International Journal of Scientific Research in Computer Science, Engineering and Information Technology

ISSN : 2456-3307 OPEN ACCESS

Available Online at : www.ijsrcseit.com

doi : https://doi.org/10.32628/CSEIT25112822

A Study on Perception of Farmers towards the Impact of Cloud Based Services on Agricultural Sector

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ARTICLEINFO

Article History:

Accepted : 05 April 2025

Published: 08 April 2025

Publication Issue

Volume 11, Issue 2

March-April-2025

Page Number

3321-3331

ABSTRACT

The rapid advancement of digital technology has significantly transformed the agricultural sector, with cloud-based services emerging as a crucial tool for enhancing farming efficiency and productivity. This study explores the perception of farmers towards the impact of cloud-based services on agriculture, focusing on their awareness, accessibility, benefits, market linkages, and financial feasibility. The research examines how socio-demographic factors such as age, education, gender, and income levels influence farmers' adoption and utilization of these digital solutions.

A structured survey was conducted among farmers in Gujarat State, and data analysis was performed using descriptive statistics and chi-square tests to determine significant differences in perceptions. The findings reveal that awareness and knowledge of cloud-based services vary significantly based on education, gender, and income levels, with younger, educated, and higher-income farmers showing greater familiarity. While accessibility to digital infrastructure remains consistent across demographics, perceptions of productivity benefits, market linkages, and financial feasibility differ significantly among socio-demographic groups.

The study highlights the potential of cloud-based services in improving decision-making, market access, and overall farm productivity but also identifies key challenges, including limited affordability, digital literacy gaps, and gender disparities in adoption. The research underscores the need for targeted government initiatives, training programs, and financial support to ensure widespread and equitable adoption of cloud-based agricultural solutions. These findings provide valuable insights for policymakers, agritech firms, and agricultural institutions in designing effective digital interventions to support sustainable farming in Gujarat State and beyond.

Keywords: Awareness and Knowledge, Accessibility and Digital Infrastructure, Farming Productivity, Market Linkages and Supply Chain Efficiency.

Introduction

Agriculture is the backbone of the Indian economy, contributing significantly to GDP and employment. However, traditional farming practices often face challenges such as unpredictable weather conditions, inefficient resource utilization, and limited access to real-time market information. In response to these challenges, cloud-based services have emerged as a transformative solution, providing farmers with data-driven insights, remote monitoring, and digital access to agricultural resources.

Cloud-based technologies enable precision farming, automated irrigation, weather forecasting, supply chain management, and real-time market price updates, helping farmers make informed decisions. With increasing digitalization in the agricultural sector, cloud services have the potential to enhance productivity, reduce costs, and improve overall farm management. Despite these advantages, farmer adoption and perception towards cloud-based services remain varied, influenced by factors such as digital literacy, affordability, accessibility, and trust in technology.

This study aims to examine the perception of farmers towards the impact of cloud-based services on agriculture, identifying key benefits, challenges, and adoption barriers. By analyzing farmers' awareness, willingness to adopt, and perceived effectiveness of cloud services, the study provides valuable insights for policymakers, technology providers, and agricultural stakeholders to develop farmer-friendly digital solutions and strategies for sustainable agricultural growth.

Literature Review

Johnraja, J. I., et.al., (2024) defined that Smart agriculture, often referred to as precision farming, is a new paradigm that uses the Internet of Things, cloud computing, and machine learning to automate and improve activities. Cloud computing has made it feasible for agriculture to achieve incredible increases in productivity, efficiency, and quality. The advantages, applications, and challenges of using cloud computing in smart farming are thoroughly examined in this abstract. We examine the fundamentals of conventional farming, including its definition, traits, and results, in the first portion of this chapter. Unlike contemporary industrial agriculture, traditional farming uses time-tested methods that have been handed down through the generations. Rather of significantly depending on artificial chemicals and mechanical technology, physical labor, local knowledge, and natural processes used. Traditional farming relies heavily on ecosystems, local communities, and cultures. Crop rotation, polycultures, and the utilization of natural manures are typical characteristics. Its comprehensive and sustainable approach is founded on thousands of years of wisdom, despite criticism that it is less successful than contemporary procedures. Despite the widespread belief that traditional methods are less effective, their sustainable, holistic approach is founded on centuries of experience and provides priceless insights and practices, particularly in light of the present environmental and climatic concerns. There are several ways that cloud computing may be used in "smart farming." Throughout the different phases of smart farming, including data management,

