International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 18(15s) 2026 pp. 1164-1172
https://doi.org/10.70917/ijcisim-2026-4510
Article

IMPACT OF AI-BASED CROP FORECASTING ON FARMERS' INCOME: BOON OR BANE

Salma Begum[1], Adusumilli Prudhvi Raj[2], Chepuri Gokul Nanda Krishna[3]

[1]Faculty of Management Studies, CMS Business School, JAIN (Deemed-to-be University), Bengaluru, Karnataka, India.
Email: salma.begum999@gmail.com
ORCID: **0000-0003-0416-8700**
[2]Faculty of Management Studies, CMS Business School, JAIN (Deemed-to-be University), Bengaluru, Karnataka, India.
[3]Faculty of Management Studies, CMS Business School, JAIN (Deemed-to-be University), Bengaluru, Karnataka, India.

Abstract: The current study examines the effect of adopting AI in farming on the net income of the farmers of India. The study is based on primary data analysis considering small, medium and large scale farmers in selected districts considering their understanding and implementation of AI tools in crop yield and forecasting. Several studies have emphasis that AI based farming has improved efficiency and productivity, and discussed challenges in implementation. However, it is significant to measure the impact of the new technologies globally recognized, in improving farm income. The study has used a structured questionnaire, 105 responses from farmers and analysed using descriptive statistical techniques and regression analysis. The finding of the study aligning with existing studies and evidence-based implementation of AI has improved productivity and efficiency by forecasting accurately. Further, challenges highlighted by the farmers and feasible solutions are suggested in the study.
Keywords: AI, Crop yield, Forecasting, Farmers, Net income, Policies

1. Introduction

Agriculture plays a significant role in economic development of most countries and is the primary income source of millions of farmers all over the world. In India agriculture, besides sustaining rural employment, also plays an important role in providing food security, including national income. Yet, the agricultural sector remains highly dependent on multiple elements of nature, such as rainfall, temperatures, soil quality, and subject to uncertainty and financial risks. Such uncertainties are regularly resulting in volatility in crop yields, and therefore in farmer earnings and economic stability.

There are numerous problems facing farmers which impact on their output and income. Climate change has caused weather patterns to be erratic, leading to erratic rainfalls, drought and floods. To further complicate matters, pest attacks, soil erosion, and fluctuating market prices also complicate agricultural planning. conventional techniques of crop forecasting, place strong emphasis on experience and past trends hence could not be as accurate in the environment, which undergoes quick changes. This usually leads to loss of farm produce and profitability amongst farmers.

Over the last few years, Artificial Intelligence (AI) has emerged as an influential technological solution that can transform agriculture. AI-based crop forecasting: AI-based crop forecasting applications can predict crop yield, detect disease outbreaks, and determine the optimal time to harvest the crop using machine learning, advanced algorithms, and large datasets. With the provision of data-driven knowledge, AI can support farmers to make informed choices on crop choice, irrigation, application of fertilizer, and harvests. The resulting breakthrough technology could lead to better productivity and lesser risk factors such as risks related to farming.

They also serve as a tool for farmers to be climate-resilient by providing them with early warnings and adaptive suggestions to combat the effects of unseasonal weather and other environmental stressors. These solutions are vital for farmers in India who are experiencing more and more unpredictable monsoon seasons, soil degradation problem, and other adverse effects of climate.

In spite of significant technological advancements and a large number of promising pilot projects, there are still major issues in regards to whether the benefits derived from AI will be distributed equitably and justified among the stakeholders. The past agricultural innovations and mechanization, irrigation infrastructure, genetically modified seeds have shown that their impacts are not evenly distributed, and mainly, resource-rich farmers have gained while the marginalized groups who failed due to differences in affordability and knowledge dissemination have been left behind. This piece of research takes on the challenge of these issues through the lens of farmers' data collected from 105 Indian farmers and tries to find out how socio-economic and technological factors can together affect both the extent and the outcomes of AI-based crop forecasting implementation, Northrop, J. (2025).

The Indian agriculture has different layers, governments and private sector entities have spent a lot on developing AI platforms that are suitable for local needs. For instance, the Saagu Baagu program in Telangana integrates AI-powered advisory services with soil testing and digital market linkage, thus creating a measurable increase in yields by more than 20% along with significant reductions in the input cost of the crops like chilli. Besides that, the country-wide schemes are providing AI-based monsoon weather forecasts via mobile SMS to millions of smallholders. This initiative has enabled them to base the timing of their agricultural activities on a solid data records and eventually the risk of crop failure is lowered. These actions reflect a commitment to the embedding of AI in rural advisory and extension systems.

