in agriculture. The green zone needs their IT-IM expertise, the yellow need their agriculture expertise, where as the blue needs their validation and go-to-market experience.

Whilst they do not own a specific technology or platform, they know how to cherry-pick the right ones that can bring value and bridge the gaps. This market vision combined with their unusual set of skills makes them the ideal fit to create what digital agriculture lacks: strong proofs of concept.

Figure: Capgemini's holistic approach to digital transformation in Agriculture



Appendices

Appendix 1

The MGI Industry Digitization Index

2015 or latest available data

Relatively low digitization — Relatively high digitization

● Digital leaders within relatively undigitilized sectors

Sector	Overall digitization	Assets: Digital spending	Assets: Digital asset stock	Usage: Transactions	Usage: Interactions	Usage: Business processes	Usage: Market making	Labor: Digital spending on workers	Labor: Digital capital deepingning	Labor: digitization of work	GDP share %	Employ-ment share %	Productivity growth, 2005-14[2] %
ICT											5	3	4.6
Media		1									2	1	3.6
Professional services											9	6	0.3
Finance and insurance											8	4	1.6
Wholesale trade											5	4	0.2
Advanced manufacturing					4						3	2	2.6
Oil and gas											2	0.1	2.9
Utilities		2									2	0.4	1.3
Chemicals and pharmaceuticals											2	1	1.8
Basic goods manufacturing											5	5	1.2
Mining											1	0.4	0.5
Real estate	●										5	1	2.3
Transportation and warehousing	●										3	3	1.4
Education	●								5		2	2	-0.5
Retail trade	●			3							5	11	-1.1
Entertainment and recreation											1	1	0.9
Personal and local services											6	11	0.5
Government	●										16	15	0.2
Health care		6									10	13	-0.1
Hospitality	●										4	8	-0.9
Construction											3	5	-1.4
Agriculture and hunting											1	1	-0.9

1. Knowledge-intensive sectors that are highly digitized across most dimensions
2. Capital-intensive sectors with the potential to further digitize their physical assets
3. Service sectors with long tail of small firms having room to digitize customer transactions
4. B2B sectors with the potential to digitally engage and interact with their customers
5. Labor-intensive sectors with the potential to provide digital tools to their workforce
6. Quasi-public and/or highly localized sectors that lag across most dimensions

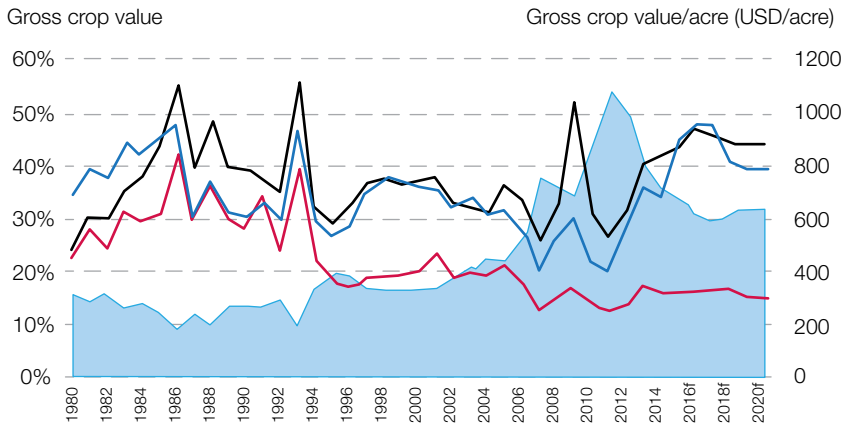
1 Based on a set: of metrics to assess digitization of assets (8 metrics), usage (11 metrics), and labor (8 metrics); see technical appendix for full list or metrics and explanation of rnethodology.

2 Compound annual growth rate.

SOURCE: BEA; BLS; US Census; IDC; Gartner; McKinsey social technology survey; McKinsey Payments Map; LiveChat customer satisfaction report; Appbrain; US contact center decision-makers guide; eMarketer. Bluewolf Computer Economics; Industry expert interviews; McKinsey Global institute analysis

