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Digital Agriculture: Opportunities and Challenges in India

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Digital agriculture represents the utilisation of different digital technologies to enhance farming practices as well as improve productivity, efficiency and sustainability in agriculture. It incorporates several tools and techniques viz., artificial intelligence, remote sensing, precision agriculture, machine learning etc. This kind of technologies assist data-driven decision-making, adjust resource utilisation, and increase complete management of farm. Digital agriculture also known as smart farming or e-agriculture. These are tools which digitally collect, store, analyze, as well as share electronic data or information in agriculture. Digital technologies applying big data analytics, computing, sensors, IoT, AI, satellites, drones, block-chains, cloud storage and dynamical modelling and robots and generate a new shift in agriculture (King, 2017; Himesh et al., 2018). Digital disruption become more a requirement than a choice in the present difficult agriculture (Prakasa Rao, 2022a,b). In the advanced world, precision agriculture in which plant and animals are maintained to enhance the proficiency and result of agriculture which has developed in future with the help of digital technologies (Cook, 2021). Developing digital technologies with potential will be game-changers for traditional agricultural practices. According to the Food and Agriculture Organization of the United Nations has considered to this change as a revolution: "a 'digital agricultural revolution' which will be the novel transfer which could assist to confirm agriculture meets the demands of the global population in future." Artificial Intelligence applications are executed across different parts of agriculture. Analytics, networked sensors, Artificial intelligence (AI) etc. technologies have the capability to enhance agricultural yields and improve the proficiency of farm input management. Digital technology assist the farms to be more resilient as well as sustainable while fulfilling global food need. "Digital agriculture" indicates to the practice of digital technology to manage animals, crops and other farm assignments associated with development and maintenance of agricultural resources. Receiving accurate and timely information by farmers will enhance agricultural output, encourage food security and increase rural livelihoods.

What is Digital Agriculture?

Digital agriculture has the capability to enhance productivity of agriculture, resource, consistency and usage of time. To generate new opportunities, it also provide possible way for businesses to communicate with others. Digital agriculture assist farmers in the agricultural value chain to enhance food output. Application of digital technology to manage animals, crops and other related activities engaged in growing and sustaining food resources is called as "digital agriculture."

Benefits of digital agriculture

- **Improved Crop Management**: Digital tools offer farmers with worthy insights into crop health, pest infestations, and disease outbreaks, enabling them to make informed decisions about crop management and optimize resource allocation.

- **Precision Agriculture**: Digital technologies *viz*., data analytics, sensors and drones agree for the detailed use of inputs like pesticides, fertilizers, and water. This approach increases crop yields by reducing waste and environmental impact.
- **Real-time Monitoring**: IoT-based sensor system facilitate farmers to supervise environmental conditions like humidity, temperature and soil moisture in real-time. This permits for quick recognition of stress factors affecting crops and appropriate intervention.
- **Reduced Input Costs**: By adjusting the application of fertilizers, water and pesticides, digital solutions support farmers to lower their input costs.
- **Efficient Resource Management**: Digital tools enable better management of resources, minimizing wastage and optimizing the use of available resources.
- **Direct Selling Platforms**: Digital marketplaces helps to connect farmers directly with retailers, consumers and exporters by eliminating middleman which ensures proper prices for their produce.
- **Transparent Transactions**: Documentation in digital form make sure smooth transactions as well as agreement with food safety standards and promoting trust among stakeholders.
- **Access to Information**: Digital platforms helps farmers in getting weather forecasts, market prices and other related informatio which empower them to make their produce.
- **Soil and Water Conservation**: Soil mapping and remote sensing are the two digital technologies which help to monitor soil health, availability of water, fostering sustainable water management practices.
- **Reduced Environmental Impact**: Targeted use of inputs and precision agriculture and reduce the application of agrochemicals, diminishing the environmental impact of farming.
- **Increased Income**: Digital agriculture can enhanced income for farmers by optimizing yields, lowering costs, and increasing market access.
- **Improved Livelihoods**: The increased income and access to information which can enhanced the socio-economic status of farmers along with their families.