In spite of the rapid progress of AI, there are still doubts raised about whether the implementation of such technology will lead to fair economic benefits or will worsen the existing inequalities. In the past, as is the case with innovations in agriculture such as mechanization and genetically modified seeds, there have been situations in which economic impacts have been mixed and these impacts have differed greatly depending on social strata because of factors like affordability, access, and knowledge.

1.1 Research Objective

- To evaluate the effect of AI based crop forecasting tools on small, marginal and large farmers’ income.
- To identify challenges and limitations faced by farmers.

1.2 Methodology

The study is based on primary data collected from 105 farmers through structured questionnaire. A sampling method was used to accomplish the representation of the different farmer demographics such that smallholders, tenants, and owner cultivators were included to reflect the heterogeneous nature of Indian agriculture and technology adoption patterns. The dependent variable is the improvement of the farm income, independent variables covered a wide range of factors that were assumed to influence the AI adoption and economic outputs of the farming community. The study, through the diligent crafting of the data collection instruments and operational definitions, not only secured the reliability and the validity of the measures but also the relevance for statistical analysis that take into account both the determinants and the effects of AI integration in India’s heterogeneous farming ecosystem.

2. Literature Review

Sujay, S., Bharath, K., & Reddy, T. S. (2025) focuses more on how AI is brought into traditional Indian farming & how crop monitoring systems which run by AI are helping farmers to get better yield and less losses. Naseem, Adekar A, Hegade S (2025) AI & ML are changing agriculture but this research paper also focuses more on crop yield and precision farming. AI works well for detecting crop diseases, soil types, irrigation & pest control and there have been good and significant improvements in predicting the accuracy of yield. Patel, N., Dorin, B., & Nagaich, R. (2022) in their report discussed how Indian agriculture needs to move away from the old agroindustry way of thinking & shift more towards agroecology. Sharma, (2011) from extensive literature review established relationship between farm size and productivity, the role of credit and subsides on productivity, and price polices that have changed consumption patterns that favour high value agriculture, horticulture, dairy and fisheries. Himani (2014) outlines the trajectory, significance, and difficulties of India’s agricultural sector in the broader economy. Dutt, A., & et al. (2024) using econometric analysis provides evidence on how forecasting based models integrating AI tools enhances decision making leading to improved productivity, profitability and food security. Northrop, J. (2025) examined how AI powered IoT system provides accurate forecasting on the soil quality and weather leading to improved crop yield. Sattigeri, A. (2025) emphasis on the role of AI based technology in weather forecast and personalized platform in crop patter, monitoring and accessibility to the farmers leading to higher productivity and sustainable agricultural practices.

Miller, T. (2025) discusses the positive impact of AI tool while testing soil quality, irrigation and crop health using random forest test. Further, identifying challenges in implementation by the farmers and suggestion policy intervention. Pandey, D. K., & Mishra, R. (2024) highlights the role of AI in not only improving the soil conditions, productivity of crop yield but also the solution to the challenges implied for supply chain reducing the losses post harvesting. Nautiyal, et al. (2025) emphasises though AI has shown potential to revolutionize the Agricultural sector, yet, it has not reached its full potential due to challenges in adopting to the AI tools- limited financial support, digital literacy, infrastructural challenges etc. Boote, T. (2024), crop yield prediction has benefited from artificial intelligence (AI), but there is a significant flaw in its interpretability and transparency. Lowers prediction accuracy in unpredictable weather, is another area of unmet research need. Additionally, current methods fall short in providing farmers and policymakers with useful field insights. Mohan, J, N.V. Pravallika, R. Praneetha, R. (2025) Despite AI's apparent accuracy, the study points out important research gaps in its application to crop yield prediction. Lack of interaction among the scientists and agricultural practitioners. Aijaz, N. (2025) AI helps farmers in producing more output using less inputs but it requires integration of technology and real time data to predict accurately. The tools not only help in the optimum use of resources but also in making farming resilient against the impacts of climate change. Roy, S. Hoque, A. Saikia, P. and Padhiary, M. (2025) highlights the way the increasingly looming threat of climate change to food security and agricultural sustainability necessitates AI-driven solutions in the context of Climate Smart Agriculture (CSA). Geetha, S. (2024) precision thorough AI has revolutionized agriculture across the globe. AI is important for sustainable future of agriculture, mainly in country like India, which is agrarian in nature.

