Artificial Intelligence and Agriculture: Brief overview in Indian Context

Vidya Madhuri E[1], Rupali J S[1], Sagar D[1,2], Ratna Prabha[3,4,*]

[1]Division of Entomology, ICAR-Indian Agricultural Research Institute, New Delhi-110012, India.

[2]ICAR-National Bureau of Agricultural Insect Resources (ICAR-NBAIR)

[3]Agricultural Knowledge Management Unit (AKMU), ICAR-Indian Agricultural Research Institute, New Delhi 110012, India

[4]EPC, ICAR-NRC Equines, Bikaner, Rajasthan

Corresponding Author: ratnasinghbiotech30@gmail.com

Artificial Intelligence (AI) is revolutionizing agriculture globally, with significant implications for India's agricultural sector. India's agricultural sector accounts for around 15% of the GDP (Reddy et al. 2024). The country faces challenges such as declining soil fertility, inaccurate soil analysis, irrigation, and disease infestation (Singh and Kumar 2023). The use of AI in Indian agriculture aims to boost productivity, efficiency, and farmers' income (Mary et al. 2022). The use of AI in agriculture in India includes applications such as irrigation, sensor-based sprinkling, robotic weeding, and drone systems, leading to efficient resource utilization and increased productivity (Kalfas et al. 2023; Bhairavi et al. 2020).

In India, over 500 agricultural startups are leveraging AI technologies such as machine learning, deep learning, IoT, and expert systems. As of July-August 2021, the Indian AI market is valued at $7.8 billion, reflecting a 22% increase from 2020 (Analytics India Magazine & TAPMI). A detailed assessment of AI adoption across four sectors—banking, services, insurance, and agriculture—indicates that these sectors will contribute 60% of the projected $450 billion AI value-add to India's GDP by 2025 (NASSCOM). The Compound Annual Growth Rate (CAGR) of AI in agriculture from 2017 to 2021 stands at 22.68%. Projections estimate that by 2030, there will be 75 billion IoT devices in agriculture, and by 2050, there will be 4.1 million farm data points (Justice et al. 2002). Overall, AI is playing a crucial role in transforming Indian agriculture by addressing key challenges and enhancing productivity, resource efficiency, and sustainability (Mary et al. 2022; Wadhe et al. 2023).

In 2018 NITI Aayog conducted a discussion on artificial intelligence in different aspects and identified important needs and strategies for the development of artificial intelligence. They compared the water usage and yield parameters of different countries in which India produces poor yields even after utilizing more gallons of water. There is much development in the usage and possession of mobiles by farmers an average of 70 million farmers possessing mobiles and there is an increase in the possession by farmers to 150 million by the end of 2030. So, there is a need to develop the strategies like app development for precision development and reducing the application of pesticides by using AI. In 2020, the Indian government increased the outlay for Digital India to $477 million to boost AI, IoT, big data, cybersecurity, machine learning and robotics. India's flagship digital initiative aims to make the internet more accessible, promoting e-governance, e-banking, e-education and e-health. In the 2019 Union Budget, Finance Minister Nirmala Sitharaman said the government would offer industry-relevant skill training for 10 million youth in India in technologies like AI, Big Data and robotics. Additionally, policy-level initiatives by the Ministry of Electronics and Information Technology (MeitY) and programs around AI by NASSCOM and Defense Research & Development Organization (DRDO) have laid the groundwork for future disruption and created a roadmap for AI in India (Rahman and Ravi 2022).

Responsible AI for Youth is a national program for government schools to empower the young generation to become AI-ready and reduce the skill gap in India. Established by the National e-Governance Division of MeitY, the platform aims to help the students develop a new-age tech mindset and relevant skill sets. The Ministry of Corporate Affairs (MCA) recently launched a new version of its portal, version 3.0, MCA 21, which will leverage data analytics, AI, and ML, to simplify regulatory filings for companies. The idea behind the revamp is to promote ease of doing business and compliance monitoring. Jointly developed by MeitY and NASSCOM in June 2020, the Indian government launched a dedicated artificial intelligence (AI) portal, India AI is slated as a central hub for everything. The portal will act as a one-stop shop for all AI-related developments and initiatives in India. The Indo-US Science and

Technology Forum (IUSSTF) launched the US-India Artificial Intelligence Initiative on 18th March 2021 to foster AI innovation by sharing ideas and experiences, identifying new opportunities in research and development and bilateral collaboration (Geraci 2022).