Disadvantages of digital farming:

- The robotic machine could not change their culture we have to set their programme manually
- Improve the scouting programmes.
- The excessive use of chemicals with the help of machines reduces the fertility of the land. Overuse of machines may lead to environmental damage.
- It is efficient but has many side effects and drawbacks.
- Furthermore, driverless agriculture machine is a liability to access the technology.
- Most of the farmers are illiterates so they are unable to use the modern machines.

Applications of Digital Technologies in Agriculture:

Robotics: Robotics is transforming agriculture by automating various tasks, enhancing efficiency, and improving precision. Robots are now used for planting, harvesting, livestock management, and precision agriculture tasks like weed control and irrigation management. These advancements are leading to increased productivity, reduced labor costs, and a smaller environmental footprint. Presently, processing factories apply robots to chop up corpses milk cows and harvest strawberries.

Artificial intelligence (AI): AI is changing agriculture by increasing productivity, efficiency and sustainability. AI-systems analyse data from different sources like drones, sensors, satellite imagery for fertilization, irrigation, pest control which ultimately leads to improving yield. AI can analyze images of crops so that it can detect signs of disease as well as pest infestations early for regular intervention and reducing crop damage.

Kisan Drones: In India, Kisan Drones are developing different farming practices by improving proficiency, decreasing costs, and encouraging sustainable agriculture. These drones are operated with improved technology for doing crop observation, applying fertilizers and pesticides, land surveying of land. The Indian government is fully promoting their drones for adoption through different schemes and subsidies.

Virtual Reality (VR): Virtual Reality (VR) is converting agriculture by providing training, farm management and incresed learning experiences. It agrees students and farmers to corporate with agricultural environments, enhancing skills, boosting practices, and promoting a understanding of farming processes.

Cloud Connectivity: Cloud connectivity in agriculture, also called as cloud-powered farming which empowers farmers to graps remote servers and data management by internet-based platforms and its analysis. This involves soil conditions, weather data, crop health etc. all avaialable in real-time. Cloud computing improve decision-making, resource use, and enhance total farm efficiency.

Blockchain technology in Food System: Blockchain technology in agriculture and the food system improve traceability, transparency and effectiveness through the supply chain. It also permit for the protected and absolute recording of data which related to production of food, processing, and distribution and ultimately profiting both producers as well as consumers and lead to improved trust, decrease fraud, and enhanced food safety.

Unmanned aerial vehicles (UAV): Unmanned Aerial Vehicles (UAVs), mostly known as drones, are applied in agriculture for crop monitoring, precision spraying and field mapping. They offer farmers a direction to raise resource management, increase yields, and decrease operational costs.

Key Challenges of Digital Agriculture in India

1. In adequate internet connectivity as well as mobile network coverage, especially in rural areas which hamper in use of digital tools and services.
2. Many farmers, especially older generations, lack the necessary skills to effectively use digital technologies, hindering adoption.
3. The high cost of digital tools and services can be prohibitive for small farmers.
4. Lack of Relevant Information in local language on crops, weather conditions and market.
5. Poor access to credit and information.
6. Lack of crop diversification.
7. Inadequate infrastructure and resources.
8. Digital Technologies and Labour Dependency.

Opportunities of Digital Agriculture in India

In India, digital agriculture offers various prospects for increasing efficiency, productivity and sustainability in the farming sector. It involved access to markets and information, resource management, and access to financial services. There are different opportunities of Digital Agriculture in India as follows:

1. Improving Production
2. Social Opportunities
3. Open Innovation System
4. Reaching the Sustainable Development Goals
5. Higher Health Conditions
6. Territorial Resilience
7. Environmental Protection
8. Food Security
9. Improved Market Access
10. Production Model Transformation
11. Reducing the use of Fertilizers and increasing the efficiency of Agriculture production.

Conclusion

Digital agriculture is developing speedily due to improvement in AI, robotics, remote sensing etc. These technologies provide farmers the capability to boost their performance as well as quality, reducing negative environmental impacts and produce transparent crop and livestock products in a regional and national scale. Available technologies are purely consumer-friendly, cost-effective, speedily solves problems. In India, the attitude for digital agriculture is generally positive. Simplicity of use, effective governmental support, cost of technology, prompt resolution of complaints and easy access and action are the important criteria which will determine the success of digital agriculture in India.

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