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DIGITAL FARMING: HOW AI AND IOT ARE REVOLUTIONIZING INDIAN AGRICULTURE

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INTRODUCTION

Agriculture in India is characterized by diverse climatic conditions, small landholdings, and a reliance on traditional practices. However, challenges such as unpredictable weather patterns, declining soil health, water scarcity, and fluctuating market prices are putting immense pressure on farmers. Digital farming, powered by technologies like Artificial Intelligence (AI) and Internet of Things (IoT), has the potential to address these challenges and revolutionize the way agriculture is practiced in India. The quick development of digital technologies in recent years has created new opportunities to tackle these issues. The IoT and AI are two of these technologies' most promising developments. These technologies collectively serve as the foundation for what is often called "smart" or "digital" agriculture.

AI and IoT are revolutionizing agriculture by replacing traditional methods with more accurate, data-driven methods. AI can analyze large amounts of data to predict crop performance, detect diseases early, optimize supply chains, and even recommend the best times to plant or harvest crops. Precision farming, made possible by IoT devices like soil moisture sensors, weather stations, and drones, allows farmers to monitor their fields with unprecedented accuracy. This real-time data helps farmers make informed decisions about irrigation, fertilization, pest control, and harvesting, which increases crop yields and makes better use of resources.

Figure 1: Pictorial representation of AI in agriculture. (Source- Prismathon)

Artificial Intelligence (AI)?

AI is a set of technologies that enable computers to perform tasks that are usually done by humans. AI uses logic and math to simulate human reasoning, learning, and problem-solving.

Internet of Things (IoT)

IoT is a network of physical objects that can connect and share data with other devices and systems over the internet. IoT devices are also known as "smart objects".

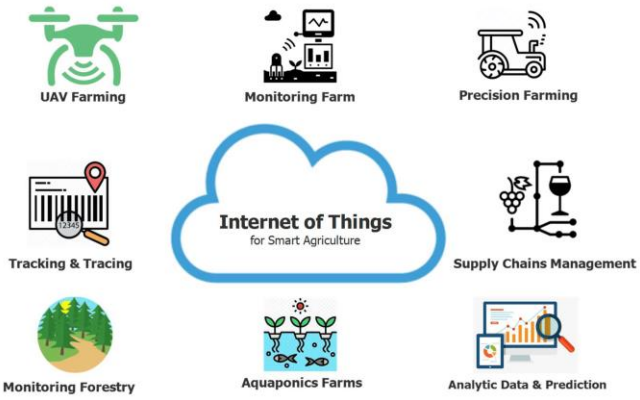

Figure 2: An illustration of IoT in agriculture

Artificial Intelligence in Indian Agriculture

AI, with its ability to analyze vast amounts of data, provides actionable insights that help farmers make informed decisions. Applications and solutions that use AI in agriculture have been drafted to assist farmers in precise and regulated farming by giving them the right advice on moisture management, crop rotation, timely harvesting, the type of crop to be cultivated, optimal planting, pest attacks, and nutrition management. Below are detailed applications:

1. AI in crop management and monitoring

- **Satellite Imagery Analysis:** AI processes satellite data to monitor crop growth, and

detect anomalies like pest infestations or nutrient deficiencies.

- **Soil Health Monitoring:** AI models integrate data from soil tests, weather reports, and crop histories to recommend the best practices for improving soil fertility.

2. **AI in yield prediction:** AI predicts yield based on factors like weather conditions, soil health, and crop type. Such predictions help farmers plan their harvest and storage strategies, reducing post-harvest losses.

3. **AI for pest and disease management:** Tools like Plantix and Satsure use AI-based image recognition to diagnose plant diseases and recommend control measures. AI models predict pest outbreaks by analyzing historical data, temperature, and humidity trends, enabling preventive action.

4. **AI for precision agriculture:** Precision agriculture uses AI to analyze field variability and optimize inputs like fertilizers, pesticides, and irrigation. This reduces costs and minimizes environmental impact.

Internet of Things (IoT) in Indian Agriculture

IoT connects devices and systems to collect, exchange, and act on data, enhancing operational efficiency across the agricultural value chain. Crop production and other sustainable products are increasing dramatically as a result of the Internet of Things' (IoT) application in agriculture. In farming, a variety of IoT applications are utilized to collect data on soil humidity, temperature, climate, water levels, soil sterility, and other factors.

1. **IoT in smart irrigation systems**
   a. **Soil moisture sensors:** Sensors embedded in the soil measure moisture levels and automatically activate irrigation systems only when needed, conserving water.
   b. **Remote irrigation management:** Farmers can control irrigation through smartphone apps, even from remote locations.

2. **IoT in livestock management:** IoT devices, such as wearable health monitors, track livestock health, detect illnesses early, and monitor reproductive cycles, ensuring better productivity.

3. **IoT in smart greenhouses:** IoT sensors regulate greenhouse parameters like temperature, humidity, and light. This ensures optimal growth conditions for high-value crops like tomatoes, cucumbers, and flowers.

4. **IoT in supply chain management:** IoT devices monitor storage conditions, ensuring produce is stored at the right temperature and humidity levels. GPS-enabled trackers ensure real-time visibility of produce during transportation, reducing spoilage and ensuring timely delivery.

Benefits of Digital Farming in India:

a. Economic benefits

- Farmers save money by using precise amounts of fertilizers, pesticides, and water.
- Increased yields and better market insights lead to higher profits.

b. Environmental benefits

- Optimized input use reduces chemical runoff and soil degradation.
- Water conservation through smart irrigation helps combat droughts.

c. Social benefits

- Digital tools empower small and marginal farmers, who form 86% of India's farming community.
- Reduced financial risk improves the quality of life for farming families.

Challenges in Implementing Digital Farming in India

a. **Affordability and accessibility:** High costs of IoT devices, AI-based platforms, and smart machinery make them unaffordable for small farmers.
b. **Digital literacy:** Many farmers lack the technical know-how to use apps and devices. Training programs are essential to bridge this knowledge gap.
c. **Internet and power infrastructure:** In rural areas, inconsistent power supply and limited internet connectivity hinder IoT adoption.
d. **Scalability of technology:** Fragmented landholdings limit the scalability of large-scale digital farming solutions. Collaborative farming models could be a solution to this issue.

CONCLUSION

Digital farming, driven by AI and IoT, offers an unprecedented opportunity to modernize Indian

agriculture, ensuring higher productivity, sustainability, and resilience against future challenges. However, for its benefits to reach every farmer, efforts must focus on affordability, accessibility, and skill development. With the right strategies and collaborations, India can lead the global agricultural revolution.

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