
Imagine Agriculture without Technology

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ABSTRACT

Technology has contributed significantly to the integration of agricultural practices with improvement and challenges. Innovations led to improvements in productivity and efficiency, with significant improvements in crop cultivation, irrigation, and land use practices. Traditional practices and agricultural scientific knowledge have contributed to sustainable change with the help of modern technology. Farming with modern technology like machinery, post-harvest technology, Internet of Things, irrigation technology, and so on, has benefited the farmers as well as industry. Lot of technology contributed to a significant impact on food security, production, and protection practices of crops. Technological advancements keep on changing the nature of farming practices and moving towards compensating the human population and food demand.

INTRODUCTION

Agriculture encompasses the practice of cultivating crops and raising animals for the primary purpose of providing food. In addition to food production, it also involves the cultivation of non-food products, including timber. Agriculture serves as the foundation for sustaining human life, contributing to our nutritional needs through the cultivation of crops and the husbandry of animals. Agriculture technology has been an important development in the history of human civilization of livelihoods in urban areas. Farmers adopted agricultural practices to fulfil their

needs and improve their farming methods. Agricultural practices involve temporarily clearing a piece of land, plowing, and sowing seeds before the land is cultivated for an extended period and crops are harvested. Furthermore, due to excessive deforestation and over-exploitation of natural resources, soil erosion and environmental degradation are significantly increasing. The result of population growth the need of nutritional content also rises, which is the foundation of livelihood. Additionally, changing agriculture practices have also greatly affected the habitat of wildlife. So there is a need to adapt a new practices to fulfil this needs of the people. The higher the proportion of production costs that consist of labour expenses, the more labour - intensive the business is. For this, more workers were needed. Farmers utilized technological advancements in a situation where there were not enough workers available. Advancements in agricultural technologies such as automation farming and processing, modern housing for animals, and biotechnology, which are used to further enhance agriculture practices. Advanced technologies have allowed agriculture to compete the feed requirement of people and manage the labour requirement on farms to do the work. To meet the demand intensive measures are required to meet the demand and supply. This includes the data of all monitored crops and practices in hand to produce more agriculture crops. In recent times AI has majorly play a vital role in not only monitoring the crops but also do the timely process in modern agriculture.

ELEMENTS OF MODERN TECHNOLOGY

FARM POWER AND MACHINERY

Farm Power and Farm machinery are evolved from ancient days to reduce the human need and burden over them. Mechanical devices, including tractors and implements, are in usage to save labour and time, which helps the farmers meet their own requirement. Farm machinery encompasses a diverse array of tools, ranging from basic hand-held implements utilized since ancient times to sophisticated harvesters found in contemporary mechanized agriculture. This spectrum of devices reflects the evolution of farming



Figure 1. Farm power and machinery

practices, where technological advancements have gradually replaced manual labour with more efficient and powerful mechanical solutions. Farm machinery includes a range of push/pull implements and machines designed for tasks such as tilling the ground, planting seeds, and various agricultural operations. Tillage implements specifically play a crucial role in preparing the soil for planting by loosening the earth and managing weed or competing plant growth. So, the task can be completed on time which helps a lot to meet the market or demand. This modern technology has a greater impact on farming from field preparation to harvesting of produce. Without this machinery, farmers face high labour costs and even losses due to the present climate change problems. To meet these issues machines like combined harvesting and planting will make a work lot easier. Also unmanned tractors are already in process which can precisely

do the work which reduces the dependence of labour. Laser technology can level the land accurately without undulations in the field can reduce the burden on farmer in irrigation and other inter-cultivation practices.

