A global overview on opportunities, challenges and limitations for IT driven sustainable agripreneurial ventures in India

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The future opportunities for agripreneurial initiatives for sustainable growth is vast and ever growing. The use of IT based technologies for solving issues linked to agriculture ventures in production, processing, delivery and consumption is growing by the day. Knowledge, data and inspiration are available at the click of a button. This paper highlights some major innovations in IT and how as in the top Agri ventures case studies in harping on the opportunities. Digital agriculture can vastly increase efficiency as well as create new markets and opportunities. The future opportunities for agripreneurial initiatives using digital technologies for sustainable growth is vast and ever growing and is likely to reach 15 billion USD by 2021. The use of IT based technologies for solving issues linked to agriculture production, processing, delivery and consumption across the value chain is growing by the day. Knowledge, data and inspiration are available at the click of a button. The paper highlights some major innovations in IT and how the major agri-companies are harping on the opportunities, Disruptive digital technologies in agriculture innovations that will bring inspirations, knowledge and information to work upon for a huge task that lies ahead – sustainable food for the world.

1. Introduction

Agricultural production needs to increase by 70 percent globally by 2050 in order to keep pace with population growth and shifting diets, according to the UN. The food sector is currently so riddled with inefficiencies (otherwise known as “market failures”) that it has started to attract serious tech business interest and solutions. Use of Information or digital technology in agriculture has become the mantra to ensure sustainable production for the coming generations. The shift is evident even in the less developed regions in Asia and Africa. It is well known that that farm productivity needs to grow at a higher rate than the global average in order to prevent mass hunger.

With more than 9 billion people predicted to populate the planet by 2050, finding better and smarter ways to grow food is essential.

Currently, farm productivity is low, fallow periods are shorter, and farm communities are losing young people to rural-urban migration. Despite the national governments having used many policy instruments so far, farm yields improved only marginally. A considerable proportion of farmers still use traditional labour-intensive processes and tools that depend heavily on the vagaries of climate and labour availability. The problem is that existing foreign derived farm technologies donot suit our farm situation or are not remunerative to adopt sustainably. Thus, farmers are wise enough to use their traditional practices under the existing conditions. With digital revolution sweeping these countries, its high time when we need to use our traditional knowledge and blend with the farmers real needs and solve his major problems and issues. But all this is about to change because more players in the market today are offering digital services that aid agriculture. There are start-up entrepreneurs and also local enterprises closer home who can deliver solutions to small farmers at a cost that they can afford. Adding momentum to this trend is the fact that the barrier of entry into farming technology has dropped.

Digital agriculture integrates the old and new technologies into a single system so as to enable stakeholders within the agricultural value chain to enhance their food production and to achieve sustainable growth. Due to advances in technology, the farmers can make more informed decisions about their farming and it is also possible to get real time feedback on their choices, further enhancing the productivity. AI, Robotics, sensors and many other forms of technology are harnessed to add value to farming, thereby making agriculture more productive, efficient and effective.

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. Adding momentum to this trend is the fact that the barrier of entry into farming technology has dropped, as digital tools like cloud computing systems, connectivity, open-source software and other digital tools are now

affordable. There are other, slightly more complex technologies too. For example, aerial images from satellites or drones, weather forecasts, and soil sensors are makes it possible to manage crop growth in real time. Automated systems are available to provide early warnings in case of deviations from normal growth. All of this access to technology has made farming a more exciting option for young people, who are increasingly viewing it as a business.

2. Digital Farming or precision agriculture

The addition of digital technology has accelerated production agriculture in the last few years. A lot of the technology is going into the genetics of the plants. What can we do to improve crops genetically? And in order to do that we're also utilizing a lot of other technology like GPS to record yields in fields, or where we make treatments [to improve a crop]. And then on the research side of that, we're using that technology to help us identify plants that have value to the plant breeders so that we can develop useful traits in plants more quickly. The same is also now applied in cattle genomics to identify better animals for selective breeding for improving milk productivity.
The main value that precision agriculture technology brings includes:

Efficiency in use of resources like chemicals, fertilizers, water, fuel, etc.
Improving quantity and quality of produce
Higher yield in same amount of land
Reducing environmental footprint
Risks mitigation
These benefits add a tremendous amount of value to the production process, due to the increased yields that are a direct result of the integration of this technology. The added value can be determined by analyzing the estimated increase in yield, and in the same Goldman Sachs' report, they calculated the added value in dollars based on each of the main forms of precision agriculture technology.

