Corpus Intellectual
ISSN PRINT 2811-3187 ONLINE 2811-3209 Volume 4 NO 1 Conf. Edition 2025

Exploring The Adoption of Artificial Intelligence in Agricultural Information Dissemination and Food Security

Lead Author

Imran Toyin Zakariyau

Affiliation:

Department of Journalism and Media Studies, The Federal Polytechnic Offa

Abstract

Before the AI, agriculture had immensely benefitted from communication technologies in different ways. From creative word-of-mouth to the use of mass media, artificial intelligence now takes agricultural communication to a new level. This study explored the use of AI for agriculture communication and sustainable food security. The study explored that AI functions as communication channels: Surveillance, Correlation, Transmission of the media and task planning execution. The study identified nexus between AI and agriculture, its categories its applications as Robotics, Crop and soil monitoring, and Predictive analytics. The study identified factors that aid the growth of AI in agriculture to: Computing power and capacity, Data, and Algorithms. Challenges in its adoptions are: poor information communication technology infrastructure, data accessibility, validity and reliability, costs, ethical considerations, language and literacy barrier. The study provides future complementary role of communication and AI in sustainable agricultural development as: sustainable agricultural practices and innovation, smart farming ecosystems: improved supply chain management, data-driven decision-making, reverse in urban drift and stigmatization, complex ethical and regulatory challenges. This study concludes that Communication and adoption of AI as an innovation to the farmers will help in planning and execution of their farming objectives while profiting from their efforts is assured.

Keywords: development communication; artificial intelligence, food security, agriculture communication, sustainable development.

Co-Authors: Emmanuel Ifeduba, Department of Mass Communication Redeemer's University Ede, Osun State

Introduction

Before the advent of AI, agriculture had benefitted from innovative communication technologies in different ways. From creative word-of-mouth strategies to extensive use of mass media channels, adopting artificial intelligence takes agricultural communication to a relatively new level. And to place innovative agricultural communication in context, in the era of artificial intelligence, it is important to understand the communication methods that preceded artificial intelligence.

Table 1 contains a list of the agro-communication channels that preceded artificial intelligence:

Table 1:

SN	Channel	Status
1	Word of mouth	Extant
2	Agric extension	Extant
3	Radio	Extant
4	Television	Extant
5	Rural Newspaper	Extant
6	SMS	Extant
7	Satellite Communication	Extant

Advancement in technology has revolutionized the ways we receive and disseminate information. The paradigm shift in communication process has not only changed the ways professional communicators pass messages to their audience, it has permeated every sphere of life and professions including farming. As internet evolves, innovative technologies also develop while organisations and agents of innovation have embraced the use relevant to their area of profession including agriculture. In particular, Artificial Intelligence which includes machine learning, data analytics, and automation, has helped immeasurably to bring innovation to the development of agricultural extension by harnessing the power of data, algorithms, and intelligent systems (Smith *et al.,* 2020).

Adoption of Artificial intelligence is fast becoming popular, and it is one of the issues taking central stage of discussion especially after the COVID- 19 pandemic. This development hinged on the advancement and breakthrough results in Science that is particular to Information and Communication Technologies. Information Technology (IT) is

made up of computers, software, data storage and processing whereas Communication Technology (CT) includes telecommunications, Internet, networks and digital media. Issa (2024) avers that fusion of the Information and communication technologies has been able to transform the way members of the society communicate, access information, work, learn, and entertain one another through such tools and platforms as e-mail and social media messaging; remote work and digital collaboration; online education and digital resources; as well as streaming and gaming and in this direction success of some computer applications have brought into limelight the use of artificial intelligence (AI). Success of experimentations in this regard Elbehri and Chestnov (2021) noted that has lead AI systems to being deployed or piloted in many sectors including automotive, financial, manufacturing, health, security, and government. Umar (2023) pointed that AI is a powerful tool that has a potential for offering innovative solutions to longstanding even to the farming challenges.

