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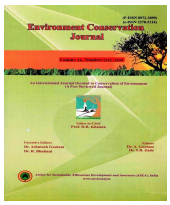

Management of agriculture through artificial intelligence in adverse climatic conditions

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ABSTRACT

Climate change has been a significant global challenge in recent years, resulting in adverse conditions for agricultural crops. Adverse climatic conditions, such as drought, flood, and extreme temperatures, have a significant impact on crop yields, resulting in food insecurity, economic losses, and environmental degradation. Agricultural experts have been working to develop innovative technologies to help farmers manage their crops better in adverse climatic conditions. One such technology is the use of Artificial Intelligence (AI) to model and manage agricultural crops. The main concern of this paper is to find the various applications of Artificial intelligence in agriculture to optimize irrigation and fertilizer application in adverse climatic conditions. By analyzing data on soil moisture levels and weather patterns, AI algorithms can determine the optimal timing and amount of irrigation and fertilizer application to maximize crop yield while minimizing water usage and fertilizer runoff. AI-based modeling and management of agricultural crops in adverse climatic conditions can help farmers improve crop yields, reduce costs, and mitigate the effects of climate change.

Introduction

The population of the globe is projected to reach over 10 billion people by the year 2050, which would result in an increase in agricultural production of up to 50% compared to 2013 despite modest economic growth. Currently, agricultural production accounts for around 37.7% of the total land area. Agriculture plays a significant role in creating jobs and raising the national income. It is actively participating in the economies of both rich and developing countries, making a considerable contribution to the prosperity of both. The income per person in rural areas has significantly increased as a result of the expansion of agriculture. It will thus be sensible and appropriate to place more attention on the agriculture sector. AI-based crop modeling involves collecting and analyzing large amounts of data from various sources, such as weather stations, soil sensors, and satellite images (Bochtis *et al*., 2019). This data is then used to create models that can predict crop growth, yield, and quality. The models can also be used to simulate different scenarios, such as changes in weather patterns, irrigation schedules, and fertilization regimes, to identify the most effective strategies for managing crops in adverse climatic conditions. One example of AI-based crop modeling is the use of machine learning algorithms to predict crop yields in drought-prone areas. Researchers have developed a model that uses satellite images and weather data to predict crop yields with an accuracy of up to 90%. The model can help farmers plan their irrigation schedules, optimize their use of fertilizers and pesticides, and reduce water wastage, resulting in higher crop yields and lower costs. Another example is the use of AI-based tools to monitor crop growth and

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health. Researchers have developed algorithms that can analyze images of crops taken by drones or satellites to detect signs of stress, such as wilting or discoloration, which can be indicative of adverse climatic conditions. The tools can also identify nutrient deficiencies, pest infestations, and other problems that can affect crop yields. This information can be used to develop targeted interventions, such as precision irrigation (Huang *et al*., 2021)or pest control, to mitigate the effects of adverse climatic conditions. Fifty percent of the workforce in nations like India is employed in the agricultural sector, which contributes 18% of the GDP to the nation. Rural development will be boosted by agricultural sector growth, which will eventually lead to structural change (Mogili and Deepak, 2018).With the introduction of technology; several sectors have seen a drastic transition. Surprisingly, despite being the least digitalized sector, the research and commercialization of agricultural technology have gained traction. With the power to expand our perceptions and change the environment around us, artificial intelligence (AI) has started to play a significant part in daily life (Oyinbo*et al*., 2020). The fundamental idea behind AI is to create technology that works similarly to the human brain. Intelligent software and systems are created based on research into how the human brain functions, and how people learn, make decisions, and work together to solve problems. These intelligent gadgets, like the human brain, feed this software with training data and further provide us with the appropriate response for every legitimate input. AI encompasses a wide range of fields, including machine learning and deep learning (Sukhadia *et al.,* 2020).A system for harvest planning that couples crop assignment with vehicle routing. With the help of these new technologies, labor, which was formerly limited to a small number of industrial sectors, is now active in many other fields. In-depth fields including biology,linguistics, computer science, mathematics, psychology, and engineering are the foundation of AI.