The bottom line in precision agriculture is also about cutting food waste. The impact will be highest when the food that is ultimately produced is used effectively through the best preservation and storage methods. Having food safety systems and facility to track supply chains will also boost the

overall value of the sector. There is optimism in the agriculture sector in Africa, where the maximum of its citizens are employed, that extreme hunger can be cured.

The next step in feeding the world's rapidly growing population involves self-driving tractors, precision farming, and Internet of Things sensors to quantify agriculture in vast new ways.
Technology is changing the world, and farming is catching up. The introduction of everything from automated farm equipment to a wide array of Internet of Things (IoT) sensors that measure soil moisture and drones that keep track of crops have changed the business of agriculture. Some experts even call this movement "Agriculture 4.0"—a term used by the World Government Summit.

If you think about if you're measuring any observable trait of a plant, known as phenomics, how do you do that? You do it with sensors of all types. You do it with everything from handheld devices that measure the color in a plant to UAVs [unmanned aerial vehicles] that fly over and take LIDAR and hyperspectral images because those spectrums of color provide information. At Purdue, on a 1,408-acre research farm, IoT sensors assess what the plants are revealing by their molecular responses and how it impacts growth and color. "Our job is to understand what every input, whether that's water, fertilization, the soil types, etc., whatever input there is, we need to know what its impact has on the plant, both in terms of nutritional value because we've got to increase the nutritional value of the same amount of biomass than we have now if we're gonna feed the world," Smoker from Purdue University said. He added, "If you put all that together in two specific areas, there's the farm management side, which uses technology to help farmers make informed decisions and management decisions in terms of producing high yields with low input, all the way to research, which means you're collecting, analyzing, visualizing, modeling, and all the compute that has to be behind that. "We're talking about big data, connected to everything, just like our consumer market. Our refrigerators, our light bulbs, etc., are all connected today, and the same is true for farm implements and even the plants themselves will one day be connected in some way in terms of embedded sensors or telling their story through imagery or any other one of a thousand different phenomic observations. That's the whole of what we're trying to do, and the technology plays many roles in that," Smoker said.

One of the first things Purdue had to do was install Wi-Fi connectivity across the 1,408 acres of fields in order to collect the data. So Purdue worked with Aruba, a Hewlett Packard Enterprise company, to understand the challenges and figure out how to engineer a solution at that scale. But it was necessary to have the Wi-Fi in place for vehicles with sensors, such as ACRE's PhenoRover. And so imagine a machine running over rows and taking in all that data and then pushing it somewhere, the compute happens automatically, creates us a stream of data and it goes through all its algorithms, its data transformation and at the end, the researcher has visualized data or modeled data waiting for them...so it's really about timeliness of data collection and an entire stream of transport, translation, and consumption of data.

Land O'Lakes teaches its co-op farmers to use WinField United's Answer Plot system, which serves as a data warehouse for crop information. The R7 tool that is part of the system collects data from 200 specific fields around the US in order to provide data on which hybrid crops will do best in a given area. Crafton Farms uses this satellite technology to improve cost efficiency. The way that the Crafton family decided to add technology was fairly traditional—Austin begged his dad to try something new. Now that neighboring farmers see the technology improving profits for the Craftons, they're considering it as well, Austin said.

At Crafton Farms, Austin, who runs the farm with his dad, Johnny Crafton, sits down with a cup of coffee in the morning and looks at his iPad to review satellite imagery to see which fields need attention that day; areas with damage are highlighted on the imagery. With more than 40 fields, it would be impossible to go over every row of every field each day, but by pinpointing which fields might have problems, Crafton can narrow it down to a handful to visit. So, if you're looking at it from a satellite image, you've got a red spot in the middle of that field, and you can track yourself and make sure that you're in that particular spot in the field. Then, the agronomy takes over. In the past, farms had to send scouts to look at every field, which still didn't show what was going on in the midst of a huge field. Once a problem is identified, the farmer can determine whether to try to repair the damage, which could be caused from too much rain, or assume the area is a loss and stop spending money on it. Since fertilizer is expensive, it's better to avoid spending money on a field that isn't going to produce a healthy crop. This helps the farmer to make crucial decision on

cost cutting strategies, if prediction on field costs of production is known to be higher. Comparing current fields to those of previous years allows for more accurate data analysis as well. Drones come in handy when farmers need to see the field in its entirety without walking the distance.