The use of AI driven technologies, such as drones, satellite and ground-based sensors have helped farmers in produce processing, data capturing and analysis, land management, irrigation farming, soil management, produce costing, change in production system, use of pesticide, farm mechanization, and prediction of weather system and climate change among others. Effective application of AI technologies according to Patel, et al, cited by Adewusi, Asuzu, Olorunsogo, Iwuanyawu, Adaga, and Daraojimba (2024) will thereby minimize waste, optimize resource allocation and reduce environmental footprint of agriculture.

Artificial Intelligence as A Concept

As AI evolves with the development in information and communication technologies and machine tools so also defining it also changes with these developments but Kok, Boers, Kosters (2002) categorised the definition in four ways, according to them AI is a system that thinks like a human, acts like a human, thinks rationally or acts rationally. Elbehri and Chestnov (2021) refers to AI as a family of technologies that allow computers and other machines (e.g. robots) to perform tasks previously thought to rely on human experience, creativity and ingenuity. It involves the ability of machines to function autonomously, and "learn" from large volumes of input data, without being explicitly programmed for the required task. Elbehri, Eskandar, and Chestnov (2021) noted that AI systems learn and sometimes exceed human performance in particular areas. From transcribing handwritten texts, to recognizing objects and patterns in images, to

providing complex predictive analysis, AI can take on a share of many "clever" tasks (that are often resource-intensive) and complete them at a fraction of the time and effort required by a human, especially if coupled with other technologies. There are three categories of AI namely;

Artificial Narrow Intelligence (ANI) this relates to machine intelligence that equals or exceeds human intelligence for a particular domain, such as chess, self-driving cars, disease detection, or automated plant classification.

Artificial General Intelligence (AGI) refers to a computer that is as smart as a human being and can perform intellectual tasks that a human being can.

Artificial Super Intelligence refers to the hypothetical intelligence that greatly exceeds the cognitive performance of humans in virtually all domains of interest (Bostrom, 2014)

Information and communication capabilities of artificial intelligence enabled machineries

AI works in line with the functions of the media given by Harold Laswell and Charlse Wright as follow:

Surveillance (Sensing and perception) by obtaining the awareness of surroundings. i.e., gathering, processing and providing information about situations.

Correlation (Reasoning and learning): Conducting logical deduction, mathematical analysis, heuristic inference and experiential adaptations. That used to derive conclusions, make decisions and issue instructions.

Transmission or Communication: Coordinating and delivering information among various entities;

Task planning and execution: Activating device operations for control activation and physical work.

AI and Agriculture: the nexus

Artificial Intelligence in agriculture refers to the utilization of advanced technologies, including machine learning, data analytics, and automation, to enhance various aspects of agricultural processes

(Smith, 2018; Misra, et al., 2020). The application of AI in agriculture is a shift from traditional methodologies adopted in farm practices (Bannerjee, et al., 2018). This new shift allows for precision farming and crop monitoring to predictive analytics for yield optimisation. AI in agriculture leverages data-driven insights and computational capabilities to make informed decisions, increase efficiency, and address complex challenges faced by the agricultural sector.

Bobicey and Connecterra (2021) and Umar (2023) were of the opinion that of many technologies being explored for agriculture AI is the most powerful and promising tools for farmer and agriculture capable of promoting sustainable development. AI has opened a new horizon for a data driven solution supporting decision-making, facilitate supervision and monitoring, improve timeliness and effectiveness of safety measure and automation of many agricultural activities.

Categories and Examples of AI Application in Agriculture

With the media convergence as witnessed by the emergence of internet and the accompanied products, customers with knowledge of and access to sophisticated information and communication technologies have emerged (Davenport *et al.,* 2007), giving them access to the creation of content and the power to influence other consumers using digital innovation technology (Osei-Mensah, Asiamah, & Sackey, 2023). These innovations evolve in the diffusion and adoption of communication of innovative technologies in the agricultural sector which AI is one of the most successful attempts to actaulise sustainable agricultural practice and food security (Vora, & Wadhwani, 2021; Kummer, Raut, & Rupavathara, 2021).