data retrieval, data storage and distribution, real-time data analysis, remote monitoring and control, enhanced decision support systems, and continuous improvement, this chapter describes how to fully utilize cloud computing. Cloud computing has a lot to offer smart farming, but there are still some challenges to be solved. This chapter delves deeply into the issues that are fundamental to digital literacy, data privacy, data quality, and insufficient infrastructure. In an attempt to provide a secure environment for intelligent farming, it also looks at concerns around privacy and vendor lock-in. The scalability and computational overload issues that cloud computing systems face are discussed, along with potential solutions and innovative strategies. The chapter concludes by examining the potential applications of cloud computing in conjunction with smart farming. It talks about possible developments in supply chain management, soil monitoring, and climate forecasting that might improve the effectiveness and flexibility of agricultural operations. Furthermore, in order to create policies and frameworks that support the ethical and responsible use of cloud computing technologies in the agricultural industry, the abstract calls for cooperation between farmers, researchers, and cloud architects. In an attempt to provide a secure environment for intelligent farming, it also looks at concerns around privacy and vendor lock-in. The scalability and computational overload issues that cloud computing systems face are discussed, along with potential solutions and innovative strategies. The chapter concludes by examining the potential applications of cloud computing in conjunction with smart farming. It talks about possible developments in supply chain management, soil monitoring, and climate forecasting that might improve the effectiveness and flexibility of agricultural operations. Furthermore, in order to create policies and frameworks that support the ethical and responsible use of cloud computing technologies in the agricultural industry, the abstract calls for cooperation between farmers, researchers, and cloud architects. This abstract provides a thorough overview of the importance of cloud computing in smart farming. It gives academics, farmers, and decision-makers important insights to fully utilize cloud computing and propel the agricultural sector into a more intelligent, efficient, and sustainable future by shedding light on its uses, difficulties, and possible future paths.

Bissadu, K. D., et.al., (2024) defined those numerous issues plagued the current agricultural methods, which also failed to meet some of the most pressing demands of the expanding population. Food insecurity, the high upfront costs of smart farming, the global scarcity of farm labor, and the economic, social, and political challenges associated with poverty, famines, and climate change, along with Agriculture 4.0's emphasis on technology, necessitate a reconsideration of the agricultural paradigm. Furthermore, the Japanese government's promotion of the concept of Society 5.0 sparked a wide range of responses from governments, academics, researchers, business entities, and politicians. Scholars have recently become interested in the concept of a human-centered society in which people live their lives to the fullest while sharing a common goal of resilience, sustainability, social harmony, and happiness. Numerous scholars looked at the key elements of society 5.0, such as agriculture 5.0. In addition to being used to solve a number of current problems, agriculture 5.0 has the potential to play a significant role in accomplishing the objectives of society 5.0. In order to examine the key factors, enabling cutting-edge technologies, and different possibilities and difficulties for creating, embracing, and implementing Agriculture 5.0, this article employs a methodical literature review methodology. It also emphasized the comprehensive and all-encompassing architectural framework built around the Agriculture 5.0 paradigm's twelve tiers. Even though Agriculture 5.0 holds great promise for increasing mass customisation and opening up new career prospects for the next generation, it will also

likely confront several obstacles. Adapting agricultural production strategies and models to continuously shifting consumer preferences is one of the challenges, along with cybersecurity and privacy issues, standardization issues, and the difficulty of creating an efficient legal, regulatory, and compliance system because of high automation and mass personalization

Research Methodology

3.1 Research Problem

The agricultural sector in India, particularly in rural regions like Gujarat, faces several challenges, including inefficient farming practices, inadequate access to timely information, and lack of market linkages. With the rise of cloud-based services offering innovative solutions such as weather forecasting, soil analysis, crop management, and real-time market price information, there is a growing potential to address these issues and enhance agricultural productivity. However, despite the promise of these services, farmers' perceptions and adoption rates remain varied.

