Science and Technology in the Modern Agricultural Sector: An Overview

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Abstract: Innovation is an important one in contemporary agricultural sector than ever before. Contemporary farming and agricultural activities work another way than those a few years ago, principally because of progressions in the science and technology, with sensors, devices, equipments, machines, and information technology. This sector, as a whole is facing huge confronts, from increasing costs of inputs, a scarcity of workers, and changing consumers’ preferences for lucidity and sustainability. There is mounting importance from agricultural corporations that solutions are desirable for these confronts. As a consequence recent agricultural sector habitually uses classy technologies like robotics, sensors for measuring temperature and moisture, aerial images, and Global Positioning System (GPS) technology. In the last 10 years, application scientific technologies in the agricultural sector has witnessed a increment in the investment worth of 6.7 billion USD endowed in the last five years and attracted 1.9 billion USD in the last one year alone. These modern technologies and accurate modern agricultural and robotic systems permit businesses to be more gainful, competent, safer, and more eco friendly. Further these modern technologies have paying attention around different areas such as interior vertical farming, computerization and robotics, livestock rearing technology, up to date greenhouse farming practices, exactitude agricultural and artificial intelligence, and blockchain. With this backdrop the present paper made an attempt to explain applications of the science and technology in the modern agricultural sector.

Keywords: Science and Technology, Agricultural Sector, Modern Farming, Blockchain Technology, Artificial Intelligence.

I. INTRODUCTION

Innovation is an important one in contemporary agricultural sector than ever before. Contemporary farming and agricultural activities work another way than those a few years ago, principally because of progressions in the science and technology, with sensors, devices, equipments, machines, and information technology. This sector, as a whole is facing huge confronts, from increasing costs of inputs, a scarcity of workers, and changing consumers’ preferences for lucidity and sustainability. There is mounting importance from agricultural corporations that solutions are desirable for these confronts.

As a consequence recent agricultural sector habitually uses classy technologies like robotics, sensors for measuring temperature and moisture, aerial images, and Global Positioning System (GPS) technology. In the last 10 years, application scientific technologies in the agricultural sector has witnessed a increment in the investment worth of 6.7 billion USD endowed in the last five years and attracted 1.9 billion USD in the last one year alone. These modern technologies and accurate modern agricultural and robotic systems permit businesses to be more gainful, competent, safer, and more eco friendly. Further these modern technologies have paying attention around different areas such as interior vertical farming, computerization and robotics, livestock rearing technology, up to date greenhouse farming practices, exactitude agricultural and artificial intelligence, and blockchain.
II. IMPORTANCE OF SCIENCE AND TECHNOLOGY IN THE AGRICULTURAL SECTOR

Agricultural sector is a backbone of any economy and it has been following from the ancient times with traditional manner, and it has replaced by the modern farming technologies, thereby it is enjoying much progression in modernization over the centuries. In that time, science and technology has become a large part of innovation and quality control mechanism in agriculture. Thus the science and technologies are supporting the agricultural sector in the following manner.

2.1 Improves the Efficiency of the Farmer

In the ancient days, our intimates had done the agricultural activities manually such as cultivating, weeding, and harvesting and made ready their land by with the help of a cow or buffalo or horse-pulled plow. Nowadays, those trend has changed and the farmers are using various farming technologies such as tractors, plant plughers, cultivators, weeder, sprayers, cultipackers, harrowers, automated irrigation systems, balers, and harvesters. When automation became realism in the agricultural sector, the whole thing has changed for farmers specially their farming efficiency. The introduction and usage of technology innovations in farming activities enable the farmers to complete farming activities in considerably less time than it would have taken by our intimates.

2.2 Digital Farming Techniques

The modern agricultural sector also used various modern technologies to assist them for maintaining their crops in a better manner. Of which Global Positioning System (GPS) is one of the technologies, which permits the farmers to supervise their land and precisely take samples of their soil every year. As well, there is automated irrigation systems that farmers can be installing thereby it allow them to water their crops optimally and monitor the same from the smartphone applications. However in Some areas farmers are also utilize drones to persuade pollination for the reason that of the lack of bees.

2.3 Scientific Lab Equipments

The scientific lab equipments make sure the top-quality goods and soil of course, the farming is being the source of our food, quality of the inputs and produces consider seriously. With the help of various analytical gadgets such as chromatographers, farmers can find out more about the dietary truth of food. Even though chromatography has numerous uses in agriculture, one of the majority useful relevance includes the study of agronomy and substance testing in insect repellents. All things measured, the importance of science and technology in agriculture and how it has made the farming sector little easier than it was originally.