Appendix 2

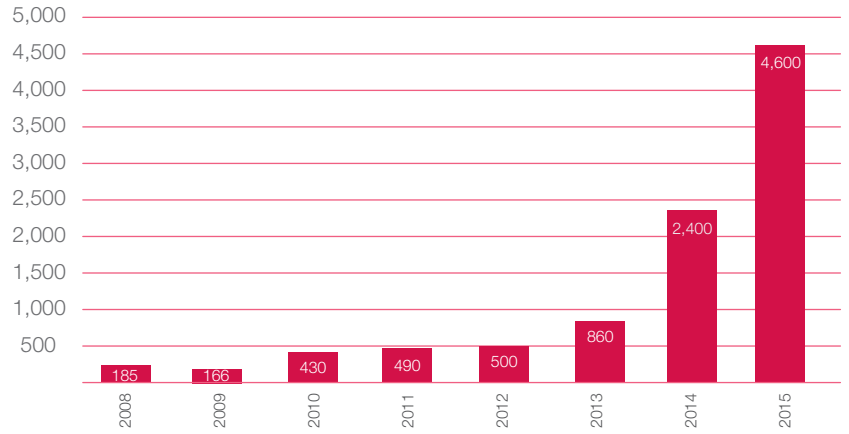
Input Costs Relative to Crop Value, 1980-2020f



Source: Rebobank 2016

Appendix 3

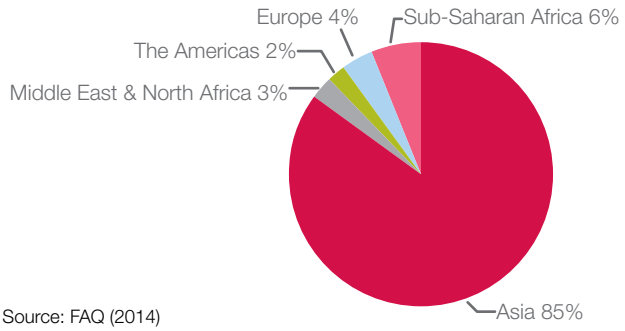
Growth capital investment in Agriculture is on the rise (Private only)



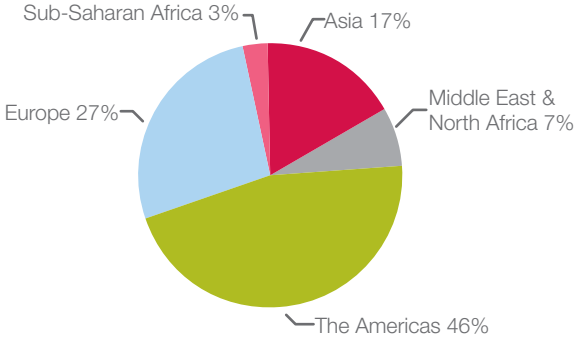
Source: Cleantech group

Appendix 4

Growth distribution of farms below 10 hectares



Growth distribution of farms over 10 hectares



Source: FAQ (2014)

References

[1] Statistics Netherlands, Statistical yearbook of the Netherlands, 2014.

[2] McKinsey Global Institute, DIGITAL AMERICA : A TALE OF THE HAVES AND HAVE-MORES, 2015.

[3] McKinsey&Company, Pursuing the global opportunity in food and agribusiness, 2015.

[4] FAO, WORLD AGRICULTURE TOWARDS 2030/2050, 2012.

[5] European Commission, Prospects for EU agricultural markets and income 2015-2025, 2015.

[6] FAO, Smallholders and family farmers, 2012.

[7] IPSOS-Agriavis, L'INNOVATION EST DÉJÀ DANS LE PRÉ !, 2016.

[8] BCG, Lessons from the Frontlines of the Agtech Revolution, 2016.

[9] Forbes, Grocery Delivery Startups Lead Financing In Food Sector For First Time, Forbes, 2016.

[10] G. M. a. M. Fritz, Expectations, Experiences, Trust in the Case of Short Circuit Food Supply Networks.

[11] International Risk Governance Council, Emerging food safety risks: Melamine-tainted milk in China, 2010.

[12] Monsanto, Monsanto Acquires The Climate Corporation, [En ligne]. Available: http://www.monsanto.com/features/pages/monsanto-acquires-the-climate-corporation.aspx.

[13] John Deere, John Deere and The Climate Corporation Expand Options for Farmers, [En ligne]. Available: https://www.deere.com/en_US/corporate/our_company/news_and_media/press_releases/2015/corporate/2015nov03-corporaterelease.page.

[14] Bayer, Bayer to Acquire Monsanto, 2016. [En ligne]. Available: https://www.advancingtogether.com/en/social-disclaimer-b/.

[15] FAO, PROTEIN SOURCES FOR THE ANIMAL FEED INDUSTRY..., 2002.

https://www.theguardian.com/global-development/poverty-matters/2011/jun/02/abcd-food-giants-dominate-trade?CMP=share_btn_link

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