Empact of Digitalization on Agriculture & Farmers Empowerment

Name :- Hemant Kumar (Junior Research Fellow, University Department of Commerce and Business Management. Ranchi University, Ranchi.)

Email Id :- [hemantkr107@gmail.com](mailto:hemantkr107@gmail.com) Contact no. 6204105008

Address :- Kamal Niwas, C/O Ram Mohan Mahto – Tiril Road Kokar, Ranchi – 834001

Name :- Ankita Kumari (Junior Research Fellow, University Department of Commerce and Business Management. Ranchi University, Ranchi.)

Email Id :- ankitashisodiya321@gmail.com Contact no. 8092748552

Address:- Seema Girls Hostel, Near Paul Optics, HB Road Ranchi - 834001

Abstract

The agricultural landscape is undergoing a profound metamorphosis through the pervasive integration of digital technologies. This study delves into the diverse impacts of digitalization on agriculture, shedding light on its pivotal role in empowering farmers. With the advent of cutting-edge innovation such as precision farming, the Internet of Things (IoT), expert systems, and data Mining, a paradigm shift is occurring, fostering efficiency, sustainability, and empowerment within the agricultural sector. Digitalization has revolutionized farm management practices by delivering real-time insights into weather conditions, soil health, and crop vitality. Precision farming, leveraging advanced sensors and GPS technology, enables farmers to optimize resource allocation, resulting in heightened productivity and diminished environmental impact. Concurrently, deploying smart farming practices has seamlessly integrated automation and robotics into agricultural processes, bolstering efficiency and minimizing labour requirements. Farmer empowerment in the digital age extends beyond operational enhancements. Access to digital platforms and mobile applications has democratized information, equipping farmers with invaluable insights into market trends, pricing dynamics, and optimal agricultural practices. This democratization of information empowers farmers to make informed decisions, negotiate fair prices, and diversify income streams. Additionally, the advent of digital financial services has further empowered farmers, simplifying access to credit, insurance, and other financial tools, thus fortifying their financial resilience. Nevertheless, the transformative potential of digitalization in agriculture is accompanied by challenges, including concerns about data privacy, connectivity in remote areas, and the digital divide. Addressing these challenges is imperative to ensure that the benefits of digitalization are inclusive, reaching all segments of the farming community.

Keywords: - Digitalization, Precision Farming, Farmer empowerment, Smart agriculture, Sustainability.

Introduction

The advent of digitalization has become a catalyst for a profound change in diverse industries, with agriculture being one of the sectors undergoing significant transformation. In India, where agriculture is vital to the economy and supports millions of farmers, integrating digital technologies has the capacity to transform agricultural practices significantly. Digitalisation has the potential to transform Indian agriculture and empower farmers with tools and information to enhance productivity, sustainability, and profitability (Vig, 2023). Digitalisation has the potential to substantially boost farmers' earnings, fostering the development of the agricultural sector and contributing to economic advancement(Gautam et al., 2021). The adoption of digital technologies significantly reduces the likelihood of households experiencing extreme poverty. Even in regions with limited access to electricity, digitalization plays a large role in poverty alleviation efforts, facilitating expanded financial inclusion with a focus on impoverished households, especially those led by women, in rural areas. Digitalisation has an impact on consumer financial behaviour and is directly related to financial literacy. Over the past few years, there has been a growing integration between the digital economy and agricultural systems. With digitalization serving as its foundation, modern agriculture has opened up new avenues for environmentally friendly agricultural development. Information and Communication Technologies (ICTs) are poised to play a crucial role in driving the transition towards intelligent and sustainable farming practices. This transition is considered essential to meet the growing demand for food in the face of climate change and increasing resource scarcity (El Bilali et al., 2020).

The agricultural sector holds considerable importance in the Indian economy, contributing to more than 20% of the gross domestic product (GDP). Only dedicated efforts in agricultural research and extension would be able to meet the rising demand for food grains. Despite its significance in the Indian economy, the agricultural sector faces several challenges such as inadequate market linkages, fragmented supply chains, delayed and unreliable information dissemination to farmers, small land holdings, and limited adoption of modern technology. It become critical to investigate various methods of keeping our farmers up to date on modern technology and important knowledge to keep pace with the current technological era. Currently, the focus remains on addressing agricultural challenges, particularly through the advancement and modernization of the sector via innovative technology implementation