Technology such as crop modeling is used for precision agriculture is a crop model using remote sensing. The farmer simply plugs in information such as the soil type, how much fertilizer was used, and what day it was planted. The software models the crop and gives the farmer information on when to expect the crop to be at a particular growth stage, and what the expected yield will be. This type of technology can reduce costs significantly and make farming profitable. Now farmers plug that info into software that gives them info on how much fertilizer is needed for a particular field. The IoT sensors at Purdue are used for collecting the aforementioned big data to create better plants. At Purdue University in West Lafayette, IN, the Agronomy Center for Research and Education (ACRE) is constantly assessing better ways to farm to increase yields and improve efficiency, with sensors collecting 1.4 petabytes of data daily. Indoor farms such as Plenty in San Francisco and Jones Food in Europe are farming on vertical racks in massive indoor facilities that significantly reduce the carbon footprint needed to grow food.

Courtesy: iftf.org, breakthrough.unglobalcompact.org

Some significant applications of digital technologies in Agriculture are stated below:

A. Field Monitoring using NDVI—general indicator of crop health

Crop Health Monitoring (mostly based on NDVI)—Normalized Difference Vegetation Index (NDVI) is a method that is used to determine the health of crops through the analysis of drone and

satellite imagery. It looks at various wavelengths of light, both visible and nonvisible, to make these calculations. This technology can allow you to assess the general health of your crops and detect crop variability.

Crop Scouting—This precision agriculture technology also makes use of NDVI, but it is also being facilitated through tablets and mobile phones. Scouters go out in their fields with a tablet and collect important data about their crops. There are some platforms that analyze and make meaning out of this data. This helps farmers monitor pest populations and weed activity on their land, and allows farmers to increase yields and make more money.

Yield Monitoring and Forecasting—The yield information can be collected either from satellite imagery and drones or from the sensors installed on the farmer's machinery. These yield sensors can be attached to harvesters or tractors and collect information on things like grain yield, moisture levels, and more, which allows farmers to make better decisions on when to harvest, plan next season and fertilization, analyze field variability, and many other things.

B. **Detection of Diseases, Pests, or Weeds—**As you can see, drones have many uses in precision agriculture, and the detection of diseases, pests, and weeds are yet another value that comes from drones and hyperspectral imaging. Gamaya's hyperspectral camera is the smallest, most lightweight commercial hyperspectral camera that is currently available, and this makes it perfect to attach to drones and nano satellites. Gamaya's camera is tightly integrated with proprietary software to translate raw data into actionable information for farmers.

C. **Weather, Irrigation, and Soil Quality**—Ground-based and plant sensors are used to collect information about the soil and water. For soil, some of the things these sensors measure are texture, organic matter, salinity levels, and nutrient status. Weather stations are used to gather the appropriate weather data, which allows farmers to see how different weather patterns may affect their water and soil. There are many different technologies for irrigation, but one very useful one is called drip irrigation, which allows farmers to irrigate their land by the use of pumps and valves that can be manually or automatically controlled.

D. Data Management

Farm Management Software Platforms—Farm management software platforms are just what they sound like—platforms that help farmers manage their crop production. These platforms (i.e.

Granular) integrate with the different hardware devices that are used in precision agriculture. The data from these devices are aggregated onto the central platform where they can be processed and analyzed to help farmers make better decisions on how to manage their operations.

Data Platforms—Outside of farm management solutions, there are data platforms like Field View from Climate Corporation and Farmers Business Network, whose focus is more on data aggregation so that they can provide data to farmers as a resource. They also want to give farmers a central location where a multitude of information sources come together to provide an overall picture of the industry.