3. Data Analysis

The study is based on primary data analysis collected from the farmers based on structured questionnaire. 105 responses were received from the farmers

3.1 Primary Data Analysis

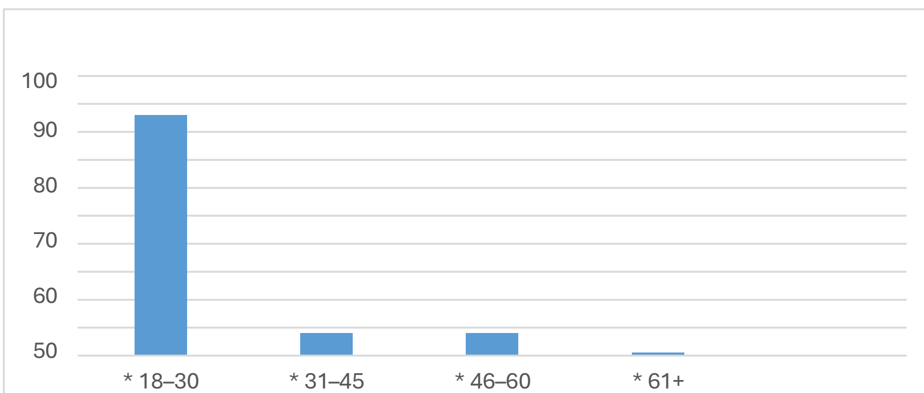

Fig. 1: Age

Fig 1 shows there is a fairly balanced representation across 18-30, 31-45, 46-60, and 61+ age brackets which reflects a broad cohort that spans across younger and older generations. This representation is also significant given that age has an effect on technology adoption disposition and digital literacy.

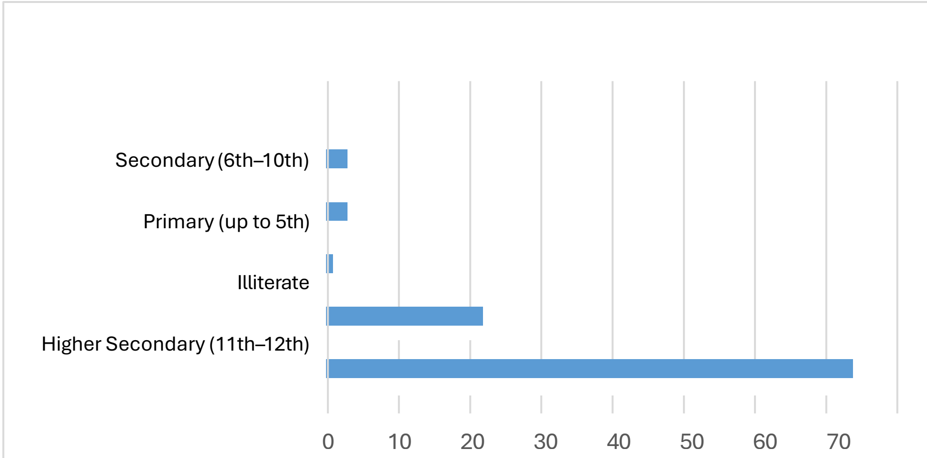

Fig. 2: Education

Fig. 2 shows that the farmers vary from illiterate to graduate and above, with major clusters in primary, secondary and higher secondary education. Education affects farmers' ability to understand and use AI-based advisories which suggests a need for training that is accessible and usable

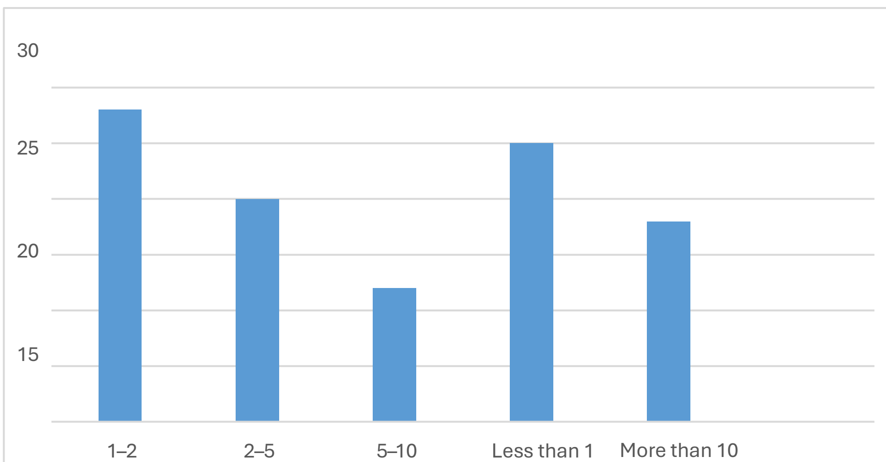

Fig. 3: Farm size (acres)