AI is expected to play a significant role in achieving sustainable agriculture by addressing challenges related to water availability, climate variability, and labor shortages (Kalyanaraman et al. 2022). The penetration of AI in agriculture is hindered by its uneconomical nature and the requirement for big data for accuracy (Dawn et al. 2023). The lack of expertise in AI technologies and the knowledge gap between farmers and technology (Eli-Chukwu 2019) is a major challenge. The future holds potential advancements and trends in plant protection technologies, including the widespread adoption of advanced technologies such as drones, remote sensing, and precision agriculture (Khang et al. 2023).

Selected References

Bhairavi KS, Bhattacharyya B, Manpoong NS, Das PPG, Devi EB, Bhagawati S (2020) Recent advances in exploration of acoustic pest management: a review. J Entomol Zool Stud 2056:2061.https://www.entomoljournal.com/archives/2020/vol8issue3/PartAI/8-3-343-345.pdf

Dawn N, Ghosh T, Ghosh S, Saha A, Mukherjee P, Sarkar S, Guha S, Sanyal T (2023) Implementation of artificial intelligence, machine learning, and Internet of Things (IoT) in revolutionizing agriculture: a review on recent trends and challenges. Int J Exp Res Rev 190–218.https://orcid.org/0000-0002-0046-1080

Eli-Chukwu NC (2019) Applications of artificial intelligence in agriculture: a review. Eng Technol Appl Sci Res 9:4.https://doi.org/10.48084/etasr.2756

Geraci RM (2022) Futures of artificial intelligence: perspectives from India and the US. Oxford University Press.

Justice CO, Townshend JRG, Vermote EF, Masuoka E, Wolfe RE, Saleous N, et al. (2002) An overview of MODIS land data processing and product status. Remote Sens Environ 83:3–15.https://doi.org/10.1016/S0034-4257(02)00084-6

Kalfas I, De Ketelaere B, Bunkens K, Saeys W (2023) Towards automatic insect monitoring on witloof chicory fields using sticky plate image analysis. Ecol Inform 75:102037.https://doi.org/10.1016/j.ecoinf.2023.102037

Kalyanaraman A, Burnett M, Fern A, Khot L, Viers J (2022) The AgAID AI institute for transforming workforce and decision support in agriculture. Comput Electron Agric 197:106944.https://doi.org/10.1016/j.compag.2022.106944

Khang A, Rath KC, Panda S, Sree PK, Panda SK (2023) Revolutionizing agriculture: exploring advanced technologies for plant protection in the agriculture sector. In: Handbook of Research on AI-Equipped IoT Applications in High-Tech Agriculture. IGI Global1–22.https://doi.org/10.4018/978-1-6684-9231-4.ch001

Rahman SM, Ravi G (2022) Role of artificial intelligence in pest management. Curr Top Agric Sci 7:64–81.https://doi.org/10.9734/bpi/ctas/v7/2141B

Reddy LV, Ganesh D, Madhavi A, Ahmad I, Madamala R, Logeshwari P (2024) Plant disease detection and classification using advanced artificial intelligence and machine learning approaches. AIP Conf Proc 1:3101.https://doi.org/10.1063/5.0221328

Singh S, Kumar TVV (2023) Trends, challenges, and opportunities of artificial intelligence in agriculture. Int J Agric Res Govern Ecol.https://doi.org/10.1504/IJARGE.2023.138618

Wadhe V, Nemade M, Agarwal S, Shah S (2023) AI revolution in agriculture of India. In: 6th International Conference on Advances in Science and Technology (ICAST). IEEE166–169.http://dx.doi.org/10.1109/ICAST59062.2023.10454977.

* * * * * * * * *