The core research problem revolves around understanding how farmers perceive the impact of cloud-based services on their agricultural activities and what factors influence their willingness to adopt these technologies. Limited awareness, access to digital infrastructure, and financial feasibility are key challenges that may hinder the effective utilization of cloud-based services in agriculture. Additionally, socio-demographic factors such as age, education, income, and gender might significantly shape farmers' perceptions and their ability to leverage these digital tools.

This study aims to explore the perception of farmers regarding the benefits, barriers, and impact of cloud-based services on their farming practices, and identify the socio-demographic variables that affect their engagement with such services. The research seeks to bridge the knowledge gap and provide insights into how to better promote and implement cloud-based solutions for agricultural development.

3.2 Objectives of the Study

The objectives of the study are mentioned below:

- To study the socio-demographic profile of the farmers of the Gujarat State.
- To define the important parameters of the cloud-based services that have been used in the agricultural activities in the Gujarat State.
- To define the significant difference of opinion among the socio-demographic profile of consumers towards the factors that have been received for the cloud-based services for the agricultural sectors in Gujarat State.

3.3 Hypothesis of the Study

Based on the objectives mentioned above, the Hypothesis of the study are mentioned below:

- H0: There is no significant difference of opinion among the gender of farmers towards the factors of cloud-based services for the agricultural sector.
- H0: There is no significant difference of opinion among the age of farmers towards the factors of cloud-based services for the agricultural sector.
- H0: There is no significant difference of opinion among the educational qualification of farmers towards the factors of cloud-based services for the agricultural sector.
- H0: There is no significant difference of opinion among the annual income of farmers towards the factors of cloud-based services for the agricultural sector.

3.4 Variables of the Study

These are the factors that influence farmers' perception and adoption of cloud-based services.

- Awareness and Knowledge: Level of awareness about cloud-based services, digital literacy, participation in training programs.
- Accessibility and Digital Infrastructure: Availability of the internet, mobile penetration, affordability of digital devices, rural connectivity.

- Benefits and Impact on Farming Productivity: Cost of cloud-based services, financial support, government subsidies, return on investment.
- Market Linkages and Supply Chain Efficiency: Expected benefits in farm productivity, efficiency in resource utilization, data-driven decision-making.
- Financial and Economic Feasibility: Expected benefits in farm profitability, efficiency in resource utilization, data-driven decision-making.

3.5 Ethical Consideration of the Study

This study on the perception of farmers towards the impact of cloud-based services on the agricultural sector follows strict ethical guidelines to ensure the rights, privacy, and well-being of participants. Informed consent will be obtained from all farmers before participation, ensuring they are fully aware of the study's purpose and their voluntary involvement. Confidentiality and anonymity will be maintained by securely storing personal data and using anonymized responses in analysis and reporting. The study will ensure that no harm, whether financial, psychological, or social, is caused to the participants, and their daily agricultural activities will not be disrupted. Transparency will be upheld by presenting unbiased findings without any external influence, and participants will have access to summarized results upon request. Cultural sensitivity will be prioritized, respecting local traditions and communicating in the farmers' preferred language. Additionally, responsible data handling measures, including encryption and secure storage, will be implemented to prevent unauthorized access. By adhering to these ethical principles, the study aims to conduct a fair, respectful, and responsible assessment of farmers' perspectives on cloud-based services in agriculture.

3.6 Limitations of the Study

While this study provides valuable insights into the perception of farmers towards the impact of cloud-based services on the agricultural sector, certain limitations must be acknowledged. Firstly, the study is geographically limited to a specific region, which may not fully represent the perspectives of farmers from other areas with different agricultural practices, technological infrastructure, and socio-economic conditions. Secondly, the reliance on self-reported data introduces the possibility of response bias, where farmers may provide socially desirable answers rather than their actual opinions. Thirdly, variations in digital literacy among farmers may influence their understanding and perception of cloud-based services, potentially skewing the results. Additionally, access to reliable internet and digital devices is not uniform across all farming communities, which could limit the applicability of cloud-based services and impact farmers' perceptions. The study also focuses on a specific timeframe, meaning that rapidly evolving technology and policy changes in agricultural digitization may render some findings less relevant in the future. Lastly, external factors such as government policies, climate conditions, and financial constraints affecting technology adoption are not fully controlled in this research. Despite these limitations, the study aims to provide meaningful insights that can contribute to future research and policy development in agricultural technology adoption.

