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Sustainable and Smart Agriculture with Big data and Artificial Intelligence: A review on different applications and challenges.

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Abstract: In era of digitization and big data, sustainable and smart agriculture is the imperative concept which makes agriculture more systematic and efficacious with the help of different high-precision algorithms. Artificial Intelligence (AI) plays a pivotal role in the enhancement of smart way of agriculture. It gives an assurance on agricultural revolution when world need to produce more food with a few numbers of resources to feed global population. It divides the agriculture into different segments such as robotics, soil, water and crop management etc. This paper present a comprehensive review of research dedicated to applications of machine learning, deep learning with big data in smart agriculture and agricultural production systems. It also discusses current and potential applications of deep learning with big data in the various nodes of the agricultural supply chain and their impact, different future challenges regarding sustainable agriculture.

Keywords— deep learning, machine learning, big data, GIS, AI etc.

I. INTRODUCTION

Sustainable and smart agriculture is the imperative concept which makes agriculture more systematic and efficacious with the help of different high-precision algorithms. India is in second rank in worldwide in agriculture, farm production and allied sectors like forestry and fisheries which is 15.4% of the GDP and 14% contribution from agriculture alone and about 50% of the total manpower in India. India report 7.39 percent of total global agricultural output. The agricultural sector in India report for just 18% of India's gross domestic product, but it holds about 42% of India's employment generation. Gross Value Added by agriculture, forestry and fishing is estimated 18.55 lakh crore in FY19 which is 2.1 percent in 2019-20.Despite large size of the agricultural sector yields per hectare of crops are lower in India. For economic and production enhancement in agriculture, sustainable and smart farming is the best way.

Sustainable agriculture assures production of food with minimum use of pesticides which result in nutritious food, sustain livelihoods of local communities. The mechanism used in smart farming is machine learning. It together with big data and high-performance precision algorithms creates new opportunities to understand data. This development indicates that agriculture can benefit from machine learning at every stage like spices management, spices recognition, yield management, field management, crop management and livestock management. It is used in yield prediction algorithms based on weather and historical yield data, image recognition algorithms

to detect pest and diseases in plants and robotics to harvest different types of specialty crops.

II. NEED OF SUSTAINABLE AND SMART AGRICULTURE

1.To increase agriculture productivity: According to Forbes report till 2050 population of the world will be more than 9.6 billion consequently leading to 70% increase in food consumption.

2. Prevents soil degradation and restore its nutrition: Soil degradation is a decline in soil quality due to misuse. Soil erosion is main cause of soil degradation. It refers to the loss of top soil and its nutrients. It can occur due to deforestation and poor land management. Sustainable agriculture restores its nutrition.

3. Reduction of chemical application in crop production: The chemical fertilizers and pesticides have important role in crop production by increasing quantity of crops but would reduce pesticide applications on crop to increase the quality of food.

4. Efficient use of water resources: To increase the efficient use of water resources by various methods that conserve water, including the use of mulching, drip irrigation etc.

III TECHNOLOGIES USED

1. Global Positioning System (GPS) receivers: Manufacturers of GPS equipment's have developed various tools in order to help farmers for more productive and efficient in their farming activities.

2. Differential Global Positioning System (DGPS): DGPS are used for various purposes in precision farming and in which a few of them are to map out crops, map crop yields, control chemical applications and seeding.

3. Geographic information systems (GIS): GIS in agriculture helps farmers to achieve increased production and reduced costs by enabling better management of land resources. The risk of small and peasant farmers, who represent about 85% of farmers globally, also gets reduced.

4. Remote sensing: RS is the process of obtaining or detection of information without any physical contact. It has various applications including photography, surveying, geology, forestry and many more. But it is in the field of agriculture that remote sensing has outstanding use.

5. Combine harvesters with yield monitors: The combine grain yield monitor is a device coupled with other sensors to calculate and record the crop yield or grain yield as a modern-day combine harvester operates.

6. Geoinformatics Sustainable Agriculture Framework: Existing GIS systems with a new architectural pattern referred to as WebGIS. It facilitates the transparency of environmental costs and reduces cost of real-data monitoring systems to the producer.

IV. ADVANTAGES

1. Increased Production: Due to optimization of farming methods production will increase. Efficacious and significant crop treatment such as precise planting, watering, pesticide application and harvesting all affects production rates.

2. Water Conservation: Weather predictions and soil moisture sensors are present which increase effective use of water when needed.

3. Real-Time Data and Production Insight: Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.

4. Lowered Operation Costs: Automating processes in planting, treatment and harvesting can reduce resource consumption and cost.

5. Increased Quality of Production: Analyzing production quality and results in correlation to treatment can teach farmers to adjust processes to increase quality of the product.

V. APPLICATIONS OF BIG DATA AND ARTIFICIAL INTELLIGENCE IN DIFFERENT AREA OF AGRICULTURE

With integration of data recording, big data analysis, machine learning, and decision-making Tools into an interconnected system, farming practices would change into knowledge-based agriculture that would be able to increase production levels and its quality.

Techniques	Application Area	Advantages
CNN	Plant Disease Identification	Increase production, low cost
CNN	Seed Classification	Increase production
CNN	Precision Irrigation	Effective irrigation system
CNN	Soil/Root segmentation	Increase productivity ,Less climate effect

Table 1. Techniques with its application area

VI CHALLENGES

1. Food security and productivity: Sustainable agriculture need to address the food security issue by producing more in less time, with fewer natural resources.

2. Natural resources availability: The other big challenge is that rapid degradation and depletion of natural resources.

VII CONCLUSION

Large numbers of applications of machine learning techniques with big data in agriculture are required from many resources which can be analyzed to find the hidden knowledge from data and make decision accordingly to make agriculture more efficacious. This is an advanced researched field and is expected to grow in the future. The integration of various technologies, frameworks with agriculture helps in forecasting agricultural crops. It facilitates the transparency of environmental costs and reduces cost of real-data monitoring systems to the producer.

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