E. Variable Rate Applications (VRA)

Variable rate application in precision agriculture focuses on the automated application of materials like herbicides, chemicals, and seeds to a landscape. These materials are applied in an automated fashion, which is based on data that is collected by sensors, maps, and GPS. This process involves different forms of precision agriculture technologies like multispectral and hyperspectral cameras, satellite imagery, and application machinery on tractors. VRA is one of the main features of precision agriculture, that allows to optimize use of chemicals, fertilizers and other resources.

Digital tools like cloud computing systems, connectivity, open-source software and other digital tools are now affordable. There are other, slightly more complex technologies too. For example, aerial images from satellites or drones, weather forecasts, and soil sensors are makes it possible to manage crop growth in real time. Automated systems are available to provide early warnings in case of deviations from normal growth. There are also other start-up ventures like Zenvus, that deals with precision farming, with the facility to measure and analyse soil data like temperature, nutrients and vegetative health to help farmers apply the right fertilizer and irrigate their farms optimally. The process reduces input waste, thus automatically improving farm productivity. Such analytics can easily be used by small-scale farmers. Ujuzi Kilimo, a Kenyan startup, uses big data and analytic capabilities with the goal of transforming farmers into a knowledge-based community, using precision insights. All of this access to technology has made farming a more exciting option for young people, who are increasingly viewing it as a business.

3. Disruptive technologies

Disruptive technologies in 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 disruptive 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.

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.

A. Wireless technologies

Wireless technologies have numerous applications in agriculture. One major usage is the simplification of closed-circuit television camera systems; the use of wireless communications eliminates the need for the installation of coaxial cables.

B. Global Positioning System (GPS)

In agriculture, the use of the Global Positioning System provides benefits in geo-fencing, map-making and surveying. GPS receivers dropped in price over the years, making it more popular for civilian use. With the use of GPS, civilians can produce simple yet highly accurate digitized map without the help of a professional cartographer.

In Kenya, for example, the solution to prevent an elephant bull from wandering into farms and destroying precious crops was to tag the elephant with a device that sends a text message when it crosses a geo-fence. Using the technology of SMS and GPS, the elephant can roam freely, and the authorities are alerted whenever it is near the farm.
GPS technology is used to guide automated machinery and vehicles in things like auto steering, high navigation and positioning, and more.

C. Geographic information systems

Geographic information systems, or GiS, are extensively used in agriculture, especially in precision farming. Land is mapped digitally, and pertinent geodetic data such as topography and contours are combined with other statistical data for easier analysis of the soil. GIS is used in decision making such as what to plant and where to plant using historical data and sampling.

D. Computer-controlled devices (automated systems)

Automatic milking systems from DeLaval are computer controlled standalone systems that milk the dairy cattle without human labor. The complete automation of the milking process is controlled by an agricultural robot, a complex herd management software, and specialized computers. Automatic milking eliminates the farmer from the actual milking process, allowing for more time for supervision of the farm and the herd. Farmers can also improve herd management by using the data gathered by the computer. By analyzing the effect of various animal feeds on milk yield, farmers may adjust accordingly to obtain optimal milk yields. Since the data is available down to individual level, each cow may be tracked and examined, and the farmer may be alerted when there are unusual changes that could mean sickness or injuries.

E. Smartphone mobile apps in agriculture

The use of mobile technologies as a tool of intervention in agriculture is becoming increasingly popular. Smartphone penetration enhances the multi-dimensional positive impact on sustainable poverty reduction and identify accessibility as the main challenge in harnessing the full potential in agricultural space. The reach of smartphone even in rural areas extended the ICT services beyond simple voice or text messages. Several smartphone apps are available for agriculture, horticulture, animal husbandry and farm machinery.

F. Swiss cow ear with eartag and RFID

The Veterinary Department of Malaysia's Ministry of Agriculture introduced a livestock-tracking program in 2009 to track the estimated 80,000 cattle all across the country. Each cattle is tagged with the use of RFID technology for easier identification, providing access to relevant data such as: bearer's location, name of breeder, origin of livestock, sex, and dates of movement. This program is the first of its kind in Asia, and is expected to increase the competitiveness of Malaysian livestock industry in international markets by satisfying the regulatory requirements of importing countries like United States, Europe and Middle East. Tracking by RFID will also help producers meet the dietary standards by the halal market. The program will also provide improvements in controlling disease outbreaks in livestock.