Data Analysis and Interpretations

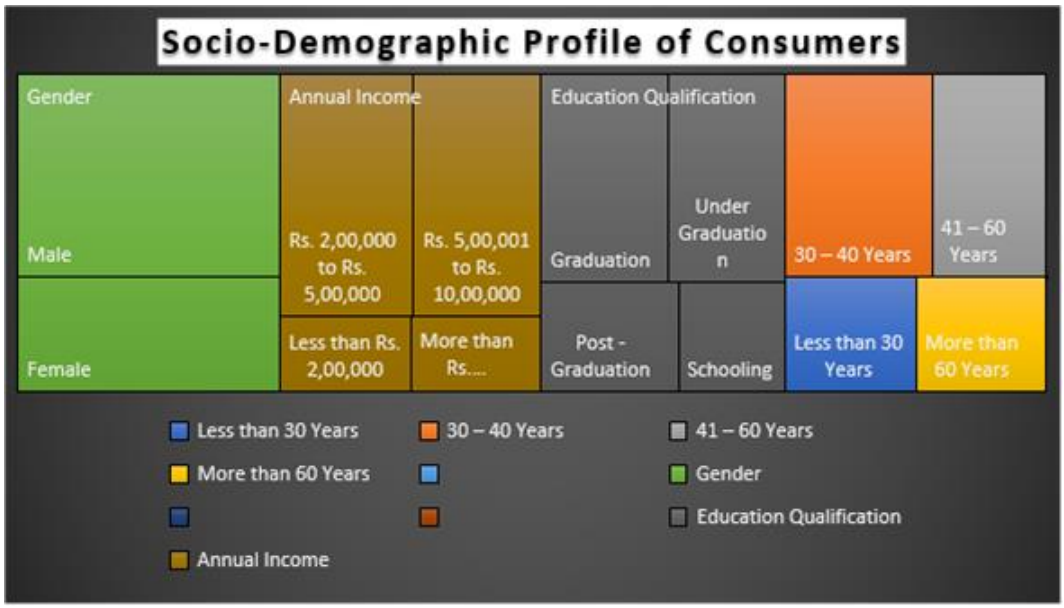
Table 1: Socio-demographic profile of the farmers from the Gujarat State

Socio-Demographic Profile	Frequency	Socio-Demographic Profile	Frequency
Age		**Education Qualification**	
Less than 30 Years	18	Schooling	14
30 – 40 Years	36	Under Graduation	29
41 – 60 Years	28	Graduation	32

Socio-Demographic Profile	Frequency	Socio-Demographic Profile	Frequency
Age		**Education Qualification**	
More than 60 Years	18	Post - Graduation	18
Gender		**Annual Income**	
Male	64	Less than Rs. 2,00,000	12
Female	36	Rs. 2,00,000 to Rs. 5,00,000	39
		Rs. 5,00,001 to Rs. 10,00,000	37
		More than Rs. 10,00,000	12

(Source: Research Output)

Figure 1: Socio-demographic profile off the farmers from the Gujarat State



The socio-demographic profile of farmers in Gujarat State reveals key insights into their age, gender, education, and income distribution. In terms of age, the majority of farmers (36%) belong to the 30–40 years category, followed by 28% in the 41–60 years category, indicating that middle-aged farmers form the dominant group in agricultural activities. Younger farmers (below 30 years) and older farmers (above 60 years) each account for 18%, highlighting a relatively balanced age distribution.

Gender-wise, the agricultural sector in Gujarat is male-dominated, with 64% of the respondents being male and 36% female. This suggests that while women are involved in farming, men still constitute the majority of the farming workforce.

Educational qualification data show that a significant portion of farmers have completed at least basic education, with 32% holding a graduation degree, 29% having an undergraduate degree, and 18% completing post-graduation. However, 14% of farmers have only completed schooling, which may indicate challenges in accessing higher education among rural populations.