Fig. 3 shows the sizes of the farms vary from marginal farms (<1 acre) to large farms (5 or more acres), but a significant number of the farms consist of smallholders, or farms that range from 1-5 acres. Importantly, any policies or AI tools that hope to be widely adopted must take this heterogeneity into account.

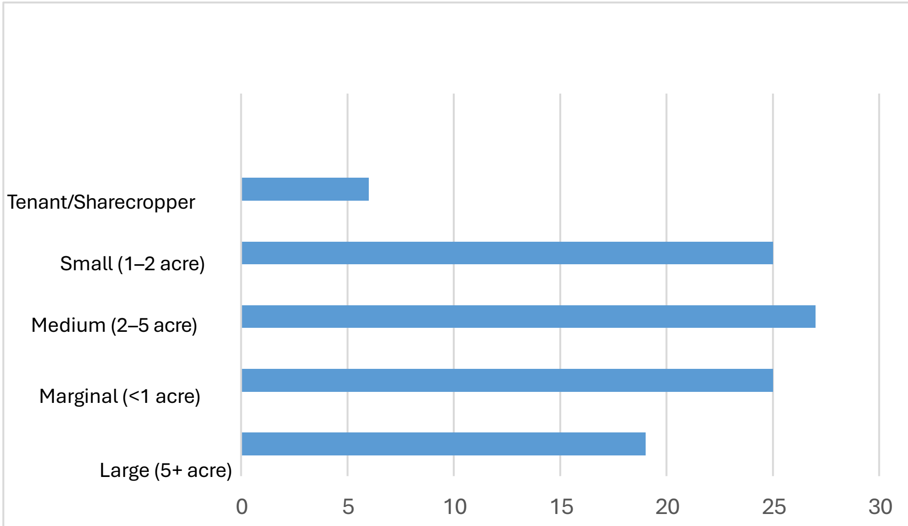

Fig. 4: Type of farmer

Fig. 4 shows that there are tenants, sharecroppers, and owners across different farm sizes that signify the complexity of landholding in India. The equity of AI adoption could be evaluated as benefits are based across this range of landholding patterns.

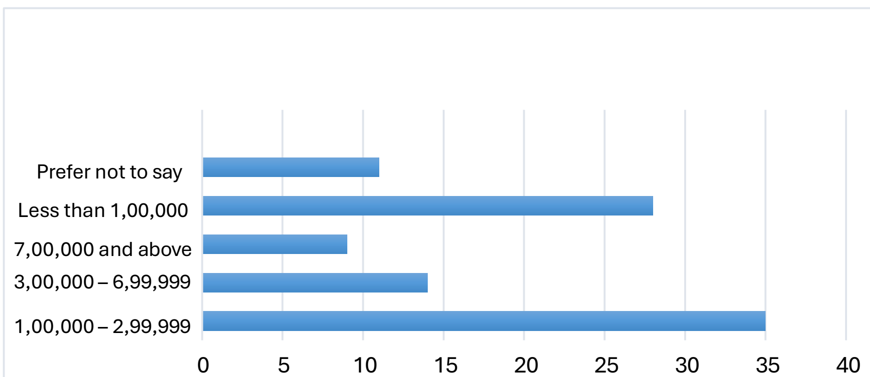

Fig. 5: Annual household Income

Fig. 5 depicts income tiers differ significantly with regional variances with some farmers earning less than ₹3,00,000 per year. The level of their income will impact their ability to afford tools to manage AI and the ability to invest in these kinds of tools - the subsidy program is beneficial in this regard.