Currently, the most popular applications of AI in agriculture appear to fall into three major categories: Robotics, Crop and soil monitoring, and Predictive analytics. The three categories have been used in both developed and developing countries of the world with a resounding success (Elbehri, Eskandar, & Chestnov 2021). The examples are as following:

Robotics; robotic machines have been used to control unwanted crops and weeds in farmstead and help farmers to increase their output, reduce the labour force needed and manpower time get the job done.

In their review of robotic weed management, Manisankar, Mahua Banerjee, Malik, Sathiyabama (2022) noted that first commercially available robotic weeding machine in England is Robocrop built by

Tillet and Hague Technology Ltd. Robocrop uses digital video camera to capture images of crop ahead to the tool bar, these images are analysed to find the positions of the individual plants as they pass through the image. Then, these details are used to screening and distinguish the difference between crop and weed. In Netherlands, The IC weeder was developed and uses a digital camera to calculate the position of cultivated crops and unwanted weed, then hoe around them accurately and quickly. All the working operations are digitally controlled and monitored by powerful software. ***Robovator - Denmark*** Robovator a mechanical hoeing robot manufactured by F. Poulsen Engineering, Denmark on 2014. Plant detection camaras are specially designed for determine and continuously monitors the passing crops and weeds. The weeder can gather the information of vegetations by high quality camara placed over each crop row based on colour, size and spacing between plants. In USA Tertill is an autonomous, self-sufficient, solar powered weeding robot designed by Robot Joe, that wanders all over the garden and taking care of the weeding daily among others.

Crop, soil and livestock monitoring; AI had been developed and used to identify potential treats to crops, deficiencies in the soil nutrients, climatic condition monitoring. Plantix application was developed in Germany and had been used to assist farmers in automated detection of plant damage that occurs during crop production. This application had been used in India and South Africa., Plantvillage Nuru mobile application was developed initially foe education and awareness raising, it is now used by cassava farmers in Kenya to find and cultivate healthy plants in farms affected by pests.

Predictive analytics: is the use of AI to give accurate predictions about yields and potential of farming efforts which can help to forecast the sales and consumption pattern of farm produce. Data from various sources such as soil, weather, satellite and drone imagery are used in this regard.

Key factors that lead to the growth of AI in agriculture

Elbehri and Chestnov (2021) identified the recent success of AI as following:

Computing power and capacity: Processing units have advanced significantly over the past few decades; the units in use now are ten times faster than those from the early 2010s. Moreover, the emergence of cloud computing has led to significantly lower costs for on-demand processing and storage services. These advancements

make it possible to create and employ complex artificial intelligence algorithms, many of which need a lot of processing power, which was previously expensive and in short supply.

Data: The ability to collect, organize, store, and retrieve data has also greatly increased. The rising digitization of daily tasks, ongoing sensor network deployment, the emergence of the Internet of Things, and the growth of big data all contribute to the ever-increasing amounts of data that may be utilized to train AI systems across a wider range of disciplines. According to International Data Corporation, by 2025, there might be 10 times as much data generated as in 2016—that is, 163 zettabytes, or one trillion gigabytes—of data. (Gantz et.al 2017)

Algorithms: The advancements in computer science and mathematics have led to improvements in the tools and approaches used for teaching AI algorithms and creating AI architecture. Improvements in neural network architecture have produced models that learn more quickly and with less training data, as well as more accurate AI systems. As more algorithms and procedures were learned, AI systems improved in dependability and versatility, creating opportunities for new uses.

Matters Arising and the way forward

The numerous concerns thrown up by the conception, adoption and deployment of AI agriculture innovative information to farmers especially in Nigeria are real and undeniable. Some of these are:

Poor information communication technology infrastructure: penetration of ICT facilities has led to deployment of smart phones and relatively cheap bundle data in communities which can accommodate the effective use of AI tools and platforms for agriculture information but in some remote communities where the task of agricultural practices is in operation are either deprived of broadband coverage or poor connectivity. In such communities the benefits of AI application elude the farmers.

Data accessibility, validity and reliability: Data is the cornerstone of any AI system. Large data sets gathered over time are needed for AI training, model testing, and verification. While small-scale data sets can be trained using cross-validation techniques, a diversified data pool is typically preferred to create reliable, functional applications. There should be more investment and commitment to building reliable data bank. The concern over reliability of the data from National

Bureau of Statistics and other research-based institutions should be laid to rest.