III. AREAS WHERE THE SCIENCE AND TECHNOLOGY APPLIED IN THE AGRICULTURAL SECTOR

The following are the various areas where the science and technology enabled equipments are being used.

3.1 Interior Vertical Farming

Interior vertical farming is a recent method used in the modern farming and it can augment crop yields, conquer restricted land area, and even decrease farming’s impact on the surroundings by minimizing the distance in the logistics and supply chain. Interior vertical farming can be used to grow the produces stacked one above one more in a closed and restricted atmosphere. By using mounting shelves mounted vertically, it considerably decreases the quantity of land required to grow plants compared to conventional farming methods. This type of cultivation is often connected with the area where the farming lands are limited such as city and urban farming because of its capability to flourish in partial space. Vertical farms are exclusive in that some setups don’t need soil for growing plants. Most of the indoor vertical farming is hydroponic, where the crops are growing in a nutrient-dense bowl of water, or aeroponic, where the plant roots are methodically sprayed with water and nutrients. In lieu of usual sunlight, simulated grow lights are used. Due to the rapid the urbanization it requires increase the crop yield with abridged labor costs, the benefit of interior vertical farming method seems apparent. Vertical farming can be controlling various variables such as glow, moistures, and...
water to exactly calculate year-round, thus it is growing food production with consistent yield. The reduced water and energy usage optimizes energy protection vertical farms use up to 70 percent less water than conventional farming. Labor is also significantly condensed by using robotics to handle planting, maintaining, harvesting, and logistics, solving the challenges which are faced by the farmers from the current labor dearth in the agricultural sector.

3.2 Farming Automation
Farming automation, often related with smart farming, is using various technologies that make farming more competent and mechanize the crop or farm animals’ production cycle. A growing number of companies are operating on robotics innovation to develop drones, autonomous or driverless tractors, automated harvesters, automated watering system, and seeding robots. Although these technologies are fairly new, the industry has seen a mounting number of conventional agriculture companies adopt farm automation into their processes. Latest advancements in farming technologies ranging from robotics and drones to computer vision software have totally distorted the contemporary agriculture. The primary goal of farm automation technology is to cover easier, mundane tasks. Some major technologies that are most commonly being utilized by farms include: harvest automation, autonomous tractors, seeding and weeding, and drones. Agricultural automation technologies concentrate on major issues like an increasing global population, agricultural labor shortages, and altering consumer predilection. The benefits of mechanizing conventional farming processes are colossal by undertake issues from consumer preferences, labor shortages, and the ecological footprint of agricultural activities.

3.3 Livestock Farming Technology
The conventional livestock sector is extensively unnoticed and under-serviced, though it is debatably the most vital. Livestock sector provides much desired renewable, natural resources that relied upon every day. Livestock management has conventionally been known as running the business such as poultry farming, dairy farming, cattle ranches, or other livestock-related agribusinesses. Livestock managers must keep precise financial records, oversee workers, and ensure appropriate care and feeding of animals. However, recent trend have established that technology is transforming the world of livestock management. New developments in the in the past decades have made huge developments to the industry that makes tracking and administrating livestock much easier and data-driven. These equipments can come in the form of dietary technologies, genetics, digital technology, and more. Livestock technology can enhance or improve the productivity capacity, welfare, or management of animals and livestock. The concept of the ‘connected cow’ is a result of more and more dairy herds being fitted with sensors to monitor health and increase productivity. Putting individual wearable sensors on cattle can keep track of daily activity and health-related issues while providing data-driven insights for the entire herd. All this data generated is also being turned into meaningful, actionable insights where producers can look quickly and easily to make quick management decisions. Animal genomics can be defined as the study of looking at the entire gene landscape of a living animal and how they interact with each other to influence the animal’s growth and development. Genomics help livestock producers understand the genetic risk of their herds and determine the future profitability of their livestock. By being strategic with animal selection and breeding decisions, cattle genomics allows producers to optimize profitability and yields of livestock herds. Sensor and data equipments have huge benefits for the present livestock sector. It can develop the efficiency and safety of livestock by identifying ill animals and cleverly recognizing room for development. Computer vision allows us to have all sorts of impartial data that will get sum up into significant, actionable imminent. Data-driven decision making leads to enhanced, more competent, and appropriate decisions that will go forward the efficiency of livestock herds.

