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The AI Era: The Future of Farming

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Abstract *Farming practises have undergone a revolution due to the swift progress in agricultural technology in recent times. The sustainability of our food system is being threatened by global issues like population increase, climate change, and resource scarcity, thus these technologies are becoming more and more important. There are several manual techniques involved in traditional farming. There are a lot of benefits to using AI models in this regard. By using AI, many problems are resolved and the negative aspects of conventional farming are lessened. In agriculture, artificial intelligence may support soil health investigations to gather data, track meteorological conditions, and suggest fertiliser and pesticide applications. Using farm management software helps farmers make better decisions at every step of the crop-cultivation process, increasing productivity and profitability simultaneously. This article will go over the many applications of AI in agriculture as well as its limitations.*

Keywords *Farming, AI, Agriculture, Crop Cultivation, Farmers, Application of AI, Technology*

INTRODUCTION

Over the next several years, AI will undoubtedly play a bigger and bigger part in agricultural and food sustainability. Agricultural technology has always been at the forefront, from early tools to irrigation to tractors and artificial intelligence. Every advancement has made farming more efficient while lowering its difficulties. However Artificial Intelligence is a collection of programming-automated technologies rather than a physical object. Essentially, an AI system learns from data and then applies that knowledge to solve issues, much like a human thinks. The agricultural sector will need to adapt if AI is to drive the industry's revolution. It is necessary to educate and train farmers in the usage of AI-powered technologies. Because of food waste, climate change, and other issues, around one billion people still experience hunger and malnutrition even though there is enough food produced to feed everyone on the planet. Thankfully, the application of artificial intelligence (AI) in agriculture has promise for revolutionising food systems and mitigating the world food issue. AI can assist farmers in making data-driven choices, maximising resource utilisation, and minimising environmental impact by analysing data from many sources.

APPLICATIONS OF AI IN AGRICULTURE

In agriculture, Crop management involves planting seeds, monitoring their development, harvesting them, storing them, and distributing them. It may be summed up as the endeavours aimed at enhancing the yield and growth of agricultural goods. A thorough comprehension of the crop class in relation to its timing and kind of flourishing soil will undoubtedly boost crop production. To deal with the water shortage brought on by the soil, the weather, or insufficient irrigation, farmers must mix a variety of crop management techniques. A thorough awareness of weather patterns aids in making decisions that will provide a high-quality and productive crop output. Decision-rule-based flexible crop management systems ought to be the standard. The drought's timing, severity, and predictability are crucial considerations when selecting between cropping options (Debaeke et al., 2004).

AI systems are capable of reliably estimating missing nutrients and performing chemical soil analysis. It gathers information from soil samples and gives farmers precise assessments of the general condition of the soil and any nutrients that are missing. This enables farmers to optimise crop growth and minimise environmental impact by modifying irrigation schedules and fertiliser applications. According to studies, the accuracy rate attained by employing AI to forecast crop maturity was greater than that of human observers. Farmers may benefit from large cost savings and better revenues as a result of this improved precision.

AI start-ups are creating farming field robots that can effortlessly do a variety of duties. Compared to humans, this kind of robot is trained to manage harvest crops more quickly and in greater quantities. Other popular robot uses include robotic weed management (Lee et al., 1999), which is based on a machine vision system and incorporates a precision chemical application system, and weed plucking (Slaughter et al., 2008). Robotic weeding is supposed to be extraordinarily accurate with the use of computer vision, saving 90% of pesticide use. These solutions use

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data analytics to determine how much pesticide is required for each field based on information about crop type, soil condition, and field history. This appears to be mostly advantageous since manually controlling weeds by hand is a labor-intensive, arduous process that requires a lot of manpower. Computer vision analyses the size, shape, and colour of leaves to differentiate weeds from crops when paired with machine learning. Robots that perform robotic process automation (RPA) activities, such autonomous weeding, can be programmed using such systems.