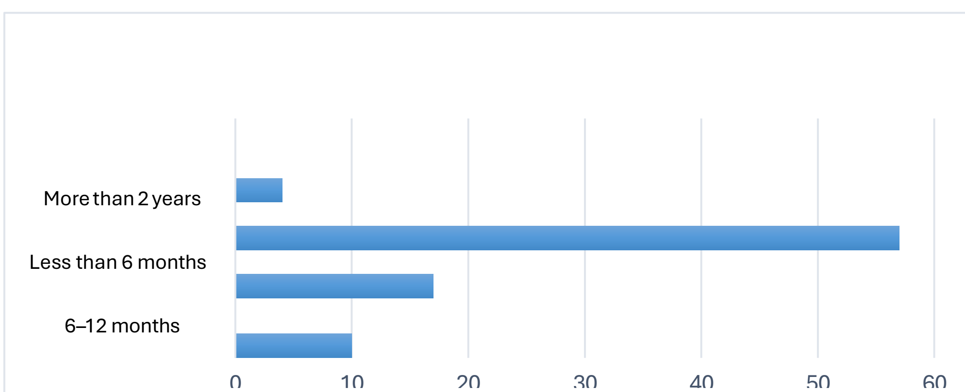

Fig. 6: Use of AI-based forecasting

Fig. 6 shows the length of Time Using AI Forecasting: Farmers had varying lengths of time using AI tools - from less than six months to over two years depending on skill level and use benefits.

3.2 Descriptive Statistical Analysis

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age group	105	1.00	4.00	1.9048	1.05177
Gender	105	1.00	3.00	1.9429	.99835
Education level	105	1.00	3.00	2.5143	.52099
Farm size in acers	105	2.00	3.00	2.4667	.50128
Are you aware of AI based crop forecasting tools?	105	1.00	2.00	1.4667	.50128
Usage of AI	105	0.00	2.00	1.5143	.52099
Inputs cost increase extent	105	1.00	3.00	1.9429	.69099
Net farm income has improved	105	1.00	3.00	1.4857	.52099
Valid N (list-wise)	105				

Table 1 illustrates major variables like Age Group, Gender, Education Level, and Farm Size. Each variable has 105 respondents (N). Variables contain a set of values with minimum and maximum reported (e.g., Age group 1 to 4, Gender 1 to 3). Mean and standard deviation yield average values and variation, i.e., average age group is around 1.9 with SD 1.05, indicating that the sample is relatively evenly spread over age groups.

3.3 Regression Analysis

Table 2: Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.983[a]	.966	.965	.09812

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.276	5	5.455	566.671	.000[b]
	Residual	.953	99	.010		
	Total	28.229	105			

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.527	.176		8.661	.000
	age group	-.004	.010	-.008	-.397	.693
	usage of AI	.064	.047	.064	1.365	.175
	frequency of use	-.170	.017	-.287	-10.098	.000
	The extent of the cost increase	.409	.033	.542	12.363	.000
	The cost of using AI is affordable	-.296	.021	-.484	-14.411	.000

a. Dependent Variable: net farm income has improved
b. Predictors: (Constant), cost of using AI is affordable, age group, usage of AI, frequency of use, inputs cost increase extent.

Table 2, depicts the regression model as a good fit with ($R^2 = 0.966$), indicating 96.6 % of the variation in the net farm income improvement at a significant level of $p< 0.01$. Among the variables, the extent of cost increase has a significant positive effect suggesting that higher investment will lead to income gains and the use of AI frequency and affordability show negative impact. Further, age and usage of AI are not significant.

4. Findings & Discussion

The study provides solid real-world data that can convince the stakeholders of the significant contribution of AI-based crop forecasting technology in increasing the revenues of Indian farmers, especially for those who can access and are able to bear the cost of these technologies. A regression analysis reveals that monetary accessibility and regularly use of AI tools are the main factors which lead to substantial economic benefits. So, it is necessary to support targeted affordability measures and expanded digital literacy programs for more effective outcomes.

Besides that, the finding that the differences in income between various types of farmers are not statistically significant in the one-way ANOVA, emphasizes the potential of AI to be a levelling agent in rural economies. This means that both smallholders as well as larger-scale farmers can become instrumental in advancing agriculture by the adoption of AI-enabled innovations in a manner that is open to all which is a prerequisite for the Indian agriculture sector to be able to overcome the structural inequalities and problems in which a vast majority (about 86%) are smallholders who are resource-poor but essential providers of food security at the national level.

The study also found that demographic factors such as the age of farmers do not significantly influence income improvement. This indicates that AI technologies can benefit farmers from different age groups if they have access to the tools and basic knowledge about how to use them. Therefore, the benefits of AI in agriculture are more dependent on accessibility, affordability and usage rather than on demographic characteristics like age and gender.

