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Analysis and Prioritization of Constraints Affecting ICT Tools Adoption among KVK Personnel

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HIGHLIGHTS

- Insufficient training was the most severe constraint affecting ICT adoption among KVK personnel.
- Technical, economic, and infrastructural issues significantly influenced ICT utilization in extension services.
- Capacity building and technical support are essential for improving ICT adoption efficiency.

ARTICLE INFO

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ABSTRACT

Information and communication technology (ICT) emerged as a crucial instrument for enhancing the dissemination of information and bolstering agricultural extension services. The current study was conducted in 2025–2026 with the aim of identifying and ranking the constraints to the adoption of ICT technologies that Krishi Vigyan Kendra (KVK) staff at Acharya Narendra Deva University of Agriculture and Technology, Uttar Pradesh, faced. Using a multi-stage sample process and an ex post facto study approach, 142 KVK employees were chosen. A structured interview schedule was used to gather data, and the Garrett ranking method was used for analysis. The results showed that the lack of training opportunities was the biggest constraint, followed by psychological constraints and a lack of technical know-how. Other significant constraints included frequent technical changes, expensive maintenance costs for ICT tools, and software-related problems. However, limitations pertaining to data privacy, interoperability, and intellectual property rights were seen as less serious. The study emphasized the necessity of better infrastructure, increased technical assistance, and capacity-building programs to guarantee extension staff members' efficient use of ICT tools.

INTRODUCTION

Agricultural extension is undergoing a significant transformation with the integration of Information and Communication Technology (ICT). ICT has emerged as a powerful tool for enhancing information dissemination and strengthening decision-making among stakeholders. It facilitates effective communication through digital platforms such as mobile phones, internet services, and software applications, thereby bridging the gap between research and farmers (Mukherjee & Jha, 2024). As a result, extension services have become more responsive, demand-driven, and accessible, contributing to improved agricultural productivity and rural livelihoods. ICT's involvement in agricultural growth has grown significantly in recent years because of its capacity to give farmers fast, location-specific information. By facilitating knowledge exchange between researchers, extension staff, and farming communities, ICT tools improve the overall effectiveness of extension services (Satapathy et al., 2024a). The need for training of extension officers in the deficient areas was well highlighted by

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Paul et al. (2015). Furthermore, ICT has made it possible to provide real-time communication, online training courses, and digital advisory services all of which are crucial to contemporary agriculture. Despite its promise, several barriers affect how ICT technologies are adopted and used in agriculture. ICT adoption is greatly impacted by technical, economic, and social variables, such as ignorance, poor infrastructure, and restricted access to support services, according to studies (Satapathy et al., 2024b). In the same way, the degree to which extension workers use ICT is greatly influenced by elements including training, organizational culture, and the accessibility of ICT services (Shashidhara, 2020). Furthermore, the efficient use of ICT tools is still hampered by a lack of experience and insufficient abilities. Krishi Vigyan Kendras (KVKs) are the front-line extension system in India that disseminates agricultural innovations and develops farmer capacity. The role of scientific staff in KVK is very crucial, vital and multifarious to address and support farmers in their decision process enabling them to achieve their goals of higher farm income (Sinha et al., 2021). The proficiency and technological preparedness of extension staff play a major role in the efficient operation of KVKs. However, the effective use of ICT tools in extension efforts is limited by a number of factors, including lack of training, technical challenges, infrastructure limits, and workload issues. Furthermore, research has shown that ICT use in extension is still uneven, necessitating systematic measures to improve its efficacy (Haqyar et al., 2025). While several studies have looked at ICT accessibility and usage. However, limited studies have systematically identified and prioritized the constraints faced specifically by KVK personnel. Most existing studies report constraints without ranking their severity. Therefore, this study aims to fill this gap by identifying and prioritizing constraints affecting ICT tools adoption among KVK personnel.