G. E-commerce

Online purchasing order of agri-inputs and agri-equipments is a subset of E-commerce.

H. Digital Technology in IoT

Digital agriculture employs the Internet of Things, a principle developed by Kevin Ashton that explains how simple mechanical objects can be combined into a network to broaden understanding of that object. Farmers can adopt artificial intelligence (AI) optimize the use of water and fertilizer. Sensors can measure moisture content and soil fertility in real time. Those readings signal the farmer to optimize the timing of amount of inputs to the crops. Along with AI, soil sensors, and communication networks, digital agriculture uses advanced imaging to look at temperature gradients, fertility gradients, moisture gradients, and anomalies in a field. Imaging features low financial and ecological cost, and high spatio-temporal resolution. Integration with weather forecasts can prevent overwatering.

I. Telematics

This involves machine-to-machine communication between the hardware and sensors that are involved in automation. For example, when a camera identifies a weed, it needs to communicate this information to another piece of machinery that can pluck the weed out of the ground or spray it with some herbicide. Telematics is crucial in automation.

J. Automation In Agro Machinery

Farm Robots—Robots are used in many industries to automate different tasks. In farming, robots are used for a handful of reasons, but one big use is the automation of weed management. Blue River Technology and Ecorobotix are two companies that have developed robots that use cameras to identify weeds in real time and will make decisions on how they should deal with them.

Precision Planting—Precision planting is an automated approach to optimizing the planting of seeds. It allows for better seed spacing, better depth control, and better root systems. There are many pieces of information that are used to make the proper analysis in identifying the optimal conditions for planting, and this is all easily collectable with the various forms of precision agriculture technology on the market.

These technologies are being adopted by farmers at an accelerating pace. The Roland Berger and Goldman Sachs reports show how both the market size and the adoption are at all time highs, showing no signs of slowing down. From field monitoring technologies to variable rate application, the available precision agriculture technologies offer an end-to-end solution for today's farmers.

4. The benefits of digital technologies

A. Sustainable Development Goals

According to Project Breakthrough, digital agriculture can help advance the United Nations Sustainable Development Goals by providing farmers with more real-time information about their farms, allowing them to beter decisions. Technology allows for improved crop production by understanding soil health. It allows farmers to use fewer pesticides on their crops. Soil and weather monitoring, reduces water waste. Digital agriculture ideally leads to economic growth by allowing farmers to get the most production out of their land. The loss of agricultural jobs can be offset by new job opportunities in manufacturing and maintaining the necessary technology for the work. Digital agriculture also enables individual farmers to work in concert, collecting and sharing data using technology.

B. Evolution of Digital Agriculture, Source: Accenture

The adoption of digital technologies in agriculture has been increasing at a rapid pace. In fact, the adoption of digital technologies in every industry has been increasing. The reason why this is such a prevalent trend is that digital technologies bring tremendous value for businesses and individuals. In the agricultural industry, there are many digital technologies that fall under the category of "precision agriculture". Precision agriculture technologies are changing the way that farmers manage their crops and is being adopted at a growing rate.

C. Precision Agriculture Technology Adoption

Precision agriculture is a data driven methodology for managing and optimizing the production of crops. In recent years, agricultural producers have been adopting precision agriculture technologies for a handful of reasons. A recent study that was conducted at the University of Nebraska-Lincoln, which is focused on precision agriculture technology adoption, reflects this trend.

Another report, which was published by Goldman Sachs, highlights the significant increase in expected yields based on the technological improvements being introduced by precision agriculture. Their report estimates that these new technologies with allow for 70% higher yields on the existing agricultural land. This translates into a total addressable market of $240 billion by 2050. From this report, it is clear that these technologies will have a significant impact on the agricultural industry. The technology solutions that are offered and will be offered in the future increase the value of land by making it possible to produce significantly more crops per acre.