Costs: Although operating and data storage costs have significantly decreased, deploying AI systems can still be expensive due to the high cost of developing and configuring AI models and acquiring data. In Nigeria there is high rate of rural poverty, the smallholder farmers may not be able to afford the use of AI tools. Open-source solutions, such as freely available datasets from specialized foundations and research institutes, can help lessen this difficulty.

Ethical considerations: Although AI systems increase production and efficiency, workers may be impacted as a result of the higher cost of human labor compared to AI applications, thereby leading to job losses. According to a McKinsey Global Institute estimate from 2017, artificial intelligence might eliminate up to 800 million jobs by 2030. (Global McKinsey, 2017). It is important to give careful thought to how this trend may affect agriculture. AI solutions have the potential to boost small-scale producers' expansion and generate employment opportunities.

Adopting the AI: either machine learn AI-powered or software application, it application in agriculture must be simple and easy to use while language barrier and literacy level must be considered to engender adoption of the innovation. It is a known fact that illiteracy: education, and ICT is high among the rural dwellers who are predominantly farmers who could not be aware, understand and adopt the message of innovation brought by AI.

A Future Complementary Role

As the future is bright for the application of AI driven agriculture so also it opens new challenges. However, it can be projected what the future hold for communication, AI and agricultural development as follow:

Sustainable agricultural practices and innovation: AI-powered agricultural surveillance and self-governing farming machinery are examples of innovations that will be crucial (Li & Wang, 2023) in the future. And this will go a long way to effectively manage the much scarce agricultural resources and reducing ecological footprints will be included into agricultural development in the future, with a focus on building economic, financially viable, socially responsible and applies regenerative farming practices.

Precision Agriculture: with the use of AI and communication technology in agriculture that has revolutionalised the farming systems, literature confirmed that where it has been used absolute precision was achieved. Precision farming will increase crop yields, maximise resource utilisation, and lessen its negative environmental effects by using artificial intelligence (AI) and the Internet of Things (IoT) to make data-driven decisions (Zhang et al., 2022).

Smart farming ecosystems: Artificial intelligence (AI) and cutting-edge communication technologies will be combined in future to build smart farming, according to Singh et al. (2023), these ecosystems will use sensors, drones, and AI algorithms to deliver real-time data and practical insights that will improve sustainability and efficiency in farming practice. This practice will turn the farmers from manual labour workers to smart agricultural planner and manager. At this point, Piddubna (2024) noted that understanding of information technological solution and agribusiness will be potentially useful than ability to use conventional tools or carryout physical labour

Improved Supply Chain Management: By increasing traceability and efficiency, artificial intelligence and communication technology will boost supply chain management in the agricultural industry. With blockchain technology in particular, agricultural products can be transparently tracked from field to table, decreasing fraud and enhancing food safety (Kshetri, 2022).

Data-driven decision-making in agriculture is made possible by AI and contemporary communication technologies. Farmers will be able to make more informed decisions on planting, irrigation, and harvesting thanks to real-time data from sensors and satellite images combined with AI analytics (Tsoi et al., 2022).

Reverse in urban drift and stigmatization of farming as a career: AI built on high ended communication technology when moved to the rural areas will attract more young people back to their hometown injecting a vigorous, elite workforce into rural development this will halt the issue of ageing and unlettered farming population and then farming will be seen as a profitable and sustainable business.

Complex Ethical and Regulatory Challenges: As AI technologies develop, they will pose intricate ethical and regulatory issues, including privacy, bias, and openness in decision-making. It will be essential to address these problems if responsible AI development and application are to occur (Kirkpatrick, 2022).

Conclusion

Communication of the fringe benefits and adoption of AI as an innovation to the farmers will in no small measure be helpful to them, it will aid them in planning and execution of their farming objectives while profiting from their efforts is assured. Though AI is a new introduction to agriculture circle, when the farmers are encouraged by the support providers and extension agents on the imperativeness of adopting the AI the more it will be better for them. The fear of job lost should be allayed for its introduction will increase and enhance job creation in different phases of agricultural production chain while AI-powered machines and software application be subsidized or created with the rural poor in mind to be accessible to the rural smallholder farmers.