METHODOLOGY

The study was conducted using an ex-post facto research design, as the variables under investigation had already occurred and were beyond the control of the researcher (Kerlinger, 1964). The study was carried out among Krishi Vigyan Kendra (KVK) personnel working under the jurisdiction of Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, Uttar Pradesh. A multi-stage sampling technique was followed for the selection of respondents (Cochran, 1977). In the first stage, KVKs under ANDUAT were selected purposively based on their active involvement in extension activities and ICT-based advisory services, ensuring that respondents had relevant experience with ICT tools. In the second stage, KVK personnel including Subject Matter Specialists, Programme Assistants, and other extension staff were selected, as they were directly involved in the use of ICT tools for agricultural communication. A total of 142 respondents were included in the study, ensuring representation of different categories of extension personnel. The sample size was determined using the formula suggested by Cochran (1977): $n = (Z^2 \times p \times q) / e^2$, where: n = sample size, Z = 1.96 (95% confidence level), p = 0.5, q = 1 – p, e = 0.05, Based on this, the sample size was calculated and 142 respondents were selected. Data were collected through personal interviews using a well-structured and pre-tested interview schedule, ensuring that respondents had relevant experience with ICT tools. The schedule included various constraints related to the adoption and utilization of ICT tools. The constraints were identified through review of literature, expert consultation, and discussion with KVK personnel. A total of 15 constraints were considered, covering infrastructural, technical, economic, institutional, and personal aspects. The constraints were examined and ranked using the Garrett ranking method (Garrett and Woodworth, 1969). The discovered restrictions were ranked by the respondents according to their severity. The following formula was used to convert the ranks into percent position: Percent Position = $100 (Rb_{ij} - 0.5) / N_j$, where N_j represented the total number of constraints ranked and R_{ij} represented the rank given for the i^{th} constraint by the j^{th} respondent. The Garrett conversion table was used to translate the % positions into Garrett scores. Each constraint's mean score was determined and arranged in descending order. Further, suggestions provided by the respondents to overcome the constraints were compiled and analyzed using frequency and percentage, and ranked accordingly. These statistical tools were used to summarize and interpret the data in a simple and meaningful manner, facilitating clear understanding of the major constraints and suggested measures.

RESULTS

The Garrett ranking technique was used to identify and prioritize the constraints affecting ICT adoption among KVK personnel (Table 1). The results indicate that insufficient training opportunities was the most severe constraint, highlighting the critical need for capacity-building initiatives. This was followed by physiological constraints and limited technical knowledge, suggesting that both human and skill-related factors significantly influence ICT utilization. Among technical constraints, software and virus-related problems and high repair costs of ICT tools were found to be major barriers. In addition, frequent technological updates also posed challenges, indicating difficulties in adapting to rapidly changing digital tools. Moderate constraints included high cost of devices and services**,** poor infrastructure and connectivity, and limited competence in handling ICT tools. In contrast, institutional and policy-related constraints, such as lack of resources, administrative workload, data privacy concerns, interoperability issues, and intellectual property concerns, were perceived as less severe. Overall, the findings reveal that training, technical, and individual-level constraints are more critical compared to institutional and policy-related issues in influencing ICT adoption among KVK personnel.

DISCUSSION

The results of the Garrett Ranking technique provide important insights into the constraints affecting ICT adoption among KVK personnel. The findings clearly indicate that lack of training is the most critical barrier, reflecting inadequate exposure and limited opportunities for ICT-oriented capacity building among extension staff. As reported by Kale et al. (2017), lack of training facilities is a major constraint among KVK scientists, while Agwu and Ogbonnah (2014) also emphasized that inadequate training and technical expertise significantly hinder ICT utilization. Similarly,

Table 1. Garrett Ranking of Constraints in the Adoption of ICT Tools among KVK Personnel

S.No.	Statements	Percent Position	Garrett Value	Garret Score	Rank
1	Inadequate infrastructure and poor connectivity limit effective use.	56.67	47	21.51	IX
2	Insufficient training opportunities restrict skill development.	03.33	85	75.42	I
3	Limited technical knowledge reduces confidence in use.	16.67	69	50.53	III
4	The high cost of devices and services discourages adoption.	50.00	50	25.35	VIII
5	Physiological Constraints	10.00	75	61.79	II
6	Lack of institutional and financial resources.	70.00	40	15.49	XI
7	Problem of software and viruses.	23.33	65	44.40	IV
8.	Competence in handling ICT tools.	63.33	43	17.86	X
9.	Excessive usage of ICT tools has affected socialising with family and friends.	43.33	53	30.97	VII
10.	High cost of repairing ICT tools.	30.00	60	38.45	V
11.	Concerns regarding data privacy and security discourage users from adopting ICT tools.	83.33	31	08.95	XIII
12.	Frequent technological updates and rapidly changing digital platforms create difficulties in continuous adoption.	36.67	57	35.72	VI
13.	Heavy administrative workload reduce he time available for effectively utilising ICT tools in research and extension activities.	76.67	36	11.40	XII
14.	Lack of interoperability between different ICT systems and database limits efficient information exchange.	90.00	25	06.16	XIV
15.	Concerns about intellectual property rights while sharing digital research outputs discourage ICT based collaboration.	96.67	15	02.95	XV