In today's dynamic world, constant progress is the goal, particularly in enhancing the processes involved in advancing agricultural production. The agricultural sector holds immense significance and is prevalent across nearly all countries. There is extensive knowledge available about emerging technologies and development programs aimed at agriculture, with digitalization emerges as a particularly attractive and modern strategy. Integrating digital technologies into agriculture encompasses more than just pilot projects and techniques for industrial modernization; it also involves collaboration through integration and various forms of multifaceted cooperation

.Increasing productivity and meeting output demands are significant catalysts for the mechanization of agricultural farms. The emergence of Internet of Things (IoT) technologies presents an opportunity to develop innovative solutions and enhance applications across all aspects of the agricultural industry. In the contemporary era of agriculture, numerous ideas have emerged to digitize and modernize the sector. These include automated guidance systems, precise application of fertilizers and pesticides based on data analysis, field robots and unmanned aerial vehicles (UAVs), sensors for soil analysis, and autonomous driving. Digitalization is progressing within agriculture, as it is in other domains (Kenney et al., 2020).

Agriculture faces the challenge of meeting this heightened demand with only a marginal 5% increase in land usage while striving to conserve resources. (Microsoft: Empowering Agriculture Through Digital Transformation, 2020). Achieving these objectives may be possible through the adoption of smart farming practices, which involve leveraging modern information and communication technologies to digitize agriculture.

Why is it important to conduct research and innovate in the realm of digital transformation for agriculture and rural regions?

- Technological advancements have the capacity to revolutionize agriculture, allowing farmers to operate with greater precision, efficiency, and sustainability.

-Digital technology have the ability to provide greater transparency to consumers about how their food is produced.

Digital technologies are essential not only for enhancing rural communities, making them more appealing, intelligent, and sustainable, but also for mitigating issues associated with remoteness and enhancing access to services.

(Digital Transformation in Agriculture and Rural Areas, n.d.)

This research delves into the profound implications of digitalization on agriculture and the empowerment of farmers, exploring the multifaceted dimensions of this technological revolution. As the global population continues to surge, the need for innovative approaches to food production becomes increasingly urgent. Understanding how digital technologies empower farmers is not only pivotal for the agricultural sector's sustainability and productivity but also holds the key to addressing broader issues such as food security, economic development, and rural livelihoods. This study aims to unravel the intricate relationship between digitalization and agriculture, shedding light on how technology empowers farmers and shapes the future of this indispensable industry.

Review of literature

The literature explores the effects of digitalization on farmers and its role in addressing challenges in agricultural development. This broadens the conversation to sustainable development theories regarding rural livelihoods, emphasizing the necessity of modernizing agricultural infrastructure and progressing in digital agriculture. This literature review aims to examine the relationship between farmers, agriculture, and the process of digitization. Additional research suggests that agricultural universities should not only equip students with the skills to utilize new information technology but also assist farmers in optimizing web resources through various channels, such as extension services, and the development of specialized websites (Havlíček, 2004). As the field of research on the impact of digitalization on agriculture continues to evolve, Literature reviews provide a basis for furthering understanding and expanding knowledge in a given field. They assist by recognizing the current state, identifying research gaps, and highlighting areas for further investigation requiring further investigation, laying the groundwork for future developments in the understanding of this dynamic domain.

With the ongoing rise in mobile penetration within agricultural communities and the adaptive proliferation of information services, there is considerable potential for significantly enhancing rural productivity in the future. (Mittal, 2010).

Enhancing productivity, efficiency, and effectiveness in agriculture is critical for addressing the global challenge of food security. The pivotal advancement is facilitated by the capabilities of sensing, analytics, and visualization, especially through the utilization of IoT.(Jayaraman et al., 2015).

Collaborative research between social sciences and natural or technical sciences can provide valuable insights for the development of digital agriculture. By considering and addressing social dynamics, such research aims to maximize the benefits and minimize potential drawbacks of emerging technologies in agriculture(Klerkx et al., 2019). Digital agriculture, referred to as Agriculture 4.0 or intelligent farming, has surfaced as an approach that employs intelligent, data-rich ICT services and applications alongside sophisticated hardware.(Monteleone et al., 2020)

(Fielke et al., 2020) Agricultural digitization encompasses the adoption of precision farming technologies, aimed at diminishing input expenditures and elevating yields or sustainability metrics. These technologies incorporate sensors, machinery, UAVs, and satellites for data gathering and informed decision-making.

Numerous authors have underscored the transformative potential of digital technologies, including the Internet of Things, Smart sensors, and many more, in reshaping agricultural systems and methods within India.