According to Gibbons (2000) and Waheed et al. (2006), advanced information processing technology for timely in-season crop management like variable rate technology, airborne and satellite remote sensing, multispectral and hyperspectral ground-based, computer modelling, global positioning systems (GPS), geographic information systems (GIS) are innovative system approaches on which precision agriculture is based.

Diseases of plants are a significant barrier to yield growth. These diseases are influenced by a number of variables, including genetics, soil type, rain, dry weather, wind, temperature, etc. Managing the impacts is difficult because of these variables as well as the erratic nature of some illnesses' causal influence. Computer vision may be used to classify and identify diseases using a variety of algorithms and techniques. Using Deep Convolutional Neural Networks, the corresponding illness and plant were identified with a 99.53% success rate (Ferentinos, 2018). Additionally, illnesses in crops like rice have been detected using neural networks (Phadikar & Sil, 2008).

In order to determine the acreage and track crop health in real time, businesses are integrating meteorological data and satellite photography. Businesses can identify pest and disease infestations, predict crop production and productivity, and anticipate pricing with the use of technologies like big data, artificial intelligence, and machine learning. When AI and big data analytics are combined, farmers may receive advice based on precise, up-to-date information, which boosts output and lowers expenses. On future pricing trends, demand, crop to plant for optimal profit, use of pesticides, and other matters, they may advise farmers and governments. Market demand analysis is an essential component of contemporary agriculture. AI can assist farmers in choosing the best crop to plant or market.

LIMITATIONS OF AI IN AGRICULTURE

Despite the various advancements in agriculture throughout its lengthy history, many farmers are still more accustomed to using conventional techniques. It's improbable that the great majority of farmers have ever worked on AI-related projects. To enumerate some of the limitations of AI in agriculture:

There is no getting around the reality that the initial investment in AI solutions may be highly costly, even though they can be cost-effective in the medium-to-long run. Adopting AI may not be practical for the time being given the financial struggles of many farms and agribusinesses, particularly small-scale farmers and those in developing nations.

Even though artificial intelligence (AI) has clear advantages, farmers may find it difficult to completely embrace the technology due to people's reluctance to accept unfamiliarity.

AI is still in its early stages of development, thus there will be limitations. Good models require a wide range of high-quality data, which are hard to come by in agriculture. Restrictions can make it challenging for robots equipped with sensors to adjust to shifting farming conditions.

If an AI system is just designed to maximise agricultural yields in the near term, it may overlook the environmental costs of doing so, which might eventually result in excessive fertiliser usage and soil erosion. In an effort to increase yields, excessive use of pesticides might destroy ecosystems, and excessive use of nitrogen fertiliser would contaminate the land and nearby streams.

There are several legal issues with using AI in smart farming and precision agriculture. Cyber-attacks and data breaches are examples of security risks that might seriously affect farmers. It's even possible that hackers may target AI-based farming systems.

Millions of field workers are expected to lose their jobs in the next decades, mostly as a result of artificial intelligence's effects on the agriculture sector. Expert AI farming systems that don't consider the complexities of labour inputs will ignore, and potentially sustain, the exploitation of disadvantaged communities (Tzachor et al., 2022).

CONCLUSION

The efficiency of human society's agricultural systems is largely what determines its success. There is a growing demand for improved technical solutions as traditional farming practises become outmoded. Automation has always had a major influence on sectors worldwide. Artificial intelligence will undoubtedly have a significant influence on agriculture, and digital technology is already significantly changing the sector. Artificial intelligence-driven solutions can aid with issues that the agriculture industry faces, such crop yields, soil and plant health, weeds, and disease. A large share of the world's agricultural workforce consists of smallholder farmers, whose demands and constraints must be taken into account while using AI in agriculture. The gap may be closed by programmes that give smallholder farmers access to finance and training so they can adopt AI-based agricultural techniques. This way, farmers of all stripes may profit from cutting-edge technology that the world needs to ensure the sustainability of our food system. To conclude, Artificial Intelligence greatly alleviates the labour and resource shortage, and it will be a potent instrument for enterprises to manage the growing complexity of contemporary agriculture.

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