Short Communication

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The Role of Artificial Intelligence in Agricultural Sustainability

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ABSTRACT

In order to fulfill the ever-increasing needs of the world's population for food while also protecting the integrity of the environment, it is necessary to use agricultural techniques that are environmentally responsible. This article provides an explanation of the idea of agricultural sustainability and investigates the significant part that Artificial Intelligence (AI) plays in the process of accomplishing this objective. Innovations powered by artificial intelligence, such as precision crop management, resource optimization, and pest and disease control, provide individualized solutions to improve agricultural productivity while simultaneously reducing the negative impact on the environment. In spite of the fact that artificial intelligence has a great deal of potential, its mainstream adoption is hampered by obstacles such as restricted access, limited resources, and ethical issues. In spite of this, it is possible to overcome these challenges by concentrated efforts, which will make it easier to incorporate AI into farming operations all around the world. In conclusion, the revolutionary potential of artificial intelligence highlights the vital role that it plays in guaranteeing the sustainability and resilience of agricultural systems while also assuring the availability of food supplies for future generations.

Keywords: *soil, : global, innovations, widespread, resources, artificial intelligence*

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Introduction

According to the most current estimates (UNDESA, 2017), the world population is growing at an exponential pace, and forecasts indicate that it will reach 9.8 billion by the year 2050 and 11.2 billion by the year 2100 [1]. It is imperative that the global community be ready to accommodate the predicted significant increase in population in this area. The most significant issues that mankind will face in the future century will be ensuring that there is sufficient food of a good quality and that it is reliable. A significant contribution is made by agricultural activities, which are responsible for the generation of revenue and job possibilities along the whole food supply chain. Despite the fact that the rise in population and economic affluence has led to an increase in agricultural productivity, it has also brought about negative impacts on the environment and communities all over the globe. The year 2016 [Elawama]. When it comes to agriculture, the emphasis placed on boosting output has often come at the expense of sustainability. The consequence of this is that critical natural resources have not been preserved in an acceptable manner, despite the fact that output levels have increased. This has resulted in the deterioration of soils, erosion brought on by water, contamination of groundwater, climatic changes, and global warming, all of which have exacerbated floods and drought, and will have a direct influence on food security [2].

As a consequence of this, the most significant worldwide task in the 21st century is to discover methods that would simultaneously feed the expanding population in a sustainable manner, reduce the damage done to the environment, and ameliorate the effects of climate change. 2020, according to [3]. The capability of agricultural systems to maintain production in a way that satisfies the requirements of the current generation without compromising the capacity of future generations to satisfy their requirements is what is meant by the term "agricultural sustainability." It entails utilizing agricultural techniques that minimize harmful consequences on the environment, society, and economy, all while guaranteeing a sufficient food supply to fulfill both current and future needs [4]. This is called sustainable agriculture. The phrase "sustainable agriculture" refers to agricultural practices that are designed to preserve natural resources, cut down on the use of artificial fertilizers and pesticides, and foster the long-term health and resilience of ecosystems [5]. According to the Food and Agriculture Organization (FAO), sustainable agriculture is defined as the management and conservation of resource base, as well as the orientation of technological and institutional changes in such a way that ensures the attainment and continued satisfaction of human needs of both the current generation and the generations to come. In light of this, sustainable agriculture may be defined as

the route of agricultural growth that does not do any damage to the environment, is technologically adequate, commercially feasible, and socially acceptable. According to the FAO (1991). According to the findings of several studies that have been carried out, it has been recognized by scientists that artificial intelligence (AI) has the potential to become a useful instrument for the practice of sustainable agriculture [6-8].

AI in sustainable agriculture

AI-Driven Crop Management

Technological advancements in artificial intelligence, especially in the areas of machine learning and computer vision, have brought about a revolution in crop management methods by providing solutions that are precise and data-driven. Farmers can monitor several agricultural factors effectively by using sensors and drones that are coupled with artificial intelligence algorithms [9]. These parameters include soil moisture, nutrient levels, and growth patterns. Because of the abundance of data available to them, farmers can make well-informed choices on irrigation schedules, fertilizer application, and pest management tactics, which ultimately helps them reduce the amount of resources that are wasted and their impact on the environment [15]. It is important to note that developments such as the Plantix app make use of artificial intelligence capabilities to quickly diagnose crop illnesses and nutrient shortages using picture analysis. This makes it easier for farmers to get early diagnosis and treatment programs that are specifically tailored to their needs.

Resource Optimization

A crucial component of sustainable agriculture is the optimization of resource management activities. Employing predictive analytics that are powered by artificial intelligence enables farmers to effectively distribute resources by examining historical data, weather patterns, and the qualities of the soil. This gives them the ability to precisely anticipate agricultural yields, which helps them with strategic planning for harvesting, irrigation, and fertilizer [3]. The IBM Watson Decision Platform for Agriculture is a prime example of this kind of technology. It provides farmers with actionable insights that enable them to improve irrigation operations, which ultimately leads to increased agricultural output and water conservation [10].

Pest and Disease Management

There has been a dramatic reduction in the need for chemical treatments as a result of the widespread use of artificial intelligence (AI) in the early detection and management of illnesses and pests [14]. The forecasting of disease transmission and pest infestations is made possible by artificial intelligence algorithms via the examination of a wide variety of data sources, such as weather stations, satellite imaging, and sensors. This preventative approach reduces the reliance on pesticides, which in turn reduces the amount of pesticides that are used excessively and helps to support the preservation of ecosystems. Notably, programs such as the SMART Plant Protection platform in Europe make use of artificial intelligence to scan and forecast pest dangers. This gives farmers the ability to use ecologically friendly pest control approaches [11].

Yield Prediction and Supply Chain Management

The use of artificial intelligence (AI) in agricultural techniques has resulted in a revolution in yield prediction, which has assisted farmers in planning harvests that are efficient and avoiding losses that occur after harvest. Additionally, supply chain management that is powered by artificial intelligence streamlines the distribution of produced products, therefore reducing the amount of food that is wasted and promoting the aims of sustainability. It is important to note that tools such as Agrible's Morning Farm Report use artificial intelligence to provide farmers with essential insights about yield estimates and field conditions. This enables farmers to make educated choices regarding resource allocation and operational strategies [12].

Challenges and Future Directions

When it comes to improving agricultural sustainability, artificial intelligence provides some intriguing potential; nonetheless, considerable hurdles still exist. There is an urgent problem with restricted access to artificial intelligence technology, particularly in underdeveloped nations. In addition, the effective incorporation of artificial intelligence into agricultural operations necessitates the allocation of significant resources for training and customization to meet the specific requirements of the local environment. The use of artificial intelligence in agriculture is made more difficult by concerns over data privacy, algorithmic biases, and ethical consequences respectively [13]. Despite this, coordinated initiatives that include governments, technology companies, and agricultural organizations have the potential to play a crucial role in overcoming these challenges and promoting the wider application of AI-driven solutions in farming communities.

Conclusion

To make significant strides in achieving agricultural sustainability, artificial intelligence (AI) is of the utmost importance. Traditional agricultural practices are being revolutionized by artificial intelligence (AI) as a result of its use in precision agriculture, resource allocation, pest management, and yield forecasting. The inclusion of artificial intelligence and continuous technological breakthroughs offer enormous potential for improving the flexibility, productivity, and sustainability of agriculture, even though they have encountered challenges. Based on its revolutionary potential, artificial intelligence plays a crucial role in ensuring that future generations will have access to a sufficient food supply.

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