9 Innovations That Are Transforming Agriculture

Abstract

The typical American farm or ranch looks different today than it did 50 years ago – or even 25 years ago. Advances in technology have allowed producers to increase production, reduce inputs, and make smarter and better-informed decisions about their crops and livestock. Newer innovations have the potential to drive additional changes and deliver even more efficiencies.

This paper highlights nine innovations that are transforming the practice of agriculture, and is aimed at helping insurers stay on top of current and developing exposures among their farm insureds.

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In order to feed a growing population, farmers and ranchers need to streamline agricultural production. For that, they're turning to a broad range of technological advances.

From education to healthcare to tourism, many industries have been transformed by emerging trends in technology. Agriculture is no exception.

Farmers and ranchers face a pressing need to optimize the output of each acre of land – leading many producers to embrace innovation.

Changing demographics within agriculture have also had an impact on the adoption of technology. There are currently 80 million millennials in the United States and by 2025, this age group is expected to make up 75% of the workforce.[1] More and more members of this generation are taking over traditional family farms. The 2017 Census of Agriculture reported that 27% of U.S. producers are "new," having less than 10 years of farming experience.[2] As millennial farmers and ranchers embrace innovation for increased profitability and efficiency, older producers are also adopting technological advances in order to stay competitive.

With this, there are multiple innovations that have made today's agricultural world look much different than it did 50 years ago.

Read on to learn about nine advances in technology that are helping farmers and ranchers increase production, reduce inputs, and make smarter and better-informed decisions about their crops and livestock.

1

PRECISION AGRICULTURE

Precision agriculture encompasses a wide range of methods, technology, and systems that make the practice of farming more accurate and controlled, whether producers are growing crops or raising livestock.

This technology incorporates control systems, sensors, robotics, autonomous vehicles, variable rate technology, GPS guidance, telematics, and automated hardware to allow farmers/ranchers, retailers, and agronomists to carefully monitor and retain a larger part of the production results.

Since the early 1990s, farmers have used GPS-connected controllers to automatically steer the equipment based on the coordinates of the field, which minimizes drivers' error and reduces wasted seed, fertilizer, fuel, and time. Today, GPS guidance for tractors is the most commonly used example of precision agriculture.

GPS soil sampling is a newer application of precision agriculture. This technology allows farmers to test their field's soil for proper nutrient and pH levels. Through precision mapping, growers can carefully evaluate differences within a field and in turn make more educated and profitable decisions regarding fertilizer and other tools for effectively managing their crop.

One report projects that the global precision agriculture market is expected to reach $43.4 billion by 2025.[3]

2 AUGMENTED FARMING

Augmented reality (AR) and virtual reality (VR) technology is transforming many industries. VR implies complete immersion in a simulated world (through the use of special goggles, for example), while AR lets the user experience the real world, which has been augmented or enhanced in some way (often by overlaying digital elements on top of a live view on a smartphone or tablet).[4]

According to Forbes, more than 100 million consumers will use AR and VR technology to shop by late 2020, and by 2021, the AR and VR market in the U.S. is expected to be worth $215 billion.[5]

Using AR, farmers can examine weather patterns as well as land and determine precise weather and soil properties in order to maximize production and reduce loss. Some augmented farming systems have the capability to track an entire field of crops in one dashboard to monitor for infestation, while others are so advanced that they can evaluate every insect in a field and decipher which are beneficial insects and which are actually harmful pests.[6]

3 ARTIFICIAL INTELLIGENCE (AI)

By 2021, it is estimated that 80% of all emerging technologies will have foundations in artificial intelligence (AI)[7] – a technology that makes it easier to use data to make decisions.[8] In farming, AI is utilized for a plethora of reasons. Farmers can use AI-enabled tools to ask themselves questions such as: What crops should I put in this field for this year? How fast can I determine that my crops or even my herd has disease? How will the weather affect my planting and harvesting seasons?

Bots with AI capabilities can take data gathered from other technological sources and put together comprehensive solutions and forecasting models to aid in the producers' decisions.

4 INTERNET OF THINGS (IOT) SENSORS

The "Internet of Things" (IoT) consists of devices that can take data gathered from other technological advancements, store it in the cloud, analyze it, and provide useful insights or predictions. Common examples of these inter-networking devices include smart cars, smart garage doors, and fitness trackers.

Industries of all types have embraced this technology. According to a 2019 Microsoft Trends Report, 79% of today's manufacturing leaders are using IoT in their operations, with 82% of them reporting increases in operational efficiency and improved product quality as a result.[9] Even the City of Chicago has launched an "Array of Things (AoT)," which incorporates over 500 nodes all over their downtown streets and buildings. Data collected has allowed researchers to develop tools and applications to evaluate such topics as walking patterns, wind speeds, and air quality.[10]

In agriculture, farmers can use IoT sensors to monitor crops remotely. Ranchers can use them to watch livestock's health and birthing without having to be physically present. These sensors are also useful for monitoring equipment and machine health and maintenance needs, thereby reducing downtime and expensive repairs and allowing processes to run more smoothly.

5 AUTONOMOUS VEHICLES & MACHINERY

Since farmers have the daunting task of monitoring a huge expanse of land, autonomous vehicles and machinery would be a very desirable solution. Numerous farm autonomous vehicles have been developed – beginning with a tractor called the Agri-Robot – but both research and manufacturing have been delayed on this due to legislation and safety issues.