Regarding annual income, most farmers (39%) earn between ₹2,00,000 to ₹5,00,000, followed closely by 37% earning between ₹5,00,001 to ₹10,00,000. A smaller proportion (12%) falls in both the lowest income bracket (less than ₹2,00,000) and the highest bracket (more than ₹10,00,000). This distribution reflects income disparities among farmers, possibly

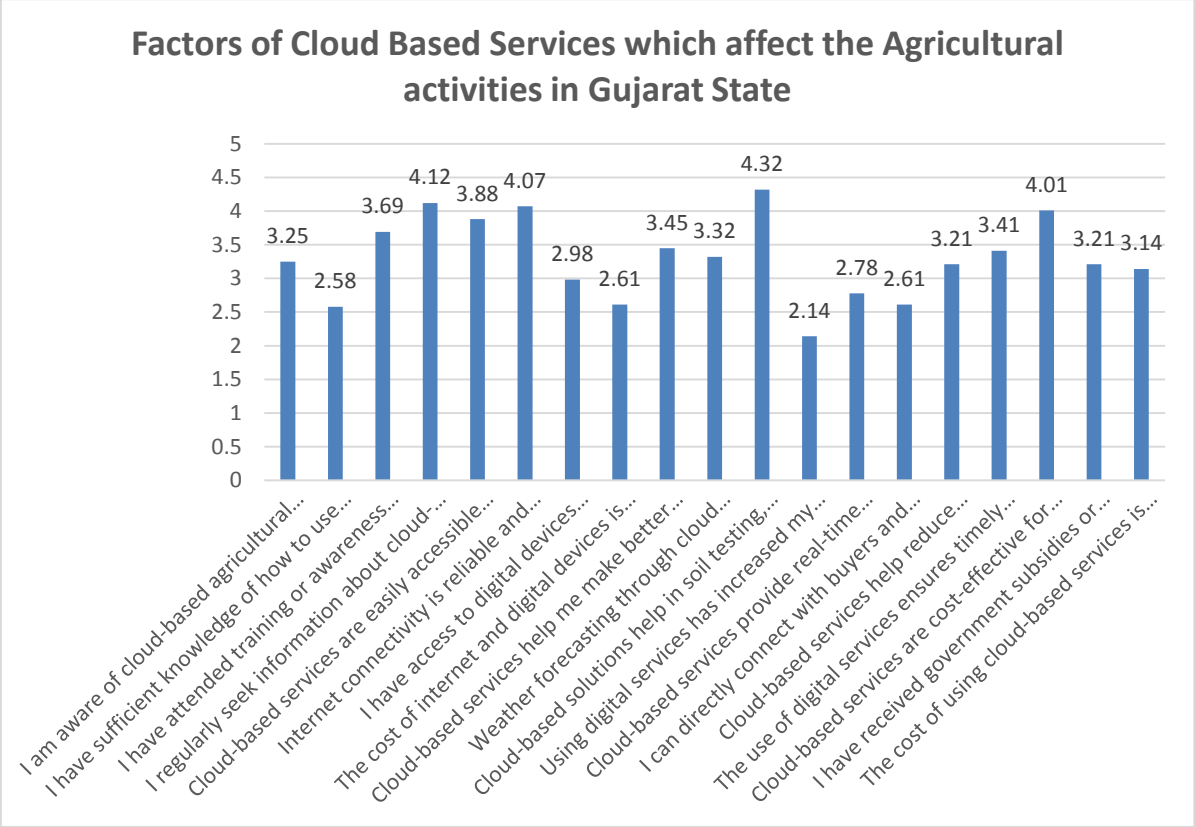
influenced by farm size, crop yields, and access to modern agricultural technology.

