

***THE ROLE OF GLOBAL ARTIFICIAL INTELLIGENCE – BASED
EDUCATIONAL MODELS IN PROMOTING ORGANIC FARMING IN
THE CHAROTAR REGION***

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Abstract

The main objective of this research paper is to analyze the role, potential, and practical effectiveness of globally developed Artificial Intelligence (AI)–based agricultural education models in promoting organic farming in the Charotar region. In the modern era, agriculture is no longer dependent solely on traditional experience; rather, it is increasingly guided by data, digital platforms, and smart technologies. AI-based educational models—such as smart mobile applications, chatbots, virtual training systems, precision agriculture platforms, and digital knowledge networks—provide farmers with personalized and real-time guidance on crop management, soil health, pest control, weather forecasting, and organic farming practices.

Although the Charotar region has traditionally been a prosperous agricultural area, the growing influence of chemical farming has had negative effects on soil fertility, environmental balance, and human health. In this context, organic farming emerges as a sustainable and eco-friendly alternative; however, its large-scale adoption requires scientific training, continuous guidance, and strong market linkages. This study highlights that global AI-based educational models can effectively address these gaps in the Charotar region.

This research is based on secondary data, including international research articles, institutional reports, and studies of digital agriculture platforms. Through descriptive and comparative analysis, it is clearly demonstrated that if AI models are implemented with due consideration to local languages, local cropping systems, and socio-economic conditions, they can play a significant role in making organic farming in the Charotar region more scientific, profitable, and sustainable.

Keywords:- organic farming, agricultural education, digital agriculture, sustainable development

Introduction

Agriculture is the backbone of the Indian economy, and the state of Gujarat makes a significant contribution to it. The Charotar region of Gujarat has traditionally been known as the “granary of Gujarat” due to its fertile soil, well-developed irrigation system, and progressive farmers. Crops such as tobacco, cotton, paddy, wheat, vegetables, and fodder are produced here on a large scale. After the Green Revolution, the increasing use of chemical fertilizers, pesticides, and hybrid seeds boosted agricultural production in the short term; however, in the long run, it has given rise to serious problems such as declining soil fertility, water pollution, rising production costs, and negative impacts on human health.

In this context, organic farming is no longer merely an alternative but has become a necessity. Organic farming is a nature-friendly system that emphasizes soil biological strength, ecological balance, and the protection of human health. Although the Charotar region has strong potential for organic farming, its adoption remains limited due to major obstacles such as lack of scientific knowledge among farmers, inadequate training facilities, uncertainty regarding pest and disease management, and difficulties in market linkages.

On the other hand, agriculture worldwide is rapidly moving towards “digital agriculture” and “smart farming.” Artificial Intelligence (AI)-based educational models—such as smart mobile applications, machine learning-based advisory systems, virtual training platforms, chatbots, and precision agriculture learning models—are revolutionizing the delivery of personalized, real-time, and scientific guidance to farmers. These models are not only useful for increasing productivity but have also proven to be effective tools for understanding, adopting, and successfully implementing organic and sustainable farming practices.

If global AI-based agricultural education models are adapted to local conditions in an agriculture-dominated region like Charotar, they can become powerful means of enhancing farmers’ knowledge, skills, and confidence. The main objective of this research paper is to systematically analyze the role, potential, and challenges of global AI-based educational models in promoting organic farming in the Charotar region, and to present practical directions for the future.

The Government has employed Artificial Intelligence (AI) methods to address various challenges in the agricultural sector to aid farmers. Some of the initiatives are given below: ‘Kisan e-Mitra’, an AI-powered chatbot, has been developed to assist farmers with responses to queries about the PM Kisan Samman Nidhi scheme. This solution supports multiple

languages and is evolving to assist with other government programs. At present, it handles over 20,000 farmer queries daily and so far, more than 92 lakh queries have been answered.

The National Pest Surveillance System, for tackling the loss of produce due to climate change, utilizes AI and Machine Learning to detect pest infestation in crop issues, enabling timely intervention for healthier crops. This tool, currently used by over 10,000 extension workers, allows farmers to capture images of pests to help them mitigate pest attacks and reduce crop losses. At present, it currently supports 61 crops and over 400 pests with approx. 1 lakh uploaded images.

AI-based analytics using field photographs for crop health assessment and crop health monitoring using Satellite, weather & soil moisture datasets for rice and wheat crops.¹

Objectives

1. To clarify the concept of organic farming and AI-based agricultural education.
2. To analyze globally prevalent AI-based agricultural education models.
3. To understand the current status and needs of organic farming in the Charotar region.
4. To explore the applicability of global AI-based models in the Charotar region.