Agricultural effects of AI

Agricultural crop production is heavily influenced by climatic conditions, and adverse weather events such as drought, heat waves, and floods can lead to significant crop yield losses. The increasing frequency and severity of these events due to adverse weather highlight the requirement for more efficient management practices to mitigate the negative impacts on crop production. Artificial intelligence (AI) has a chance to enhance crop management in unfavorable climatic conditions by providing accurate predictions and insights into crop growth and yield.The AI coordinates in many sectors and also manages the efforts of farmers who encounter a variety of obstacles including the various area in the agricultural sector such as crop establishment, weeding, crop monitoring, soil content sensing, irrigation, and crop output (Kim *et al.,* 2008). In order to supply high-value AI applications in the aforementioned industry, agricultural robots are constructed. The agriculture industry is in trouble as a result of the rising global population, but AI has the ability to provide a critical remedy. AI-based technical advancements allowed the farmers to increase output while using less input, enhance output quality, and ensure a quicker go-to-market for the produced crops. The typical farm is predicted to produce 4.1 million data points per day on average by 2050. The following list outlines the different ways that AI has benefited the agriculture industry.

Recognizing the topographical image

Autonomous UAVs and their applications, such as identification and surveillance, human body detection and geological area, search and rescue, and forest fire detection, have experienced an increase in attention in recent years. Spatial crop mapping and accuracy assessment using remote sensing and GIS also plays a very important role too (Nema *et al*., 2018)

Strengthen the workforce's skills

Farmers can gather enormous volumes of data from official and public websites, examine it all, and provide answers to a variety of confusing situations. It also offers us a more intelligent method of irrigation (Arvind *et al*., 2017) increasing the output for the farmers. As a result of artificial intelligence, farming will soon combine technological know-how with biological aptitudes, enhancing quality for all farmers while lowering losses and workload. According to one projection,

two-thirds of the world's population would reside in cities, necessitating a reduction in the load placed on farmers. AI in agriculture may be used to automate a number of procedures, lower risks, and provide farmers with the information they need for simple and effective farming.

Production Optimization

The optimum output level for all crops is determined by variety selection and seed quality. Emerging technologies have enhanced the selection of hybrid seeds that are most suited for farmers' demands, as well as the optimum crop selection. It has been put into practice by gaining a knowledge of how seeds respond to varied climatic and soil conditions. By gathering this data, the likelihood of plant illnesses is decreased. We can now efficiently fulfill customer demands, market trends, and yearly results, enabling farmers to maximize crop returns.

Effectiveness of Chat bots

Chat bots are simply conversational virtual tools that automate communication with users. Chatbots have been made possible by artificial intelligence and machine learning. We can now comprehend natural language and communicate with users more individually thanks to it. Agriculture has made use of this facility by helping the farmers by supporting them in receiving answers to their queries, offering them guidance, and giving them various recommendations. They are mostly prepared for retail, travel, and media.

Advanced Farming AI System

Farmers and scientists may use AI-based models to forecast how unfavorable weather conditions will affect crop yield, allowing them to make educated decisions about planting, irrigation, and fertilization. These models are created by fusing information from several sources, such as satellite images, climate data, and previous crop yield information. Following the application of machine learning algorithms to this data, models that can precisely forecast crop growth and yield under various environmental circumstances are created. By using data analysis and predictions that have been validated, these technologies help and benefit farmers. There are sensor-based autonomous field monitoring agriculture robots providing data acquisition and wireless transmission (Hemalatha and Sujatha, 2015).Important agricultural data acquired by IoT devices and ML algorithms are processed and channeled through data science. Agriculture real-world applications of AI/ML and data science include:

Utilizing ML to eradicate weeds by identifying species of plants/crops; Predicting yield and quality evaluation; Predictive analytics for crop sustainability; Detecting crop infections and illnesses; intelligent harvesting and pricing choices. Reducing waste and satisfying expectations • cattle-herding robots that are autonomous. Various advancements in agriculture are being driven by AI/ML, some of which are listed below:

1. Analysis of crops

In order to combat drought and other detrimental environmental phenomena affecting crop yield, drone-based crop monitoring is practiced worldwide. Drone 3D imagery is being used to predict disease outbreaks, insect infestations, agriculture patterns and characteristics, and other things. Drones are also often used for crop pesticide spraying, for advanced precision farming (Natu and Kulkarni, 2016) since they can do the task five times faster than conventional gear, according to one analysis (Ahirwar *et al*., 2019). To avoid chemical pollution of groundwater, attention must be used. Using XRF analyzers to detect the mineral content of the grains, grain analyzers to establish traceability and digitalize the quality of the grain seeds, and ultra spectral analysis, for example, can improve the nutritional quality of the grains. Imaging might be used to predict how the nutritional content of leaves would vary as they develop.