(Purohit & Purohit, 2021)

According to (Sam & Grobbelaar, 2021Globally), the agricultural industry faces various challenges, especially in developing countries, where small-scale farmers encounter barriers such as restricted availability of financial services, access to information, and formal economic recognition.

Additional research indicates that digitalization plays a role in automating agricultural tasks, resulting in enhanced productivity and product quality. It also positively impacts labor productivity growth in enterprises, highlighting the significant technological advancements within the industry(Frolova et al., 2021).

This author defines, The benefits of smart farming in agriculture are evident and well-understood. Farmers are on the verge of experiencing significant changes and widely adopt this technology, replacing traditional methods to boost productivity. While developed countries have already embraced these practices, India, China, and Africa remain untapped in this field. If implemented in these regions, it could effectively address and potentially eradicate global hungriness.

Advanced agricultural technology has the potential to bring about significant advancements in countries like India, where 58% of the population depends directly on agriculture for their main source of livelihood(Prakash et al., 2021).

Further research suggests that the integration of digital technologies into agriculture can increase farmers' earnings by improving productivity, broadening avenues for selling produce, and streamlining agricultural infrastructure development. At the same time, improving production efficiency and expanding sales avenues are vital prerequisites for the modernization of agricultural infrastructure(Zhang & Fan, 2023). In conclusion , the adoption of digitalization within agriculture holds promise for delivering substantial benefits to farmers and the agricultural industry in its entirety (Degila et al., 2023).

Digital Agriculture

To transform agricultural practices lucrative and environmentally viable providing everyone with safe, wholesome, and reasonably priced food, digital agriculture uses "ICT (Information and Communication Technologies) and data ecosystems to support the development and delivery of timely, targeted information and services." Five Memorandums of Understanding (MOUs) were recently signed by the Ministry of Agriculture and Farmers Welfare with private businesses to advance digital agriculture. As a component of the Digital Agriculture Mission, these pilot projects will make use of the National Farmers Database, which currently has 5.5 crore farmers registered through national programs that are now in place. For instance, agricultural biotechnology encompasses a variety of instruments, such as conventional breeding methods, that change or create goods by modifying live creatures or their components: enhancing plants or animals and creating microorganisms tailored for certain agricultural uses. Robotics, drone technology, weather monitoring, digital and wireless data measuring technologies, etc. (Wolfert et al.,2017)

Digital Agriculture Mission

The government has launched initiatives employing cutting-edge technologies like b, artificial intelligence, blockchains, drones, and robotics, with plans for continuation until 2025. Furthermore, a range of mobile applications, such as Kisan Suvidha, have been created to furnish farmers with vital data regarding weather updates, market rates, crop protection, agricultural recommendations, alerts for severe weather conditions, suppliers of inputs, soil quality, availability of cold storage facilities, laboratories for soil testing, premiums for crop insurance, and government initiatives.(Digital Agriculture Mission, n.d.)

The Digital Agriculture mission has been started at Krishi Bhawan and the idea is to engage private players and provide services to the farmers. So, the steps are to create a farmer’s database which the government already has 5.5 crore and the idea is to increase it further to 10 crores by the year-end. This database is to understand what kind of farming activity is being done by this farming community and what kind of support services, and information, they can be provided. The digital platform aims primarily to provide timely and relevant information to farmers when needed, utilizing various advanced technologies such as artificial intelligence, geographic information systems, blockchain, and others. These technologies will be integrated and utilized to assist in decision-making processes, reaching out to farmers, guiding them, and extending support beyond just farmers. The complete agriculture value needs to be supported in terms of what kind of market pricing at what location is there, and what the options farmers are having. So, it’s done with a long vision it’s a five-year mission, and companies like Jio Krishi, Cisco, and NCDEX, these are the companies signed a memorandum of association with the Ministry of Agriculture and the idea is to collaborate data and align those with the land records and have something like farmers I’d, So that centrally we understand the farmers, what kind of activity they are doing and how they can be provided services, what kind of services they are looking for they are provided digitally through Artificial intelligence and what kind of Soil health they are working on. It is very important for our big Nation, wherein agriculture something a major contributor to employment and GDP. So, this will enhance the growth rate within the sector. One concern that has been raised the data leakage and data privacy, which is something the governments need to be careful handling 5-10crore database of farmers.