Table 2: Factors of Cloud Based Services which affect the Agricultural activities in Gujarat State

Factors of Cloud Based Services	Statements	Mean
Awareness and Knowledge of Cloud-Based Services	I am aware of cloud-based agricultural services and their applications.	3.25
	I have sufficient knowledge of how to use cloud-based services for farming.	2.58
	I have attended training or awareness programs related to digital agriculture.	3.69
	I regularly seek information about cloud-based services for farming improvements.	4.12
Accessibility and Digital Infrastructure	Cloud-based services are easily accessible in my region.	3.88
	Internet connectivity is reliable and sufficient for using cloud-based agricultural services.	4.07
	I have access to digital devices (smartphones, tablets, computers) required to use cloud-based services.	2.98
	The cost of internet and digital devices is affordable for me.	2.61
Benefits and Impact on Farming Productivity	Cloud-based services help me make better farming decisions.	3.45
	Weather forecasting through cloud services improves my agricultural planning.	3.32
	Cloud-based solutions help in soil testing, crop selection, and yield prediction.	4.32
	Using digital services has increased my farm productivity and income.	2.14
Market Linkages and Supply Chain Efficiency	Cloud-based services provide real-time information on market prices.	2.78
	I can directly connect with buyers and suppliers using digital platforms.	2.61
	Cloud-based services help reduce dependence on middlemen for selling agricultural produce.	3.21
	The use of digital services ensures timely access to agricultural inputs (seeds, fertilizers, pesticides).	3.41
Financial and Economic Feasibility	Cloud-based services are cost-effective for small and marginal farmers.	4.01
	I have received government subsidies or support to access digital farming services.	3.21
	The cost of using cloud-based services is justified by the benefits they provide.	3.14

(Source: Research Output)

Figure 2: Factors of Cloud Based Services which affect the Agricultural activities in Gujarat State



(Source: Research Output)

The study analyzes various factors influencing farmers' perceptions of cloud-based services in Gujarat's agricultural sector, focusing on awareness, accessibility, benefits, market linkages, and financial feasibility.

Awareness and Knowledge of Cloud-Based Services: The data suggest a moderate level of awareness among farmers regarding cloud-based agricultural services, with a mean score of 3.25. However, knowledge about their usage is relatively lower (2.58), indicating a need for further education and training. Encouragingly, many farmers have attended training programs (3.69) and actively seek information (4.12), suggesting a growing interest in digital agricultural solutions.

Accessibility and Digital Infrastructure: Farmers generally find cloud-based services accessible (3.88) and report reliable internet connectivity (4.07), which is crucial for the adoption of digital farming solutions. However, access to digital devices remains a challenge (2.98), and affordability of internet services and devices is also a concern (2.61), indicating financial barriers that may hinder widespread adoption.

Benefits and Impact on Farming Productivity: Cloud-based services significantly enhance decision-making in farming (3.45) and improve agricultural planning through weather forecasting (3.32). The highest-rated benefit is soil testing, crop selection, and yield prediction (4.32), which highlights the role of technology in precision agriculture. However, the impact on overall farm productivity and income remains low (2.14), suggesting that while the technology is useful, its direct economic benefits are yet to be fully realized.

Market Linkages and Supply Chain Efficiency: Farmers see moderate benefits in using cloud-based services for real-time market price information (2.78) and direct connections with buyers and suppliers (2.61). Reducing dependency on middlemen (3.21) and ensuring timely access to agricultural inputs (3.41) are also key advantages, though adoption levels remain limited. Strengthening digital market linkages

can further empower farmers and enhance supply chain efficiency.

Financial and Economic Feasibility: The affordability and cost-effectiveness of cloud-based services receive a high rating (4.01), suggesting that many farmers find them economically viable. However, access to government subsidies and support for digital farming is moderately rated (3.21), indicating a need for more financial assistance. Farmers also believe the cost of cloud-based services is justified by their benefits (3.14), reinforcing their potential for long-term sustainability.

Table 3: Significant difference of opinion among the socio-demographic profile of the farmers towards the cloud-based agriculture activities