Research Methodology

This research is designed as a descriptive and analytical study aimed at examining the role of globally developed artificial intelligence-based agricultural education models in promoting organic farming in the Charotar region.

The study primarily relies on secondary data, collected from a wide range of authentic sources, including international research journals, reports of FAO, GOPCA, ICAR, IFOAM, Government of India and Government of Gujarat agricultural reports, and official documents related to digital agriculture and AI-based agricultural education platforms.

After data collection, the information has been systematically screened, classified, and comparatively analyzed to establish meaningful linkages between global AI-based education models and the ground realities of the Charotar region.

For analysis, the study employs a combination of descriptive methods, theme-based qualitative analysis, and the SWOT framework to evaluate strengths, weaknesses, opportunities, and threats related to the application of AI-based agricultural education for organic farming.

¹ <https://www.pib.gov.in>

Additionally, to enhance the practical relevance of the study, the research also indicates the supportive use of opinions and insights from selected farmers, agricultural experts, and extension officers of the Charotar region.

Throughout the research process, special emphasis has been placed on maintaining data reliability, objectivity, and ethical standards.

Concept of Organic Farming and AI-Based Agricultural Education

Concept of Organic Farming

Organic farming is a scientific and eco-friendly system of agriculture that relies on natural and biological resources instead of synthetic chemical fertilizers, pesticides, herbicides, growth promoters, and genetically modified seeds. The core principle of organic farming is to maintain and enhance soil biological fertility, activate beneficial microorganisms, and strengthen the natural nutrient cycle.

It includes practices such as vermicomposting, green manuring, Jeevamrut, Panchagavya, crop rotation, mixed cropping, bio-fertilizers, and biological pest control. These methods improve soil structure, enhance microbial activity, and ensure long-term agricultural sustainability.

Organic farming is not merely a production technique but a holistic agricultural philosophy that integrates environmental protection, livestock management, human health, and rural economic development. It helps in reducing soil erosion, preventing water pollution, conserving biodiversity, and lowering long-term cultivation costs. By stabilizing productivity and improving product quality, organic farming contributes to income stability for farmers. Therefore, organic farming is widely regarded as a foundation of sustainable agricultural development.

Organic farming is an agricultural practice that doesn't support the use of synthetic chemicals such as pesticides, fertilizers, or synthetic medicines on a general basis in crop production. The benefits of organic farming are a very wide vision to look for in terms of the future agricultural revolution. It pursues to production of healthy, good-quality food in a naturally sustainable way. Organic growers all over the world use ecological managing and maintain the finest natural abundance and natural activity in the soil to improve the farm environment by boosting the farm wildlife. There are some fundamental rules that organic agriculture stands by-

1. Organic agriculture refers to soil as a living being.
2. Managing and preserving all life forms in its full diversity is a profound success.

3. Nature has presented itself as a dais to learn and emulate the best over the centuries.
4. All life forms are basic parts of the system but are important contributors to their richness in fertility.

People understand the concept and the values of sustainable organic farming and the abiding by the rules that work in the baseline for practicing such noble work for a better tomorrow. It only addresses the benefits of ecological farming.

Concept of AI-based Agricultural Education

AI-based agricultural education is a modern educational system that uses artificial intelligence, machine learning, data analytics, the Internet of Things (IoT), and cloud computing to provide farmers, students, and agricultural professionals with personalized, timely, and science-based guidance. Compared to traditional training methods, this approach is more interactive, practice-oriented, and outcome-driven.

AI-powered mobile applications identify crop diseases, analyze soil and climate data, and generate recommendations related to fertilizer application and irrigation management, while AI-enabled chatbots respond to farmers' queries in local languages. Virtual learning platforms offer videos, simulations, virtual field demonstrations, and digital workshops. Precision agriculture learning systems deliver personalized training and decision-support services based on farm-specific conditions.

The concept of AI-based agricultural education in India, spearheaded by ICAR (Indian Council of Agricultural Research), involves integrating Artificial Intelligence and machine learning into farming practices and learning, focusing on data-driven decision-making, automation, precision farming (drones, sensors, robotics), crop monitoring, pest/disease diagnosis, and resource optimization (water, pesticides) to boost yields, improve sustainability, and attract youth, with training programs for scientists and mobile apps like AI-DISC for practical application.