5. Issues and Challenges

Without coordinated and strong policy reforms that not only take into account the issues arising from the Indian agriculture sector but also the concerns of the farmers, the revolutionary potential of AI-based crop forecasting in Indian agriculture will remain limited. Those in charge of making policies need to draft and execute thoughtful and multi-faceted plans that deal with aspects such as low cost, education, roadwork, and technologies for users in order to achieve the widest possible social effect of AI in the rural sector.

5.1 High Cost of AI Technologies

One of the major challenges in adopting the AI based crop forecasting tools is its high cost. Tools such as sensors, drones and AI based data platforms requires significant financial investment. Many small and medium farmers may find it difficult to purchase these technologies without financial support because of its high cost. As a result of this the adoption of AI tools remains limited among farmers who have fewer financial resources.

5.2 Weak Digital Infrastructure in Rural Areas

The effective use of AI technologies requires reliable internet connectivity and digital infrastructure. However, in many rural areas, the internet access is still limited or unstable. This makes it difficult for farmers to receive real time updates, weather forecasts and AI based advisory services. The full potential of AI technologies can only be realized when the digital infrastructure is robust.

5.3 Limited Awareness of AI-Based Agricultural Tools

Most of the farmers are still unaware of the availability and benefits of AI technologies in agriculture. Lack of awareness reduces the willingness of farmers to adopt new technologies. Without proper awareness and demonstration, the adaptation of AI-based crop forecasting tools will be challenging.

5.4 Data Availability and Reliability Issues

AI based forecasting systems rely heavily on accurate agricultural data such as weather patterns, soil conditions and crop information. This information may not be available or may not be updated in some regions. Inaccurate or incomplete data can reduce the reliability of AI predictions and it may become less useful for farmers.

6. Suggestions and Recommendations

6.1 Affordability Initiatives

Scale up cost-share programs like NMAET and SFAC that subsidize a broader range of AI-enabled tools (e.g., drones, sensors, analytics platforms). Provide low-interest loans and rent-to-own options that are simple to access, specifically for small and marginal farmers, including women, farmers from Scheduled Castes/Scheduled Tribes and farmers from Northeastern India. Encourage public-private partnerships to help reduce costs and innovate AI tools for smallholders. Complete the idea with programs that promote financial literacy for farmers to understand how to access and utilize these financial programs.

6.2 Specific Training and Capacity Development

Expand agricultural extension programs with the hiring of trainers who have skills in digital education and ongoing professional development on AI learning tools. Engage universities, NGOs, and agritech start-ups to develop regionally and linguistically appropriate training resources made available through mobile applications, digital hubs, and classroom-based learning. Develop interactive and experiential learning modules for illiterate or semi-literate farmers who cannot participate in traditional settings. Create farmer field school networks for the purpose of digital agri-education and peer learning to establish successful AI case-based learning.

6.3 Development of Rural Infrastructure

Make substantial investments in rural broadband to enhance high-speed connectivity to facilitate access to relevant and real-time AI advisory. Establish "Agritech Kiosks" with internet-enabled devices and AI software to create local access points and support to farm families. Connect AI tools with government and market data systems—soil, climate/weather, market prices to enhance forecasting and decision-making. Revamp the data structure for fluid secure and reliable AI service delivery.

6.4 Increase Awareness Through Outreach Programs

Awareness campaigns must be conducted by government agencies, agricultural organisations and technology companies to inform farmers about the benefits of AI based technologies in agriculture. These organizations can conduct field demonstrations, workshops and community-based programs which can help farmers to understand how these tools can improve productivity and reduce farming risks.

7. Conclusion

In conclusion, AI-powered crop prediction is a major change and a democratizing factor for Indian farming, which can considerably increase the farmers' incomes and their ability to withstand difficult times. How the advantages will be spread to a large number of people is dependent on solving the issues of money, infrastructure, and education that have to be overcome by the use of local, properly coordinated policy and innovation frameworks. This approach paves AI to become a fundamental element of the next era of eco-friendly agricultural development in India.