2. Importance of robotics in farming

Increased productivity and increased yields in agricultural systems are both the results of the use of robots. Robotic weeding and spraying reduce the need for agricultural chemicals by around 90%. Robots are able to clear weeds without the assistance of humans since they can navigate field columns and rows. Generally using a laser beam and a camera for direction. In comparison to conventional approaches, using robots for plant transplantation results in more effective ones. The plucking of fruits and nuts is also done by robots.

3. Tracking devices through sensors

To monitor food for customers from the source, radio frequency identification (RFID) devices are utilized. For fresh and high-quality food, these sensors build from the first to last traceability trail for the yield, improving production compliance and dependability.The Crop OS platform created by Pairwise Plants is one illustration of an AI-based crop management model. It makes use of machine learning algorithms to forecast crop development and production based on genetic data and environmental elements like temperature, humidity, and soil moisture. Another illustration is the IBM Watson Decision Platform for Agriculture, which employs machine learning algorithms to offer insights into crop development, production, and disease management based on meteorological data, soil moisture, and other factors. This advanced technology also be used to optimize watering and nutrition enrichment applications in adverse climatic conditions. By analyzing the soil moisture levels and weather patterns, AI algorithms can determine the amount of irrigation ,optimal timing and fertilizer application to maximize crop yield while minimizing water usage and fertilizer runoff.

AI can help in the development of novel crop types that are more resistant to unfavorable environmental conditions in addition to enhancing agricultural management. Breeders may create new varieties that are more suited to these conditions by using AI algorithms to find features related to drought, heat, and other stress factors by analyzing genetic data from various crop kinds.

Conclusion

AI has the huge potential to revolutionize crop management in adverse climatic conditions by providing accurate predictions and insights into crop growth and yield. However, the successful adoption of these tools requires collaboration from service provider and partnerships between farmers, researchers, and technology developers to overcome the challenges of data availability, cost, and expertise. The implementation of AI-based models, however, for crop management under unfavourable climatic circumstances is still constrained by a number of issues, such as the availability and quality of data, the high cost of technology, and the requirement for specialized skills to design and utilize these models. To create user-friendly and affordable AI-based solutions for crop management, it is imperative that farmers, academics, and technology developers work together. Given that cutting-edge technology are primarily employed on sizable, well-connected farms, India's future usage of AI in agriculture will need to concentrate on ensuring broad access. The future of artificial intelligence, machine learning, and data science in farming will depend on expanding connection and outreach to even tiny farms in isolated regions throughout the world.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Ahirwar, S., Swarnkar, R., Bhukya, S., & Namwade, G. (2019). Application of drones in agriculture. *International Journal of Current Microbiology and Applied Sciences*, 8(1), 2500-2505.

Arvind, G., Athira, V. G., Haripriya, H., Rani, R. A., & Aravind, S. (2017). Automated irrigation with advanced seed germination and pest control.In IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR).

Bochtis, D. D., Sørensen, C. G., Green, O., Zalidis, G. C., & Kittas, C. (2019). Big data in agriculture: A challenge for the future. *Agriculture*, 9(10), 215.

Hemalatha, T., & Sujatha, B. (2015). Sensor-based autonomous field monitoring agriculture robot providing data acquisition & wireless transmission. *International Journal of Innovative Research in Computer and Communication Engineering*, 3(8), 7651-7657.

Huang, X., Li, Y., Li, H., Li, H., Huang, W., & Liu, X. (2021). A review of artificial intelligence and remote sensing techniques for precision agriculture. *Remote Sensing*, 13(4), 671.

Mogili, U. M. R., & Deepak, B. B. V. L. (2018). Review on application of drone systems in precision agriculture. In International Conference on Robotics and Smart Manufacturing (pp. 502-509). *Procedia Computer Science*, 133.

Natu, A. S., & Kulkarni, S. C. (2016). Adoption and utilization *International Journal on Recent and Innovation Trends in Computing and Communication*, 4(5), 563-565.

Nema, S., Awasthi, M. K., & Nema, R. K. (2018). Spatial crop mapping and accuracy assessment using remote sensing and GIS in Tawa command. *International Journal of Current Microbiology and Applied Sciences*, 7(5), 3011-3018.

Oyinbo, O. Y., Adigun, M. O., & Oyediran, O. J. (2020). of drones for advanced precision farming: A review. Application of artificial intelligence in agriculture: A review. *Journal of Agricultural Science*, 12(1), 1-12.

Sukhadia, A., Upadhyay, K., Gundeti, M., Shah, S., & Shah, M. (2020). Optimization of smart traffic governance system using artificial intelligence. *Augment Human Res*, 5, 13.