Meera et al. (2004) highlighted that skill development plays a crucial role in successful ICT integration. These findings suggest that training remains a fundamental requirement for enhancing digital competencies in extension systems. The prominence of physiological constraints further indicates that prolonged use of ICT tools may lead to discomfort, fatigue, and reduced productivity. Although limited research is available in agricultural extension, similar patterns have been observed in broader digital work environments. In addition, the constraint related to limited technical knowledge emphasizes the importance of digital literacy in ensuring effective adoption. Hashemi et al. (2014) found that technical proficiency significantly influences ICT usage, while Mittal and Mehar (2016) and Panda et al., (2019) reported that lack of digital skills remains a major barrier among agricultural stakeholders. These findings indicate that ICT adoption is not merely a technical issue but also a human-centric challenge involving behavioral and capacity-related dimensions. Technical constraints such as software issues, virus risks, poor connectivity, and frequent technological updates were also identified as significant barriers. Klerkx et al. (2019) emphasized that digital agriculture requires continuous learning due to rapidly evolving technologies, which supports the present findings. Similarly, Arokoyo (2005) reported that inadequate infrastructure and poor connectivity are major obstacles to ICT use in extension services. These results highlight the dynamic and complex nature of ICT tools and the need for continuous adaptation. Financial and infrastructural limitations, including the high cost of ICT tools, maintenance expenses, and inadequate connectivity, were also found to hinder adoption. Aker (2011) observed that financial and infrastructural barriers significantly influence ICT usage in developing countries. Likewise, Frempong et al. (2006) and Singh et al. (2015) reported that high costs and inadequate infrastructure restrict the effective use of ICT tools in agricultural extension. These findings indicate that economic constraints continue to limit ICT accessibility and utilization. Furthermore, institutional constraints such as heavy administrative workload and lack of organizational support were found to reduce the effective utilization of ICT tools. Kumar et al. (2018) highlighted those institutional barriers, including workload and lack of support, hinder ICT adoption among extension personnel. Davis and Franzel (2018) also emphasized the importance of supportive work environments for effective extension services. In addition, psychological and social constraints, such as reduced social interaction and health concerns due to excessive ICT use, indicate emerging challenges associated with digital work environments, as also noted by Sharma (2018). Overall, the study indicates that ICT adoption among KVK personnel is influenced by a combination of training, technical, financial, infrastructural, and institutional factors. The findings emphasize the need for a comprehensive and integrated approach that focuses on capacity building, continuous technical support, infrastructure development, and strengthening institutional mechanisms. Such an approach is essential to enhance the effectiveness of ICT-enabled agricultural extension services. The consistency of these findings with previous research further strengthens the validity of the study.

CONCLUSION

The research investigation found that a number of problems, mostly related to training, technical expertise, and physiological constraints, hindered KVK employees' adoption and efficient use of ICT technologies. The most important limitation was found to be a lack of training opportunities, highlighting the necessity of ongoing capacity-building initiatives. ICT use was further limited by a lack of technical expertise and problems with software, upkeep, and rapid technological modifications. Adoption was also somewhat impacted by infrastructure limits and financial restrictions such the expensive cost of devices and repairs. Constraints relating to institutions and policies, however, were seen as less serious. The

results indicate that ICT adoption can be greatly increased by bolstering training initiatives, upgrading technical support systems, and boosting infrastructure. A coordinated and systematic approach is essential to enhance the efficiency of ICT-enabled agricultural extension services among KVK personnel.

DECLARATIONS

Ethical approval and consent to participate: Informed consent was obtained from all respondents prior to data collection.

Consent for publication: All participants provided their consent for the publication of the data included in this study.

Competing interests: The authors declare that they have no competing interests.

Conflict of interest: The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have critically reviewed, revised, and approved the manuscript and take full responsibility for its content.

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