5. Significant global cases of success and learnings

Let's take a look at some more digital applications that are being used in Africa. In the northern region of Ghana, an initiative delivers tailored climate information services to farmers. Up to 1000 farmers (33% of which are women) are now accessing this information and applying it in their farm management, and in other livelihood-based activities. A recent survey revealed that 97% of farmers are willing to pay for access to climate information. The key users include individual farmers and traders, farmers' associations, agri-business, and public sector organisations like

national agricultural ministries. Another online platform provides buy and sell offers, details of agricultural input and crop prices, extension messages, locations where seeds and fertilizers are available, as well as other information. Users can easily access this content on the internet and on their mobile phones. They can choose from a range of applications and create a personalized interface. They can even opt for specific information only, such as market prices. Another mobile phone-based service that can predict rain is helping farmers in six Sub-Saharan Africa countries sow, fertilise and harvest crops at the right time. This innovation is being used in Cote d'Ivoire, Ghana, Niger, Nigeria and Senegal to improve crop yields and optimize food production. This ICT model produces GPS-specific forecasts. A cocoa farmer in Ghana, Enoch Addo, says that with the aid of these forecasts, he was able to more than double his yield of cocoa. There are more than 80,000 such users who subscribe to the service ever since it went live. Policies that can support such investments have the potential to bring about a big change on how farming is conducted and managed on the African continent. In turn, the African government too can benefit from the increased incomes of farmers, provided they invest in such technology first.

When it comes to large farms, success in derived from four major factors: growing as much per acre of land as possible, reducing the risk of failure, minimizing operational costs and selling the crops at the best price. This demands effective management of input resources like fertilizer, water and seed quality, and minimizing the impact of unpredictable variables (such as weather and pests). The skill to be developed here is about translating available data into action. Ultimately, digital agriculture is all about "ICT and data ecosystems that support the development and delivery of timely, targeted information and services to make farming profitable and sustainable while delivering safe, nutritious and affordable food of all", according to a paper published by ICRISAT.

disrupting the food value chain – digital food futures

The future of farming is very bright. There are more and more precision agriculture technologies coming out every month. All of these solutions offer substantial value for farmers in their effort to optimize production, better manage their operations, and both save money and make money off bigger yields.

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With more than 9 billion people predicted to populate the planet by 2050, finding better and smarter ways to grow food is essential. Digital technologies is slowly changing the way we produce our food, sell and consume. While times are exciting for ag-tech entrepreneurs, it's too early to declare victory for inclusive and sustainable development. Disruptive technologies could help distribute food, wealth and data, reduce hunger and waste, and empower farmers to produce more valuable, climate-resilient and nutritious foods for their clients. Or they could spur a consolidation of the food sector, allowing a few companies to dominate the market, limiting food choices and expanding bad practices rather than correcting them.

Some of the policy choices that can steer the food system toward better outcomes have been clear for years. Green certification schemes, user-friendly nutrition information, local procurement rules and incentives for conservation all have a role to play in the battle for more nutritious and sustainable food systems.

Disruptive technologies can impact the Sustainable Development Goals of UN in achieving them more efficienctly by providing farmers with more real-time information about their farms, allowing them to better decisions. Technology allows for improved crop production by understanding soil health. It allows farmers to use fewer pesticides on their crops. Soil and weather monitoring, reduces water waste. Digital agriculture ideally leads to economic growth by allowing farmers to get the most production out of their land. The loss of agricultural jobs can be offset by new job opportunities in manufacturing and maintaining the necessary technology for the work. Digital agriculture also enables individual farmers to work in concert, collecting and sharing data using technology. Phenomics or measuring any observable trait of a plant with sensors of all types. This is done using handheld devices that measure the color in a plant to UAVs [unmanned aerial vehicles] that fly over and take LIDAR and hyperspectral images because those spectrums of color provide information.

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vehicles] that fly over and take LIDAR and hyperspectral images because those spectrums of color provide information.

6. Digital technology applications by agriculture companies

A. 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.

B. 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.

C. 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.

D. Advancing the Sustainable Development Goals (SDGs)

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.

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

Some examples of companies using digital agriculture is worth mentioning: Fujitsu's low-potassium lettuces for kidney disease patients; PepsiCo cuts water use with selective irrigation; Urban Farmers use technology to bring farming to the people; WeFarm is crowdsourcing agricultural know-how for farmers globally, while tapping into big data to turn these interactions into valuable insights; InFarm are tackling world hunger and bringing new transparency to food production, one in-store on-demand farm at a time; Scrambling the future of food and scaring sharksScrambling the future of food and scaring sharks, Josh Tetrick of Hampton Creek wants to change the world by making the 'right thing' the 'easiest thing'. He explains why business needs to be bolder than ever.