3.4 Modern Greenhouses
In recent years, the Greenhouse farming has been changing from small scale amenities used principally for research and development purposes to considerably more large-scale farming units that contend unwaveringly with land-based traditional food production. Collective, the entire global greenhouse farming market at present produces nearly 350
billion USD in vegetables annually, of which U.S. production comprises less than one percent. Currently, in large part due to the remarkable current developments in mounting technology, the industry is observing a budding like no time before. Greenhouses today are promising more and more productivity in a large-scale manner, capital-infused, and urban-cantered. As the market has grown radically, it has also experienced clear trends in modern days. Modern greenhouses farming technologies are becoming progressively more tech-heavy, using LED lights and automatic control systems to completely tailor the growing environment. Flourishing greenhouse companies are scaling considerably and situated their growing facilities near urban hubs to take advantage of on the mounting demand for local food, no matter the season. To achieve these feats, the greenhouse industry is also becoming more and more capital-infused, using venture funding and other sources to build out the communications necessary to vie in the current market.

3.5 Precision Agriculture

Agriculture is undergoing an evolution technology is flattering a crucial part of every profitable farm. New precision farming companies are mounting technologies that allow farmers to maximize yields by scheming every variable of crop farming such as moisture levels, pest stress, soil conditions, and micro-climates. By providing more accurate methods for planting and growing crops, exactitude agriculture enables farmers to augment competence and manage costs. Exactitude agriculture companies have found a huge opportunity to grow. A recent report by Grand View Research, Inc. predicts the precision agriculture market to reach 43.4 billion USD by 2025. The emerging new generation of farmers is fascinated to quicker, suppler startups that methodically take advantage of crop yields.

IV. TECHNOLOGIES BEING USED IN THE MODERN AGRICULTURAL SECTOR

The blockchain technologies and Artificial intelligence powered equipments are playing a major role in the modern farming.

4.1 Blockchain Technology

Blockchain technology is having the capability to track the ownership records and tamper-resistance can be used to resolve critical issues such as food fraud, safety recalls, supply chain incompetence and food traceability in the current food system. Blockchain technology is a unique one and its decentralized structure ensures established products and practices to create a market for quality products with precision. Food traceability has been at the center of current food safety deliberations, predominantly with new progressions in blockchain applications. Due to the temperament of unpreserved food, the food industry at whole is extremely vulnerable to making mistakes that would ultimately affect human lives. When food borne diseases threaten public health, the first step to root-cause analysis is to track down the source of contamination and there is no tolerance for uncertainty. As a result, traceability is significant for the food supply chain. The present communiqué framework within the food bionetwork makes traceability a protracted task since some concerned parties are still tracking information on paper.

The structure of blockchain makes sure convinced that each player along the food value chain would produce and steadily share data points to create an answerable and traceable system. Vast data points with labels that elucidate ownership can be evidenced punctually with no modification. As a result, the record of a food item’s voyage, from farm to table, is accessible to monitor in real-time. The use cases of blockchain in food go beyond ensuring food safety. It also adds value to the current market by establishing a ledger in the network and balancing market pricing. The traditional price mechanism for buying and selling relies on judgments of the involved players, rather than the information provided by the entire value chain. Giving access to data would create a holistic picture of the supply and demand. The blockchain application for trades might revolutionize traditional commodity trading and hedging as well. Blockchain enables verified transactions to be securely shared with every player in the food supply chain, creating a marketplace with immense transparency.
4.2 Artificial Intelligence

The rise of digital agriculture and its related technologies has opened a wealth of new data opportunities. Remote sensors, satellites, and UAVs can gather information 24 hours per day over an entire field. These can monitor plant health, soil condition, temperature, humidity, etc. The amount of data these sensors can generate is overwhelming, and the significance of the numbers is hidden in the avalanche of that data. The idea is to allow farmers to gain a better understanding of the situation on the ground through advanced technology (such as remote sensing) that can tell them more about their situation than they can see with the naked eye, and not just more accurately but also more quickly than seeing it walking or driving through the fields. Remote sensors enable algorithms to interpret a field's environment as statistical data that can be understood and useful to farmers for decision-making. Algorithms process the data, adapting and learning based on the data received. The more inputs and statistical information collected, the better the algorithm will be at predicting a range of outcomes. And the aim is that farmers can use this artificial intelligence to achieve their goal of a better harvest through making better decisions in the field.

V. HOW DO THESE MODERN TECHNOLOGIES SUPPORT AGRICULTURE?

Throughout history, scientific and technological advances have greatly impacted the agriculture industry. Early farmers improved their crop production by inventing the first hoes. Today, farmers improve crop production through the use of GPS. How did these changes happen? How did people learn about new ideas? How have these ideas changed farming methods? Early advances were shared by word of mouth. As new ideas were tried and applied to growing crops and livestock, they were shared and passed to the next generation as parents taught their children. Neighbouring tribes exchanged ideas with one another and with new settlers. In more recent times, scientists studying at universities devote their lives to research and development of farming products and practices. Iowa farmers and agricultural scientists have benefited and contributed to the ever-evolving science of agriculture.