References

Adewusi, A. Asuzu, O., Olorunsogo, T., Iwuanyawu, C., Adaga, E. & Daraojimba, D. (2024). AI in precision agriculture: A review of technologies for sustainable farming practices. World Journal of Advanced Research and Reviews, 2024, *21*(01), 2276–2285. https://doi.org/10.30574/wjarr.2024.21.1.0314

Bannerjee, G., Sarkar, U., Das, S. and Ghosh, I., 2018. Artificial intelligence in agriculture: A literature survey. *International Journal of Scientific Research in Computer Science Applications and Management Studies*, *7*(3), pp.1-6.

Bobicey, I. & Connecterra, K. (2021). Connecterra: predictive AI tools for early detection of disease - healthy cows for a sustainable dairy sector

Bostrom, N. (2014). Super intelligence: Paths, Dangers, Strategies. Oxford University Press

Elbehri, A. and Chestnov, R. (eds). 2021. *Digital agriculture in action – Artificial intelligence for agriculture*. Bangkok, FAO and ITU. https://doi.org/10.4060/cb7142en

Elbehri, A. Eskandar, H. and Chestnov, R. (2021). Adopting artificial intelligence solutions for agriculture: potential, the process, the success factors, and key recommendations. In Elbehri, A. and Chestnov, R. (eds). 2021. *Digital agriculture in action – Artificial intelligence for agriculture*. Bangkok, FAO and ITU. https://doi.org/10.4060/cb7142en

Issa A. O. (2024). Harnessing ICT potential for economic growth and national development-before and after. Keynote address at the 2nd International Conference of the School Of Communication And Information Technology, Federal Polytechnic, Offa, Kwara State, Nigeria, holding between 6thand 8th august, 2024,

Kirkpatrick, D. (2022). *Ethical AI: Navigating the challenges of artificial intelligence*. Ethics in Technology Review, 39(4), 22-45.

Kok J N, Boers E J W, & Kosters W A, et al. (2002) Artificial Intelligence: definition trends, techniques, and cases. International Symposium on Southeast Asia. Water environment.

Kshetri, N. (2022). *Blockchain's roles in improving supply chain management*. In *Blockchain and the Future of Finance* (pp. 45-64). Palgrave Macmillan.

Li, J., & Wang, Y. (2023). *Sustainable agriculture in the age of AI: Innovations and practices*. Agricultural Systems, 142, 100-112.

Manisankar, G. Mahua Banerjee, M., Malik, G, Sathiyabama, N (2022). Man robotics in weed management: A review. Ama, Agricultural Mechanization in Asia, Africa & Latin America ISSN: 00845841. 53(04)

Osei-Mensah, B., Asiamah, E. O, & Sackey, R. (2023). Strategic communication and artificial intelligence: reviewing emerging innovations and future directions. Archives of Business Research – Vol. 11(1). 85-102.

Piddubna A (2024) AI in Agriculture — Future of farming. https://intellias.com/artificial-intelligence-in-agriculture/ (retrived on 2nd September, 2024)

Singh, A., Kumar, P., & Patel, R. (2023). *Smart farming: Integrating AI and IoT for agricultural advancements*. Journal of Agricultural Innovation, 34(3), 77-92.

Smith, M.J., 2018. Getting value from artificial intelligence in agriculture. *Animal Production Science*, *60*(1), pp.46-54.

Tsoi, K., Ding, Z., & Liu, Y. (2022). *Leveraging AI and IoT for data-driven agriculture*. *Journal of Smart Agriculture*, 11(2), 95-110.

Umar, B. (2023). Artificial Intelligence in agricultural extension for sustainable development. International Journal of Applied and Scientific Research.1(3)259-268. https://doi.org/10.59890/ijasr.v1i3.740

Zhang, Y., Li, X., & Chen, X. (2022). *Precision agriculture: The role of AI in optimizing crop production*. Journal of Precision Agriculture, 58(1), 25-39.