Future of Digital Agriculture

Digital agriculture is poised to undergo significant advancements in the future, revolutionizing the way we cultivate, manage, and optimize agricultural practices. Several key trends and aspects are likely to shape the future of digital agriculture:

1. Precision Farming Evolution: The combination of cutting-edge technology like robots, AI, and machine learning will make precision farming increasingly complex. This will increase crop yields, resource efficiency, and overall agricultural production by empowering farmers to make more accurate decisions based on real-time data.
2. Internet of Things (IoT) Integration: IoT device proliferation in agriculture will only increase more. These gadgets, which will include sensors and drones, will work together seamlessly to gather and send data about crop growth, weather, soil health, and equipment performance. Farmers will gain important information from this network of connections to help them make well-informed decisions.
3. Data Analytics: Huge volumes of agricultural data interpretation will be greatly aided by the application of big data analytics. To improve planting schedules, track crop health, and anticipate any problems, farmers will use data-driven insights, which will lead to more effective and sustainable farming methods.
4. Automated Machinery and Robotics: Automation and robots will be used in digital agriculture more and more in the future. Drones, harvesters, and automated tractors will carry out operations including planting, spraying, and harvesting, saving labor expenses and human interference.
5. Blockchain for Supply Chain Transparency: The agriculture supply chain will be more transparent and traceable thanks to blockchain technology. This will promote sustainability and trust by giving customers access to comprehensive information on the production, origin, and transit of agricultural goods.
6. Climate-Resilient Agriculture: Climate-resilient farming techniques will be developed and implemented by leveraging digital technology. Farmers will benefit from the use of AI algorithms and predictive modelling to optimize water use, adapt to changing climatic conditions, and lessen the effects of extreme weather occurrences.
7. Smart Greenhouses: Growing conditions that are more optimized and managed will be made possible by the incorporation of smart greenhouse technology. In order to maximize crop productivity and resource efficiency, sensors, actuators, and automated temperature control systems will collaborate to produce the optimum growing environment.
8. Collaborative Platforms: Collaborative platforms facilitating the sharing of data, ideas, and best practices among farmers will become more prevalent in the future of digital agriculture. These platforms will help spread information, which will improve decision-making and foster a better feeling of camaraderie among those working in agriculture.
9. Consumer Engagement through Technology: Technology will allow direct connection and interaction between farmers and customers, bridging the divide. Farmers will be able to tell consumers about their experiences, methods, and the path of their products thanks to apps, social media, and internet platforms.
10. Regulatory Support and Standards: The future of digital agriculture will be greatly influenced by the norms, laws, and incentives set by governments and regulatory organizations to encourage the morally and responsibly of technology in farming.

Digital agriculture has a lot of potential to address issues with global food security, advance sustainability, and enhance farmer lives. To guarantee a constructive and inclusive change in the agriculture industry, addressing concerns such as data privacy, cybersecurity, and ensuring equitable access to technology is essential.

Benefits

* raise the productivity of agriculture.
* stops the deterioration of soil.
* lessens the use of chemicals in agricultural cultivation.
* economical use of the water supply.
* spreads the use of contemporary farming techniques to increase production's quantity, quality, and lower cost.

Significance of the study

* Using the results of these pilot initiatives, farmers will be empowered to make educated choices regarding the crops they choose to cultivate, seed varieties, and optimal agricultural practices to enhance yield potential.

* Make their logistics and procurement plans based on accurate and timely information.
* The 21st century has been defined by the usage of technology. India has a fantastic potential to make use of its position as a major player in the IT industry and transform the farming sector as the world goes toward big data, AI, quantum computing, and other emerging technologies.
* Digital topography, soil maps, land use and cover maps, digital elevation models (DEMs), and other tools can improve data efficiency.

Reference

# Vig, D. (2023, June 19). Impact of Digitalization on Indian Agriculture and former. YOURVIEWS. https://yourviews.mindstick.com/view/85340/impact-of-digitalization-on-indian-agriculture-and-former

