Technology has influenced and benefited many areas of society. Over the past twenty years technology has been increasingly disruptive to the traditional agricultural industry reshaping how certain aspects are done. One way that agriculture industries have been applying technology is through the Internet of Things. The Internet of Things is defined as the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data (Google Dictionary). New technologies will continue to affect the agriculture industry as time goes on and the Internet of things expands and is applied to new areas.

Starting off with the Green Revolution in the mid 1940’s to the invention of herbicides through the first twin rotor systems combine and the first use of genetically modified plant cell, technology has continued to help move the farming and agricultural industries toward new advancements. Satellite technology first impacted farming advance in 1994(Piper, 2017). Satellites have continued to advance and develop over time and are still bringing new benefits. One such example is the use of satellite technology to accurately measure subsurface moisture(Purdue University, 2017). "Water is becoming more and more scarce. So, managing the water that is available is becoming increasingly important. To manage it you need to be able to accurately determine the amount being used. The key there is to measure how much of it is in the soil where most of it is absorbed by the plants' roots." says James Garrison, a professor in Purdue's School of Aeronautics and Astronautics, and Electrical and Computer Engineering(Purdue University, 2017). This technique is known as Signals of Opportunity or SoOp, and if successful, can be mounted on drones for planning the irrigation schedule of crops (Purdue University, 2017).

Another example of technology impacting the realm of agriculture is that of Genetically Modified crops. Farmers have bred crops for desirable traits for centuries and genetic engineering provides a way for the same effects to be reached in an increasingly short amount of time. Genetically Modified (GM) crops offer improved yields, enhanced nutritional value, longer shelf life, and resistance to drought, frost, or insect pests (Genetically Modified Crops). An example is that of corn varieties containing a gene for a bacterial pesticide that kills larval pests(Genetically Modified Crops). Nutritionally enhanced Genetically Modified crops are under development. Crops that fall under this category include wheat that is free of gluten, vegetables with a higher concentration of vitamin E, and the production of a rice that contains iron and vitamin A to help prevent common nutritional deficiencies in developing countries (Genetically Modified Crops). Internationally, the cultivation of GM crops has grown from six countries in 1996 to 25 countries in 2009, and it is expected to reach 40 countries (mostly in the developing world) by 2015 (Genetically Modified Crops). In 2009, approximately 134 million hectares of land were under GM crop cultivation(Genetically Modified Crops).

Vertical and urban farming are also developing and impacting the agricultural industry. With the agricultural landscape facing new challenges with depleting water sources and limited land or space available vertical and urban farming have provided a solution to these issues. Vertical farming is the process of growing food in vertically stacked layers, producing food in challenging environments. It uses soil, hydroponics, or aeroponic growing methods, while using 95 percent less water, fertilizer and nutritional supplements, no pesticides, all while boosting productivity(Wyman, 2018). Since 2004 a company based in the US, called AeroFarms has been building, owning, and operating indoor vertical farms that grow food. They are leaders in the world of high-tech, data driven, commercial scale vertical farming and its farms can grow crops all year which boosts potential yield that are 390 times more productive than traditional farms (Wyman, 2018).

The Internet of Things (IoT) is having a tremendous impact in the agricultural world as new techniques are being applied. Some IoT applications include farm vehicle tracking, livestock monitoring, and storage monitoring. One interesting application is the use of a component known as a Vdrive from Precision Planting that the Rader Family Farm use to create their corn maze attraction. The Vdrive is a motor component that Precision Planting made to control the population during planting (where and how many seeds are planted in a square foot) through the use of their 20/20 seed monitoring sensors and computer monitoring (THE PLOTS ARE PLANTED, 2018). They use this sensor device to create their maze patterns and design at planting, which saves seeds which proves to be more cost effective(THE PLOTS ARE PLANTED, 2018). This application is very effective especially seeing that not all farm land had perfect corners or dimensions. It allows the correct amount of seed to be dispersed in order to not under or overpopulate trick field areas such as corners, which are often very sparsely planted (THE PLOTS ARE PLANTED, 2018). Thus, saving farmers from wasting good field space and from wasting seed.

Another application of the Internet of Things to Agriculture is that of Livestock monitoring. Farm owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their livestock (IoT Applications in Agriculture, 2018). The information helps farmers in identifying sick animals so that they can be separated from the others to prevent the spread of disease (IoT Applications in Agriculture, 2018). It also lowers the costs of labor due to the fact that farmers/ranchers can locate their animals with the help of IoT based sensors. JMB North America is an organization that offers cow monitoring solutions to cattle producers. One of the solutions helps the cattle owners observe cows that are pregnant and about to give birth. From the heifer, a sensor powered by battery is expelled when its water breaks and sends an information to the herd manager or the rancher(IoT Applications in Agriculture, 2018). In the time that is spent with heifers that are giving birth, the sensor enables farmers to be more focused(IoT Applications in Agriculture, 2018).

Storage monitoring has also been impacted and enhanced through the use of the Internet of Things. Farmers are now using remote, IoT-powered wireless monitoring devices to monitor stock levels for them. The Sigfox network and devices are an example of storage monitoring. The devices, which can be installed in minutes without the need for wiring or connecting to a network, constantly monitor levels and send data to a cloud-based online dashboard(Farms Get Smarter with IoT Storage Monitoring, 2017). The dashboard can be accessed by farm staff from anywhere and on any device, all they need is an Internet connection(Farms Get Smarter with IoT Storage Monitoring, 2017). The device will also send alerts once storage levels fall below or rise above a certain level and this allows employees to take immediate action to rectify the situation and avoid the issues that we discussed earlier (Farms Get Smarter with IoT Storage Monitoring, 2017). The implementation of these monitoring sensors will save not only save money but will also boost productivity due to the time that does not have to be spent monitoring. Even emergency deliveries can be removed if the devices are used correctly(Farms Get Smarter with IoT Storage Monitoring, 2017). Sigfox’s devices are also Low Power Wide Area devices, meaning that they use very little battery power and have a very long battery life(Farms Get Smarter with IoT Storage Monitoring, 2017). This guarantees that there is little danger for users to not get correct readings due to a dead battery and that the subscription fees are affordable and worth the investment (Farms Get Smarter with IoT Storage Monitoring, 2017).

The realm of agriculture is changing rapidly as it is faced with new problems and challenges. Over the past two decades new technologies have benefited and changed the industry. Now the Internet of Things in impacting agriculture and is bringing in a new wave of technology through the connectivity of the Internet. Technology is and will continue to help provide solutions to the challenges the agricultural society faces.

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