Still, it is expected that more autonomous operations with tractors, irrigation systems, and beyond-line-of-sight drone systems will emerge.[11] In the future, having more and more driverless farm machinery may direct agriculture toward a fee-for service model, in which farmers hire autonomous machinery for seasonal tasks instead of buying equipment outright. These tractors would work off a prescription file and could also plant, spray, and harvest the field with a professional in the driver's seat if needed.

6 BLOCKCHAIN

The supply chain is another area within agriculture where technology has the potential to make a significant positive impact. Blockchain is defined as a digital database that can be simultaneously used and shared within a large decentralized, publicly accessible network.[12]

Historically, E. coli outbreaks tied to produce have often resulted in massive recalls. In many instances, there is an inability to quickly and specifically identify which crops are the cause of the E. coli outbreaks. In turn, it is not uncommon for large quantities of uncontaminated produce to be destroyed to ensure consumer safety and confidence.

Using blockchain technology, food can be closely tracked and monitored through the entire supply chain process from start to finish, enabling sellers to effectively trace even single pieces of food back to their original source in a very timely nature. Immediate identification can result in quick product recalls, reducing both the risk of consumers becoming ill and the unnecessary destruction of unaffected produce or meat.

While this is a significant advancement in the food industry, farms have been slow to adopt such tools. Still, studies suggesting more widespread adoption of these digital supply chain tools could reduce food loss and waste by up to $120 billion annually.[13]

7 LIVESTOCK GENETICS & REPRODUCTIVE TECHNOLOGIES

One of the biggest ways technology has impacted agriculture is in respect to assisted reproductive technologies.

Artificial insemination has been used in agriculture for decades, as has in vitro fertilization (IVF), where immature female eggs are taken from infertile females and are "matured, fertilized and cultured in vitro for up to seven days until they develop to a stage that is suitable for transfer or freezing."[14] However, recent technological developments have greatly improved the rates the success. For example, studies have been conducted that point to higher success rates of frozen embryo transfer (FET) compared to fresh embryo transfer (ET).[15] Through the new technique of cryopreservation, embryos can now be stored at extremely low temperatures, even to –195.79 degrees Celsius, which stops all biological activity.[16]

Nuclear transferring, cloning, and sex determination of sperm or embryos are also additional methods used by ranchers today to optimize their livestock output.

as well as data collection about every individual animal within a large herd. Other purposes served include inventory management, asset tracking, controlling access to restricted areas, and ID badging.

9 ROBOTICS

Agricultural robots – from autonomous tractors to robotic arms – are increasing production yields for farmers.

Robotic applications can automate slow and repetitive tasks for farmers, thus giving them opportunity to improve other areas of overall production. Robots have been developed to perform useful and common tasks such as harvesting and picking, weed control, phenotyping, utility platforms, sorting and packing, and autonomous mowing or spraying.

There is even a device that uses machine vision to separate species, sorting sheep from goats with a swinging gate.[17] Automated milking parlors, automated sheep–shearing, and automated abattoir projects have also emerged from the use of agricultural robotics.

8 RADIO FREQUENCY IDENTIFICATION (RFID)

Radio-frequency Identification (RFID) technology is a concept comparable to barcoding, except that the RFID tag data can be read without being seen. This works along with blockchain as the foundation to further enhance the supply chain tracking.

Farmers can use RFID sensors to tag crops in challenging environments (such as greenhouses or cropland), as well as animals, assigning an individual identification number. Information is collected and stored using blockchain to create an accurate and trustworthy trail, providing traceability and enhancing and ensuring consumer safety.

RFID is also utilized in the ranching industry to allow better breeding control and conservation efforts,

What Does This Mean for Insurers?

With so much new technology in use, it is imperative for insurers to carefully review all the business activities that your farming insureds are involved in – along with all of their risks and exposures – in order to ensure adequate coverage. The use of these highly sophisticated machines and related technology is usually very expensive, which raises questions about the types of perils being insured and the adequacy of the limits of liability in traditional policies. Special equipment, farm equipment, and cyber liability are a few of the areas that have exposure and need to be addressed. Having an annual review with your clients is necessary to address new exposures and limit their liability and risks.

Cyber liability insurance coverage is of special importance. Robots and other automated machines are connected to networks. Hackers are becoming aware of previously unknown vulnerabilities and are able to hide malicious code in these kinds of machines. Through this, valuable proprietary information can be obtained and then traded for very high prices in underground marketplaces.[18]

In addition, the FBI has reported that the COVID-19 outbreak has become a highly targeted opportunity for criminals, and that cybercrime had jumped by as much as 300 percent since the beginning of the coronavirus pandemic.[19] Vigilance and preparation are key.

Conclusion

Agriculture has seen many new changes and ways of managing that greatly enhance profitability and reduce expenses and costly resources. With a growing world population and diminishing land space, technological innovation is a well–needed and useful concept for the industry, and needless to say will likely continue to evolve more and more for generations to come.

It is important for insurers to stay on top of these trends so they can fully understand the evolving exposures on the farm and provide the right types and amounts of coverage.

If you have any questions, please contact Sarah Kuhn, Research and Product Development Analyst, at skuhn@aaic.com or (847) 651-0889.

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