5.1 New Ideas and Inventions

One milestone in the evolution of technology in Iowa occurred with the completion of rail lines across the state. By 1870 transportation had been greatly expanded which made it easier for farmers to market their products outside the Midwest. Transportation advances greatly impacted the life of an Iowa farmer. Another event that affected farm life was the commercial production of barbed wire. As the land became more settled and there were fewer and fewer acres of open prairie, farmers needed a way to keep their own cattle at home. Barbed wire was the answer. Instead of grazing on open prairie, cattle were fenced in the farmer's own field and fed with corn. This allowed Iowa farmers to transition from cattle grazing to cattle rising.

5.2 New Ways of Farming

By the latter part of the 19th century farmers had learned to diversify their crop production and to raise livestock for profit. Iowa farmers had learned the value in planting corn and feeding it to fatten their livestock. Advances in farm machinery production changed the way farmers worked. They were able to cover more land at a faster pace; and as manufacturers added seats to farm machinery, farmers found some relief from their backbreaking labors. The development of better corn seed is one of the biggest improvements in the past 100 years. Farmers once shelled the kernels from the longest and best looking ears from the harvest and planted those kernels the next spring. However, plant scientists like Henry A. Wallace began experimenting with ways to produce even better seed. They learned how to use the pollen from one variety of corn to fertilize another variety to produce a hybrid. The new variety grew ears that were better than either of its "parents." In the 1930s many farmers began buying hybrid corn seed. Today nearly all corn planted in the United States and much of the rest of the world is some hybrid variety.

5.3 Spreading New Ideas

Early in Iowa's settlement by European farmers, a number of institutions were established to encourage agricultural advances. State and county fairs were held and became show places for the best in all areas of agriculture. They helped...
spread the news about new ideas and methods. And they encouraged farmers to develop new products and new ways of doing their work. Interests in agricultural advancement also were reflected in the early provision for a state agricultural college and model farm to promote better farming techniques. The formal program of instruction began at Ames in 1869, and the college eventually developed into a nationally recognized leader in scientific agricultural advancement. The college developed extension services, education for people who are not enrolled as students, to provide up-to-date assistance for women and men on Iowa's farms. They learned about soil conservation, corn seed selection and cultivation, crop rotation and manure management. The invention of radio and television made it possible for farm families to learn about new ideas. They learned about new kinds of technologies such as food-freezing processes that revolutionized food storage. They also learned about hybrid seed that boosted crop production and soybeans that became a major crop addition. New ways of spreading information allowed farm families to hear about soil conservation programs also. They learned about cattle and hog breeding which in turn improved the livestock industry.

5.4 Conserving Resources

Over the years farmers have become more aware of conservation methods to prevent erosion and to protect the water. Some farmers have planted buffer strips wide strips of grass along waterways. These grassy strips trap soil and chemicals before they reach the water. Many farmers have changed plowing practices plowing their fields less often and not as deep. This helps to keep soil from blowing away. All these advances in the area of science and technology have resulted in fewer farmers working bigger farms. They have also meant Iowa's farm families are producing more than in the past. Some of the changes that have occurred as a result of scientific advances have been good for Iowa; some have caused problems for Iowans. Many farmers use global positioning systems and agree that it is a new form of technology that benefits farmers. But advances in biotechnology and crop production have caused controversy. Iowa's farmers continue to adapt to the changing technologies. And they continue to contribute to the science of agriculture.

VI. Conclusion

Use of farming technologies like modified animal housing, motorized or automated equipment and biotechnological techniques has allowed improvement in agriculture and positively impacted the way of farming and growing food. Decreased use of fertilizer, pesticides and water in turn keeps food prices down and reduces environmental pollution and gives a positive impact on natural ecosystems. Beneficial effects of agriculture include; saving of countries foreign exchange; cutting import bill and reducing import; increase in crop productivity and enhanced agribusiness; and improvement in living standard of farmers. Positive effects of bio-fuel production from agricultural sources include decreased dependence on fossil fuels, increased farmers’ income and protection of natural ecosystem.

REFERENCES

[2]. Basappa, Malali Anil. "Venture capital management in micro small and medium msm enterprises."
[4]. Dhanabalan, T. "Managerial effectiveness of Mahatma Gandhi national rural employment guarantee scheme and Indira Awaas Yojana in Dindigul district."


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