AI-based agricultural education is not limited to technical knowledge alone; it also provides integrated learning on organic farming, sustainable development, climate-smart agriculture, and agricultural market management.

Relationship between Organic Farming and AI-Based Agricultural Education

Organic farming is a knowledge-intensive and skill-oriented agricultural system that requires proper training, continuous guidance, and access to scientific information. AI-based

agricultural education can effectively bridge this gap. It supports farmers in the early detection of pests and diseases, precise application of organic inputs, scientific crop cycle planning, guidance on certification procedures, and improved access to organic markets.

Through real-time advisories, predictive tools, and personalized learning modules, AI-based agricultural education helps reduce uncertainty and operational risks in organic farming. In this way, it plays a significant role in making organic agriculture more practical, less risk-prone, economically viable, and sustainable.

Global Artificial Intelligence–Based Agricultural Education Models

At the global level, digital transformation in the agricultural sector is progressing rapidly. Countries such as the United States, European nations, Israel, Japan, Australia, and several developing economies have adopted AI-based agricultural education models that not only train farmers in production techniques but also play a crucial role in transforming them into “data-driven” and “decision-capable” farmers. These models can broadly be classified into the following categories:

1. AI – based smart digital learning platforms
2. AI – Chatbot and Virtual Agriculture Mentoring Templates
3. Precision Agriculture – based Education Models
4. Virtual training, simulation and digital farm labs
5. Global open – Source knowledge network and AI learning community
6. AI – based assessment and capacity building models

Current Status and Needs of Organic Farming in the Charotar Region

The Charotar region (including districts such as Anand, Nadiad, and parts surrounding Vadodara) has traditionally been an agriculture-dominated area. The region benefits from fertile land, relatively good water availability, a favorable climate, and a strong dairy-based rural economy. However, the spread of organic farming in Charotar remains limited compared to some other regions of India. Although both the central and state governments are implementing schemes and training programs to promote organic and natural farming, the overall pace of adoption across the Charotar region has been slow. For instance, across Gujarat, the number of farmers showing interest in organic farming has remained lower than in several other states, and only a limited area is currently under active organic cultivation.

At the district level, training programs on organic and natural farming are occasionally organized by government departments and private institutions. Nevertheless,

large-scale social acceptance, certification systems, market infrastructure, and financial support mechanisms are still inadequate. Most farmers in the region continue to prefer conventional farming methods based on chemical fertilizers and pesticides due to their ease of use and immediate yield assurance, which has further slowed the transition toward organic farming.

“In the present paper, the table below provides information about some farmers who are currently practicing organic farming in the Charotar region of Gujarat. It also presents a list of crops produced through organic farming in some villages of the Charotar region.”

Certified Operators List (Individual)			
S. no.	Name of the Operator	Village	Major Crops Certified
1.	Patel Rameshbhai Ishwarbhai	Kothiya	Ginger, Maize, Turmeric ext... .
2.	Pramesh Hasmukhlal Desai	Dasharath	Banana, Guavas, Methi ext... .
3.	Janksinh Lakhdhirsinh Jhala s	Anklav	Amla, Dragon Fruits ext... .
4.	Amitkumar Arvindbhai Thakar	Narsanda	Apple, Potato, Wheat ext... .
5.	Ranchhodbhai Patel (Ranchhodkaka)	Bhaner	Cucumber, Cabbage ext... .

Source :- Gujarat Organic Products Certification Agency (GOPCA) (12/12/2025)

Applicability of Global Models in the Charotar Region

1. Global AI- and satellite-based agricultural models can be effectively applied in the Charotar region to deliver field-specific guidance. By integrating GIS, remote sensing, and climate data, these models can support scientific education on crop planning, irrigation management, soil health monitoring, and optimized organic input use.
2. Predictive analytics-based global models enable early forecasting of pest outbreaks, crop diseases, climate risks, and yield fluctuations. In a mixed-cropping region like Charotar, such models can help farmers make timely decisions, reduce uncertainty, and lower risks associated with organic farming.
3. Global AI chatbots and digital learning platforms can be localized in the Gujarati language and adapted to local crop systems, enabling 24×7 virtual agricultural advisory services. This would significantly strengthen extension services and improve access to scientific knowledge among farmers.
4. Smart sensor, drone, and IoT-based global training models can be introduced in

Charotar through demonstration farms and “living laboratories,” allowing farmers to acquire hands-on experience in precision-based organic farming practices.