1. Full Citation: Gautam, R. S., Bhimavarapu, V. M., & Rastogi, D. S. (2021, September 30). Impact of Digitalization on the Farmers in India: Evidence using Panel Data Analysis. International Journal of Management and Humanities, 6(1), 5–12. <https://doi.org/10.35940/ijmh.l1372.0851221>
2. l Bilali, H., Bottalico, F., Ottomano Palmisano, G., & Capone, R. (2020). Information and Communication Technologies for Smart and Sustainable Agriculture. 30th Scientific-Experts Conference of Agriculture and Food Industry, 321–334. <https://doi.org/10.1007/978-3-030-40049-1_41>
3. Kenney, M., Serhan, H., & Trystram, G. (2020). Digitization and Platforms in Agriculture: Organizations, Power Asymmetry, and Collective Action Solutions. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.3638547>
4. Microsoft: empowering agriculture through digital transformation. (2020, August 11). The Economic Times. <https://economictimes.indiatimes.com/industry/miscellaneous/microsoft-empowering-agriculture-through-digital-transformation/articleshow/77485128.cms>
5. Digital transformation in agriculture and rural areas. (n.d.). Research and Innovation. https://research-and-innovation.ec.europa.eu/research-area/agriculture-forestry-and-rural-areas/digital-transformation-agriculture-and-rural-areas\_en
6. Havlíček, Z. (2004, June 30). Web technology and farmers. Agricultural Economics (Zemědělská Ekonomika), 50(6), 243–248. <https://doi.org/10.17221/5197-agricecon>
7. Mittal, S. (2010). Socio-Economic Impact of Mobile Phones on Indian Agriculture. <http://hdl.handle.net/10419/176264>
8. Jayaraman, P. P., Palmer, D., Zaslavsky, A., Salehi, A., & Georgakopoulos, D. (2015). Addressing Information Processing Needs of Digital Agriculture with OpenIoT Platform. Interoperability and Open-Source Solutions for the Internet of Things, 137–152. <https://doi.org/10.1007/978-3-319-16546-2_11>
9. Klerkx, L., Jakku, E., & Labarthe, P. (2019, December 1). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. NJAS: Wageningen Journal of Life Sciences, 90–91(1), 1–16. <https://doi.org/10.1016/j.njas.2019.100315>
10. Monteleone, S., Moraes, E. A. D., Tondato de Faria, B., Aquino Junior, P. T., Maia, R. F., Neto, A. T., & Toscano, A. (2020, December 11). Exploring the Adoption of Precision Agriculture for Irrigation in the Context of Agriculture 4.0: The Key Role of Internet of Things. Sensors, 20(24), 7091. <https://doi.org/10.3390/s20247091>
11. Fielke, S., Taylor, B., & Jakku, E. (2020, April). Digitalisation of agricultural knowledge and advice networks: A state-of-the-art review. Agricultural Systems, 180, 102763. <https://doi.org/10.1016/j.agsy.2019.102763>
12. Purohit, S., & Purohit, S. (2021, October 10). Digitization in Indian Agriculture: Evolution from Simple to Smart Farming. Indian Journal of Economics and Development, 9, 1–6. <https://doi.org/10.17485/ijed/v9.2021.51>
13. Sam, A. K., & Grobbelaar, S. S. (2021). Research Trends, Theories and Concepts on the Utilization of Digital Platforms in Agriculture: A Scoping Review. Responsible AI and Analytics for an Ethical and Inclusive Digitized Society, 342–355. <https://doi.org/10.1007/978-3-030-85447-8_30>
14. Frolova, O. A., Yukhlina, J. A., Efremcev, A. V., Dozorova, T. A., & Voronov, Y. V. (2021). Overview of Digital Solutions for Agriculture. Comprehensible Science, 238–250. <https://doi.org/10.1007/978-3-030-66093-2_23>
15. Prakash, C., Singh, L. P., Gupta, A., & Singh, A. (2021). Smart Farming: Application of Internet of Things (IoT) Systems. Proceedings of the 21st Congress of the International Ergonomics Association (IEA 2021), 233–240. <https://doi.org/10.1007/978-3-030-74608-7_30>
16. Zhang, X., & Fan, D. (2023, April 17). Can agricultural digital transformation help farmers increase income? An empirical study based on thousands of farmers in Hubei Province. Environment, Development and Sustainability. <https://doi.org/10.1007/s10668-023-03200-5>
17. Degila, J., Sodedji, F. A. K., Avakoudjo, H. G. G., Tahi, S. P. G., Houetohossou, S. C. A., Honfoga, A. C., Tognisse, I. S., & Assogbadjo, A. E. (2023, June 7). Digital Agriculture Policies and Strategies for Innovations in the Agri-Food Systems—Cases of Five West African Countries. Sustainability, 15(12), 9192. <https://doi.org/10.3390/su15129192>
18. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M. J. (2017, May). Big Data in Smart Farming – A review. *Agricultural Systems*, *153*, 69–80. https://doi.org/10.1016/j.agsy.2017.01.023