POST-HARVEST PROCESSING

Every agricultural produces starts to lose their value in terms of quality and commercial sector. This can be prevented by means of proper handling of agricultural produces which includes process immediately following harvest, including drying, cooling, cleaning, sorting, and packing and. It involves the shelf life of produces freshness, nutrient content, taste, and quality. Various



Figure 2. Post-Harvest Processing

technologies have developed that can improve them. Fruit and vegetables are highly perishable,

so poor handling after harvest can result in losses. Various technologies are in process to meet the demand with a high nutritional value. It includes the development of various drying technology reduces the losses by means of natural causes (insects, rodents, dust.). Development of processing units such as shellers, cleaners and graders were highly involved in reducing the burden of labour requirement and can complete the process in time which can fetch high market values. So that these technologies can contribute to food security mainly by reducing losses and wastes. Proper post-harvest handling is crucial in agriculture to prevent significant losses and protect the efforts of the growing season. Without these kinds of technologies there can be severe financial repercussions, particularly for smallholder farmers, leading to potential business failure and income loss.

IRRIGATING SYSTEM

Water is the basic need of every living thing in this world, which includes plants, who needs this for proper growth and development of plants. Plants acquire water and essential minerals through their roots, a natural process crucial for their growth. In agriculture, irrigation serves as the deliberate application of water to fields, a method carefully employed to support crop production. This



Figure 3. Irrigation System

involves providing a controlled and measured quantity of water to the soil, tailored to the specific needs of different crops, varying soil types, and changing seasons. Various sources are tapped for irrigation purposes, including rivers, wells, ponds, tube wells, lakes, and canals. This diversity of water sources allows farmers to adapt to local conditions and choose the most suitable method for their agricultural needs. The choice of irrigation source is influenced by factors such as water availability, geographic location, and the type of crops being cultivated. In addition to these uses, irrigation is used to protect crops from frost, prevent weed growth in rain fields, and prevent soil compaction. Nutrients dissolved in water are transported to every part of the plant. More irrigation systems that conserve water are the drip system, sprinkler system, etc. The drip system delivers water and nutrients directly to plant roots via dripper lines and units, ensuring efficient water use and uniform nutrient distribution. The sprinkler system scatters water as rain through rotating nozzles in vertical pipes, which is suitable for uneven terrain with limited water availability, so farmers must use new technology to irrigate their crops. With the help of several schemes bore wells and dams are built in dry areas to pump clean water to farmers and irrigate crops. This increases food production and distribution throughout the year with a less water requirement.

NANO TECHNOLOGY

Nanotechnology, with applications ranging from medicine to energy, has gained significant attention. Nanoparticles, characterized by small size and large surface area (1-10nm), are being explored for diverse functions, in sustainable agriculture, nano chemicals show promise for plant growth, fertilizers, and pesticides. Nanomaterials are considered insects, fungi, and weeds. Some Nanomaterials, like silver nanoparticles, are utilized for their antimicrobial properties in food packaging. However, certain nanoparticles (Ag, Fe, Cu, Al₂O₃) may have adverse effects on plant growth alongside their antimicrobial benefits. Nanotechnology plays a vital role in various applications such as transferring DNA or using nanoparticles for gene modification in plants to create insect-resistant varieties. It also contributes to advancements in food storage, processing, and extending product shelf life. Additionally, nanotechnology enhances biomass-to-fuel production, fostering increased efficiency in this development.

AI TECHNOLOGY

AI technology enhances harvest quality through precision agriculture, aiding in disease detection, pest control, and nutrition assessment. AI sensors also identify and target weeds, improving farm management. The benefits are automation impact, both crop and soil monitoring, surveillance, etc.

IoT TECHNOLOGY IN AGRICULTURE

Due to fragmentation and population increase, agricultural field area is gradually decreasing. To meet the food demand for those populations smart farming comes into play. Internet of Thing s plays a major role to monitor crop growth, soil health and crop health as well as automating the irrigation system. This helps farmers to monitor the field conditions from remote areas. IoT has the potential to transform agriculture in many aspects which are given below,

AGRICULTURAL DRONES

Ground-based and aerial-based drones and technologies are being used to improve various agricultural practices such as crop health assessment, crop spraying, irrigation, planting, soil and field analysis. Drone surveying helps farmers not only monitor their crops but also monitor the movement of livestock. The Aerial photography of farms is difficult without the help of drones.