Socio-Demographic Factors * Factors of Cloud-based Services on Agriculture	Chi-Square	P Value	Sig Difference or Not
Awareness and Knowledge of Cloud-Based Services * Age	9.577	0.045*	Sig Difference
Accessibility and Digital Infrastructure * Age	0.247	0.102	No Sig Difference
Benefits and Impact on Farming Productivity * Age	11.541	0.000*	Sig Difference
Market Linkages and Supply Chain Efficiency * Age	12.657	0.002*	Sig Difference
Financial and Economic Feasibility * Age	13.579	0.000*	Sig Difference
Awareness and Knowledge of Cloud-Based Services * Educational Qualification	22.512	0.000*	Sig Difference
Accessibility and Digital Infrastructure * Educational Qualification	0.978	0.200	No Sig Difference
Benefits and Impact on Farming Productivity * Educational Qualification	11.678	0.001*	Sig Difference
Market Linkages and Supply Chain Efficiency * Educational Qualification	13.647	0.000*	Sig Difference
Financial and Economic Feasibility * Educational Qualification	25.214	0.002*	Sig Difference
Awareness and Knowledge of Cloud-Based Services * Gender	22.674	0.003*	Sig Difference
Accessibility and Digital Infrastructure * Gender	0.798	0.648	No Sig Difference
Benefits and Impact on Farming Productivity * Gender	21.541	0.000*	Sig Difference
Market Linkages and Supply Chain Efficiency * Gender	20.258	0.000*	Sig Difference
Financial and Economic Feasibility * Gender	25.364	0.000*	Sig Difference
Awareness and Knowledge of Cloud-Based Services * Annual Income	18.789	0.000*	Sig Difference
Accessibility and Digital Infrastructure * Annual Income	0.614	0.879	No Sig Difference
Benefits and Impact on Farming Productivity * Annual Income	16.654	0.000*	Sig Difference
Market Linkages and Supply Chain Efficiency * Annual Income	16.689	0.000*	Sig Difference
Financial and Economic Feasibility * Annual Income	12.654	0.002*	Sig Difference

(Source: Research Output)

Findings, Conclusions and Suggestions of the Study

Data highlighted a predominantly male, middle-aged farming population with varying levels of education and income, emphasizing the need for targeted agricultural policies and technological interventions to support farmers across different demographics. In terms of the most important factors for the measuring the perception of farmers of Gujarat State towards the

cloud-based services, while awareness and accessibility of cloud-based services in Gujarat's agricultural sector are growing, challenges related to affordability, device availability, and direct financial benefits persist. Training initiatives, government support, and enhanced digital market linkages can improve adoption rates, ultimately enhancing agricultural productivity and economic outcomes for farmers.

While considering the significant difference of opinion towards the socio-demographic profile for the measuring the impact of cloud-based computing, it had been found that the study indicates that socio-demographic factors such as age, education, gender, and income levels significantly influence farmers' perceptions of cloud-based agricultural services. Younger, more educated, higher-income, and male farmers are more likely to recognize the benefits of digital farming solutions. However, accessibility is perceived uniformly across all demographics. These findings highlight the need for targeted interventions, including subsidized access to technology, financial incentives, and customized training programs to bridge gaps in awareness and adoption of cloud-based agricultural services among different farmer groups.

References

[1]. Tomičić-Pupek, K., Pihir, I., & Furjan, M. T. (2020, September). The role of perception in the adoption of digital platforms in agriculture. In 2020 43rd International Convention on Information, Communication and Electronic Technology (MIPRO) (pp. 1429-1434). IEEE.

[2]. Bolfe, É. L., Jorge, L. A. D. C., Sanches, I. D. A., Luchiari Júnior, A., da Costa, C. C., Victoria, D. D. C., ... & Ramirez, A. R. (2020). Precision and digital agriculture: Adoption of technologies and perception of Brazilian farmers. Agriculture, 10(12), 653.

[3]. Symeonaki, E. G., Arvanitis, K. G., & Piromalis, D. D. (2019). Cloud computing for IoT applications in climate-smart agriculture: A review on the trends and challenges toward sustainability. In Innovative Approaches and Applications for Sustainable Rural Development: 8th International Conference, HAICTA 2017, Chania, Crete, Greece, September 21-24, 2017, Selected Papers 8 (pp. 147-167). Springer International Publishing.

[4]. Vrain, E., & Lovett, A. (2020). Using word clouds to present farmers' perceptions of advisory services on pollution mitigation measures. Journal of Environmental Planning and Management, 63(6), 1132-1149.

[5]. Lin, Y. C., & Lin, Y. T. (2025). The Effectiveness of Developing Cloud-Based Agricultural Environmental Sensing System to Support Food and Agriculture Education in Elementary School. International Journal of Information and Education Technology, 15(1).