There are more players in the market today offering digital services that aid agriculture. Agriculture giant Cargill is turning to digital technology to tackle the challenge of doubling agriculture production by 2050. Five of its digital initiatives in this direction are Cargill’s iQuatic software app for mobile shrimp real time monitoring; Connceted crop irrigation using weather sensors and real time IoT sprinklers technology; Cainthus – facial recognition of cows system to monitor individual cows for management performance; Cocoa in the cloud – tracking and tracing cocoa farmers in real time; Techstars – farm to fork Accelerator – a mentorship driven program for safer, secure and sustainable food supply.

There are start-up entrepreneurs and also local enterprises closer home who can deliver solutions to small farmers at a cost that they can afford. There are also other start-up ventures like Zenvus, that deals with precision farming, with the facility to measure and analyse soil data like temperature, nutrients and vegetative health to help farmers apply the right fertilizer and irrigate their farms optimally. The process reduces input waste, thus automatically improving farm productivity. Such analytics can easily be used by small-scale farmers. Ujuzi Kilimo, a Kenyan

startup, uses big data and analytic capabilities with the goal of transforming farmers into a knowledge-based community, using precision insights.

Amazon just acquired Whole Foods in perhaps one of the boldest moves to bricks and mortar, and arguably signals its comfort with reversing into the value chain of its merchant clients. It already produces goods that it markets not only developed a strong market linkage but also got control over their volatile farm indices. They can be viewed as the canary in the coal mine for food tech. They do not use any of the third-party service providers, they own their entire value chain and they are bucking the trend of global decreased unit sales, rather they are still experiencing double digit growth. They attribute this to a number of factors, the most important of which is their proprietary technology. They own their entire value chain. Their online order rate in the US is over 50%, and in the UK, a staggering 80%.

Other players like Panera and Starbucks are following suit and raising their digital game with proprietary solutions to meet consumer expectations. Freedom Pizza took a similar approach in the region. We saw the future seven years ago and established a company that has and continues to develop Freedom Pizza's proprietary online ordering and digital commerce platform. 50% of Freedom Pizza orders are online and growing quickly. Freedom also owns and controls its entire value chain (including its fleet of 125-delivery drivers) allowing it to stay connected to customers and serve them better. Whilst the future is diffcult to predict with certainty, it would appear that scale, control of consumer relationship and nimbleness are the winning recipe of this arena. It is also clear that the current disruptors are not the final form– they will be disrupted themselves.

In the past few years, fora such as Seeds & Chips in Milan and the EAT Forum in Stockholm have become hot spots of creativity, where entrepreneurs who are rethinking food mingle with advocates, policymakers and researchers. Winnow is a start-up zeroing in on food waste in commercial kitchens by connecting scales and data analytics. Protix is betting that it makes more sense to feed insects, raised locally on food waste, to Dutch poultry, than to use Peruvian anchovies, shipped halfway across the world then ground into fishmeal.

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.

Mahindra and Mahindra Farming 3.0 : Democratising technologies for small farmers through real time information services on technology use and decision making. Initiatives like DigiSense and Trringo.

Constraints and limitations

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.

The four main barriers to digital agriculture include development costs, security, case studies and employment.

Development costs include gathering long-term data to support the cost effectiveness of digital technology. A 2017 trial in the UK reported that for an 80-acre farm, costs were approximately $15 per acre per year for soil scanning and UAS monitoring. Farmers pay for this service; they require a significant output increase to motivate them.

For digital agriculture, the biggest security fear is that hackers could launch agricultural warfare. This could take many forms: whether it be systems shutting off, giving incorrect readings, or contamination of fertilizer or water. If farming comes to rely on hackable systems, agricultural warfare could be launched on a massive scale. Case studies, such as the 2017 UK trial, are a way to test developing ideas in a real-life setting. As of 2013, some one billion people were employed in agriculture. Introducing technology would potentially leave some workers out.