References

1. Aijaz, N., Lan, H., Raza, T., Yaqub, M., Iqbal, R., & Pathan, M. S. (2025). Artificial intelligence in agriculture: Advancing crop productivity and sustainability. Journal of Agriculture and Food Research, 20, 101762. https://doi.org/10.1016/j.jafr.2025.101762
2. Boote, T. (2024). Artificial intelligence for crop yield prediction: Improving accuracy and reliability. Advances in Crop Science and Technology, 12, 748. https://www.omicsonline.org/open-access-pdfs/artificial-intelligence-for-crop-yield-prediction-improving-accuracy-and-reliability.pdf
3. Dutt,A, Kulkarni, P. N., Akilan, S. M., Mishra, R., Khetan, P., & Bhadora, A. (2024). Agricultural price prediction through artificial intelligence. International Journal of Development Research, 14(3), 65161–65165. https://doi.org/10.37118/ijdr.28018.03.2024
4. Geetha, S. (2024). Impact of artificial intelligence in farming. International Research Journal of Modernization in Engineering Technology and Science, 6(1), 2842–2846. https://doi.org/10.56726/IRJMETS48807
5. Himani, H. (2014). An Analysis of Agriculture Sector in Indian Economy. IOSR Journal of Humanities and Social Science, 19, 47-54. https://doi.org/10.9790/0837-191104754
6. Miller, T., Mikiciuk, G., Durlik, I., Mikiciuk, M., Lobodzinska, A., & Snieg, M. (2025). The IoT and AI in agriculture: The time is now—A systematic review of smart sensing technologies. Sensors, 25(12), 3583. https://doi.org/10.3390/s25123583
7. Mohan, R. N. V. J., Rayanoothala, P. S., & Sree, R. P. (2025). Next-gen agriculture integrating AI and XAI for precision crop yield predictions. Frontiers in Plant Science, 15, Article 1451607. https://doi.org/10.3389/fpls.2024.1451607
8. Naseem, A., Adekar, S., & Hegade, S. (2025, March). AI innovations in agriculture: Enhancing crop yield forecasting. In Proceedings of the International Conference on Advances in Management & Technology (ICAMT). Sadabai Raisoni Women's College, Nagpur / SNDT University, Mumbai. http://www.ijcstjournal.org
9. Nautiyal, M., Joshi, S., Hussain, I., Rawat, H., Joshi, A., Saini, A., Kapoor, R., Verma, H., Nautiyal, A., Chikara, A., Ahmad, W., & Kumar, S. (2025). Revolutionizing agriculture: A comprehensive review on artificial intelligence applications in enhancing properties of agricultural produce. Food Chemistry X, 29, Article 102748. https://doi.org/10.1016/j.fochx.2025.102748
10. Northrop, J. (2025, July). AI-powered cloud-IoT systems for predictive crop yield forecasting. ResearchGate. https://www.researchgate.net/publication/393983188
11. Pandey, D. K., & Mishra, R. (2024). Towards sustainable agriculture: Harnessing AI for global food security. Artificial Intelligence in Agriculture, 12, 7284. https://doi.org/10.1016/j.aiia.2024.04.003
12. Patel, N., Dorin, B., & Nagaich, R. (2022). A new paradigm for Indian agriculture: From agroindustry to agroecology. NITI Aayog. https://www.niti.gov.in/sites/default/files/2023-03/A-New-Paradigm-for-Indian-Agriculture-from-Agroindustry-to-Agroecology.pdf
13. Roy, S., Hoque, A., Saikia, P., & Padhiary, M. (2025). Climate-smart agriculture: AI-based solutions for enhancing crop resilience and reducing environmental impact. Asian Research Journal of Agriculture, 18(1), 291–310. https://doi.org/10.9734/arja/2025/v18i1665
14. Sattigeri, A., Abhishek, S., Faisal, M., Sainath, A., & Manohari, S. (2025). AI based crop recommendation system in Karnataka. International Journal of Creative Research Thoughts, 13(7), 719-730. https://www.ijcrt.org
15. Sharma, V. P. (2011, November). India's agricultural development under the new economic regime: Policy perspective and strategy for the 12th Five Year Plan (Working Paper No. 2011-11-01). Indian Institute of Management Ahmedabad. https://www.iima.ac.in/sites/default/files/rnpfiles/16179126012011-11-01.pdf
16. Sujay, S., Bharath, K., & Reddy, T. S. (2025). The Role of AI-Powered Crop Monitoring Systems in Improving Crop Yields and Reducing Losses in Indian Traditional Agriculture. International Advanced Research Journal in Science, Engineering and Technology, 12(9), 42–49. https://doi.org/10.17148/IARJSET.2025.12907