Figure 4. Drone Fertilizer Application

Without drones, farmers would have to visit their field more frequently and it will be difficult and time consumption to monitor crops remotely and take preventive action in time. If any disease or pest attack has found on crops, then the fertilizer application will be difficult to spray evenly. Time consumption leads to more crop damage and economic losses for farmers here comes the drone technology made this look easier which has been prevented by this advancement.

SMART GREENHOUSE

Greenhouse with the help of technological advancements can monitor and controls the climate, environment and reduce the dependence on human intervention. There are a few key factors which is employed to control and capture the various climatic data with the help of battery-operated sensors and transmit these security data through are liable, cost-effective wireless connectivity to a remote gateway. It is better to create sustainable climatic conditions and environment to monitor the moisture content and salinity of water to stay on top conditions to the better development of crops. It would have been way much easier with this smart Internet of Things technologies. With this technology, even a person with a small area can produce their food with this smart one, which can meet the food requirements and space utilization.



Figure 5. Smart Greenhouse

VERTICAL FARMING

Due to the growth of population across the world makes a gradual decrease in percentage of agricultural field. To overcome this Vertical farming is an innovative farming system characterized by the cultivation of crops in vertically arranged layers, usually within regulated

structures such as urban high-rises or special indoor structures. This approach uses state-of-the-art technology such as hydroponics, aeroponics, and artificial lighting to create optimal environmental conditions for plant cultivation regardless of external climatic or geographical barriers. This can reduce the potential to effectively overcome many of the difficulties faced in conventional agriculture.



Figure 6. Vertical Farming

HYDROPONICS

Farmers use more artificial fertilizers in their farmlands to get more yield by compensating the soil quality and nutrients. But the advancement in farming practice makes this easier. One of the evolved technologies is Hydroponics, which is a modern farming technique that involves growing plants without soil. Instead, plants are grown in nutrient-rich water solutions or other growing media such as



Figure 7. Hydroponics

perlite, vermiculite, or cocoa coir. This technique differs from traditional soil-based agriculture in that it allows better control of the plant's growing conditions, including precise control of nutrients, water, and lighting. This control leads to higher crop yields and efficient use of resources. Hydroponic farming can be used to grow any type of plant including leafy greens, herbs, fruits, and vegetables. Some of the most popular hydroponic crops include lettuce, tomatoes, peppers, and strawberries. Hydroponic farming promotes sustainable farming practices and enables year-round crop production. Many benefits, especially reduced water use in agriculture.

AEROPONICS

Aeroponics is a system in which roots are continuously or intermittently placed in an environment filled with fine droplets of a nutrient solution. This method requires no substrate and allows the roots of growing plants to be suspended in a deep air or a growth chamber, periodically moistening the roots with a fine mist of atomized nutrients. System with a better ventilation has a major advantage on crop production on aeroponics. Another distinct advantage of aeroponics over hydroponics is that almost any type of plant can be grown in a true aerobic system because the aeroponics microenvironment can be better controlled. The aerobic plants

which are in suspension can 100% O₂ and CO₂ through their root system, stems, and leaves. All these processes can be monitored and controlled with the help of advanced information technologies, which will reduce the manual intervention and increase the crop yield.

CONCLUSION

From ancient years the evolving technology in agriculture is gaining substantial benefits in high productivity, lower production costs, increased efficiency, and increased income. The demand for food and nutritional source is gradually increased due to the increasing population, land reduction climate change and high production costs, but it will never stop them from producing. To overcome these struggles evolved technologies help farmers to minimize constraints. Farming is not only about weather and high production but also involves data collection and embracing modern technology. As technology continues to advance, agriculture becomes increasingly valuable. Modern agriculture not only changing the farming practices but also help farmers to automate their activities by assisting them in transitioning to precision agriculture.