5. Global traceability and certification-support models can be adopted to enhance quality control, transparency, and credibility of organic products from Charotar. These systems would also strengthen domestic and international market linkages.
6. Global market-intelligence agricultural models can support farmers through price forecasting, demand–supply analysis, and sales-timing education, thereby contributing to income stability and better marketing strategies for organic produce.
7. International university–startup–farmer collaboration models can be replicated in Charotar to bridge the gap between research, training, and field-level implementation, promoting innovation and entrepreneurship in organic agriculture.
8. Global digital skill-development and VR/AR-based agricultural training models can create specialized capacity-building opportunities for youth and women farmers in Charotar, enhancing social acceptance, technological adoption, and long-term sustainability of organic farming.

Challenges and Limitations

Technological and Infrastructure Constraints

One of the major challenges in applying global AI- and precision agriculture–based models in the Charotar region is the limited availability of digital and physical infrastructure. Many villages still face inconsistent internet connectivity, limited access to smart devices, and unreliable power supply. Advanced tools such as IoT sensors, drones, cloud-based platforms, and satellite-data services require stable digital infrastructure and technical maintenance systems, which are not yet uniformly available across rural Charotar. This limits large-scale deployment and long-term sustainability of global digital agriculture models.

High Initial Cost and Economic Barriers

Global precision and AI-based agricultural education models often involve high initial investment costs, including sensors, drones, software subscriptions, data services, and training facilities. For small and marginal farmers who dominate the Charotar agricultural structure, these costs are often unaffordable without strong institutional support. The delayed economic returns from organic farming during the transition period further discourage farmers from adopting technology-intensive global models.

Limited Technical Skills and Digital Literacy

Another critical limitation is the lack of digital literacy and technical capacity among many farmers. The effective use of AI dashboards, mobile apps, sensor systems, and data-driven decision tools requires continuous training and technical support. In the absence of strong extension systems and localized digital education, global models risk remaining underutilized or misused, reducing their practical impact.

Localization and Contextual Adaptation Issues

Most global agricultural models are designed based on agro-climatic, socio-economic, and farm-size conditions of developed countries. Direct application of these models without proper localization may produce inaccurate recommendations. The diversity of soil types, fragmented landholdings, mixed cropping systems, and organic farming practices in Charotar demands region-specific data sets, localized algorithms, and culturally adapted training content, which are often lacking.

Data Availability, Quality, and Privacy Concerns

AI-based models depend heavily on large volumes of high-quality data. In Charotar, systematic farm-level data on soil health, crop history, organic inputs, and pest incidence are limited. Inconsistent or incomplete data can lead to unreliable predictions and reduce farmer trust. Moreover, issues related to data ownership, privacy, and ethical use of farmer data pose additional institutional and regulatory challenges.

Institutional and Policy Limitations

The successful application of global models requires coordinated efforts among government departments, universities, cooperatives, startups, and extension agencies. Currently, fragmentation of institutional responsibilities, limited convergence of schemes, and short-term project-based approaches restrict the scalability of such models. Absence of long-term policy frameworks focused on AI-driven organic agriculture education also weakens structured implementation.

Market and Certification Barriers

Even if global education and precision models improve production practices, farmers still face serious limitations related to organic certification, traceability systems, price volatility, and assured markets. Without strong value-chain integration, premium pricing mechanisms, and certification support, the benefits of advanced models may not translate into economic security for Charotar farmers.

Social and Behavioral Resistance

Traditional farming practices, risk aversion, and dependency on chemical-based quick-result farming create psychological and cultural resistance to both organic methods and advanced digital models. Older farmers in particular may hesitate to trust AI-based recommendations, limiting adoption. Lack of visible local success stories further slows behavioral change.

Conclusion

The Charotar region possesses strong agricultural traditions, fertile land, and progressive farming communities, which provide a solid foundation for the promotion of organic farming through AI-based global models. Although the current adoption of organic practices remains limited due to challenges such as lack of technical awareness, weak market linkages, certification complexities, and inadequate digital infrastructure, the integration of AI-driven education systems, precision agriculture tools, virtual advisory platforms, and localized training models offers significant transformative potential. By adapting global best practices to local conditions, strengthening institutional collaboration, expanding financial and digital support mechanisms, and building farmer-centered learning ecosystems, Charotar can emerge as a leading regional model for AI-enabled organic agriculture. Such an approach will not only enhance sustainable farming practices and environmental resilience but will also improve farmer incomes, knowledge empowerment, and long-term rural development.

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