[6]. Beza, E., Reidsma, P., Poortvliet, P. M., Belay, M. M., Bijen, B. S., & Kooistra, L. (2018). Exploring farmers' intentions to adopt mobile Short Message Service (SMS) for citizen science in agriculture. Computers and Electronics in Agriculture, 151, 295-310.

[7]. Kalyani, Y., & Collier, R. (2021). A systematic survey on the role of cloud, fog, and edge computing combination in smart agriculture. Sensors, 21(17), 5922.

[8]. Das V, J., Sharma, S., & Kaushik, A. (2019). Views of Irish farmers on smart farming technologies: An observational study. AgriEngineering, 1(2), 164-187.

[9]. Patel, S., Desai, R., & Soni, K. (2024). Unveiling the drivers of green loan disclosures: a study of financial and governance determinants. Journal of Financial Regulation and Compliance, 32(5), 699-725.

[10]. Borrero, J. D., & Mariscal, J. (2022). A case study of a digital data platform for the agricultural sector: A valuable decision support

system for small farmers. Agriculture, 12(6), 767.

[11]. Saidu, A., Clarkson, A. M., Adamu, S. H., Mohammed, M., & Jibo, I. (2017). Application of ICT in agriculture: Opportunities and challenges in developing countries. International Journal of Computer Science and Mathematical Theory, 3(1), 8-18.

[12]. Johnraja, J. I., Leelipushpam, P. G. J., Shirley, C. P., & Princess, P. J. B. (2024). Impact of cloud computing on the future of smart farming. In Intelligent Robots and Drones for Precision Agriculture (pp. 391-420). Cham: Springer Nature Switzerland.

[13]. Linsner, S., Kuntke, F., Steinbrink, E., Franken, J., & Reuter, C. (2021). The role of privacy in digitalization–analyzing perspectives of German farmers. Proceedings on Privacy Enhancing Technologies.

[14]. Javaid, M., Haleem, A., Singh, R. P., & Suman, R. (2022). Enhancing smart farming through the applications of Agriculture 4.0 technologies. International Journal of Intelligent Networks, 3, 150-164.

[15]. Srikanth Yerra, "The Role of Azure Data Lake in Scalable and High-Performance Supply Chain Analytics," International Journal of Scientific Research in Computer Science Engineering and Information Technology, vol. 11, no. 1, pp. 3668–3673, Feb. 2025, doi: https://doi.org/10.32628/cseit25112483.

[16]. Farooq, M. S., Riaz, S., Abid, A., Abid, K., & Naeem, M. A. (2019). A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming. Ieee Access, 7, 156237-156271.

[17]. Caffaro, F., Cremasco, M. M., Roccato, M., & Cavallo, E. (2020). Drivers of farmers' intention to adopt technological innovations in Italy: The role of information sources, perceived usefulness, and perceived ease of use. Journal of Rural Studies, 76, 264-271.

[18]. Huo, D., Malik, A. W., Ravana, S. D., Rahman, A. U., & Ahmedy, I. (2024). Mapping smart farming: Addressing agricultural challenges in data-driven era. Renewable and Sustainable Energy Reviews, 189, 113858.

[19]. Gupta, M., Abdelsalam, M., Khorsandroo, S., & Mittal, S. (2020). Security and privacy in smart farming: Challenges and opportunities. IEEE access, 8, 34564-34584.

[20]. Derashri, P. D., Soni, M. K., Pandya, S., & Gupt, C. S. (2020). A study on integration of usefulness and challenges for implementing ICT with mediating effect of advantages for higher education in India. PalArch's Journal of Archaeology of Egypt/Egyptology, 17(7), 7115-7129.

[21]. Boursianis, A. D., Papadopoulou, M. S., Diamantoulakis, P., Liopa-Tsakalidi, A., Barouchas, P., Salahas, G., ... & Goudos, S. K. (2022). Internet of things (IoT) and agricultural unmanned aerial vehicles (UAVs) in smart farming: A comprehensive review. Internet of Things, 18, 100187.

[22]. c. Society 5.0 enabled agriculture: Drivers, enabling technologies, architectures, opportunities, and challenges. Information Processing in Agriculture.