"Cyber Agriculture Extension in Northeast Region of India – A Case Study"

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ABSTRACT

The study, which was carried out in the Indian state of Assam in 2023–2024, used the Technology Acceptance Model framework to assess perceptions of cyber extension in agriculture. The study's sample consisted of 86 Subject Matter Specialists (SMSs) who were chosen by a purposive approach from 23 Assamese Krishi Vigyan Kendras (KVKs). Nearly half were middle-aged (31–35 years), and 53.5% had postgraduate degrees, according to demographic data. Moreover, over half had worked for two to seven years, and the majority (74%) had good organizational support in their Assamese KVK. The majority of them (62.8%) demonstrated proficiency in digital abilities, whereas the same percentage (50%) were found to be less knowledgeable and knowledgeable about cyber agricultural extension technologies. Cyber agricultural extension was generally viewed favorably by the majority of respondents (79%) to the research. With respect to Technology Acceptance Model constructs, a significant majority of respondents (72.09% to 63.95%) thought that cyber agricultural extension was helpful and simple to use, respectively. The findings show a moderate level of knowledge and generally positive perceptions of cyber extension, with KVKs of Assam SMSs acknowledging its potential to improve decision support, real-time problem-solving, and farmer outreach. Language obstacles, a lack of technical skills, a lack of digital infrastructure, and opposition to change—particularly in remote and tribal areas—were some of the limitations that were noted. The study recommends the need for institutional support, localized digital solutions, and capacity-building programs. Policymakers, academics, and extension organizations working to close the digital divide in India's agricultural sector would find this research useful as it provides a region-specific analysis within the larger conversation on digital agriculture.

Key words: Cyber Agricultural Extension, Krishi Vigyan Kendra, Northeast region, Assam, Technology Acceptance Model(TAM)

INTRODUCTION

Cyber extension is a cutting-edge strategy that enhances productivity, sustainability, and rural development by fusing traditional agricultural practices with the power of information and communication technology (ICTs). It entails utilizing ICT to improve information availability for farmers, extension agents, researchers, and extension managers via a variety of digital platforms, including as social media, mobile devices, and the Internet.

Cyber-agriculture

The cyber-agricultural extension allows agricultural information to be shared virtually over cyber-space, which is comprised of linked computer networks connected by communication channels. By providing farmers with information and services via a variety of digital platforms, such as the Internet, social media, and mobile phones, this approach aims to address the shortcomings of conventional extension techniques.

This approach uses a variety of digital platforms, including as the Internet, social media, and mobile phones, to provide farmers with information and services in an effort to address the shortcomings of conventional extension

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techniques. In addition to increasing the effectiveness, efficiency, and reach of extension services, cyber extension may support livelihood, sustainability, and agricultural productivity.

Gaining access to digital technologies in rural areas, building farmers' and extension workers' manpower resources, funding computer software development projects, and encouraging and fortifying collaborations between public, private, and farmer organizations are all necessary for the success of cyber agricultural extension.

Krishi Vigyan Kendra (KVK) and Cyber Agricultural Extension

The Indian Council of Agricultural Research established KVKs, which are agricultural extension institutions in India. These hubs facilitate the exchange of agricultural technologies and expertise between government agencies, research institutes, and farmers. Utilizing agricultural extension to embrace cyber extension technology and improve communication with farmers, 721 KVK are dispersed throughout India.

Cyber extension is a potent instrument for information dissemination and last-mile outreach. Research has indicated that in Punjab, India, internet extension can greatly increase farmers' awareness and the adoption of better farming practices. KVK may play a crucial role in the growth of cyber extension in India as they give farmers access to ICTs, train them in their usage, and create and distribute cyber extension content.

Of the 26 KVKs in Assam State, 23 are managed by the Assam Agricultural University in Jorhat, two are run by the ICAR-Agricultural Technology Application Research Institute (ICAR-ATARI), and one is run by non-governmental organizations. Nonetheless, Assam has difficulties, such as restricted access to resources, modern agricultural expertise, and methods in its isolated regions. Thus, research questions are raised about how KVK professionals in Assam currently use cyber extension, how easy they think it is to use, how useful they think it is for agriculture, how they feel about using it, what problems they see with it, and how KVK can improve cyber agriculture. Thus, the research study on "Perceptions of KVK professionals towards cyber agricultural extension in Assam State" was undertaken by the researcher.

REVIEW OF LITERATURE

This study, reviews the conceptual and empirical literature on cyber agricultural extension, focusing on its applications, challenges, and concerns faced by extension workers.

Rathore and Sumanth (2021) argue that cyber extension tools are a valuable substitute for face-to-face interactions in rural India, facilitating efficient communication between scientists, extension agents, and farmers. The proliferation of Information and Communication Technologies (ICTs) has made it possible to access additional options even in difficult and isolated locations. Digital technologies can educate and connect millions of farm families, improving the quality of life for farmers. Hettige (2015) highlights the significance of cyber extension for sharing agricultural knowledge, promoting computer literacy, building communities, staying updated on market trends, predicting agricultural issues, and investigating new business opportunities. E-extension offers global understanding, discussion groups, professional advice, cultural awareness, and lifelong learning. Saravanan et al. (2017) emphasize the importance of social media in agriculture, bridging the communication gap between farmers and extension personnel.

A study by James, Shivamurthy, Lakshmi Narayan, et al. (2020) found that a majority of agricultural scientists believe social media plays a significant role in agricultural development. However, issues such as inadequate internet access, lack of credibility, and time constraints hinder the integration of social media with agricultural development. Matthews and Jadav (2020) explored the use of Information and Communication Technologies (ICTs) in agriculture, finding that 55% of extension staff used ICT to a medium extent. KVK Pathanamthitta, Kerala, uses ICT to provide farmers and extension agents with agricultural technologies quickly. Saxena et al. (2011) examined the perception of Knowledge Management Systems (KMS) and Short Message Service (SMS) among the farming community, finding that SMS delivery was appropriate in timing and context, helping farmers stay alert, save time and money during crop cultivation, and enhance social contact and credibility. The study highlights the positive perception of SMS among farmers, extension personnel, seed growers, and agri-input

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dealers, emphasizing its role in timely information delivery, saving time and resources, enhancing social contact and credibility, and contributing to the development of an information bank.

To sum, reviews of literature highlights that the extension workers in agriculture are increasingly using cyber extension for improved information access. However, challenges such as limited internet connectivity, technical know-how, high costs of ICT devices, and lack of organizational support hinder its adoption. Skill development initiatives are crucial to bridge these gaps. Despite ICT availability, traditional communication methods remain preferred. Addressing these research gaps can help develop a more comprehensive understanding of the variables affecting the adoption of cyber extension in agricultural environments.

Objectives of the study

1) To prepare the profile of selected Krishi Vigyan Kendra (KVK) professionals in Assam.

2) To study the overall and variablewise perceptions of the selected professionals of KVK towards cyber agricultural extension in Assam regarding the following variables:

    a. Age

    b. Educational qualification

    c. Work experiences.

    d. Organizational support

    e. Digital competency

3) To study the differences in overall perceptions of the selected professionals of KVK towards cyber agricultural extension in Assam about the selected variables.

4) To assess perceptions of selected professionals of KVK towards cyber agricultural extension in Assam about each of the constructs of the Technology Acceptance Model (TAM), viz., (a) ease of use and (b) usefulness.

5) To assess, perceptions of selected professionals of KVK towards cyber agricultural extension in Assam with reference to each of the Technology Acceptance Model (TAM) constructs, with the above-selected variables.

6) To obtain suggestions from selected KVK professionals to promote the cyber agricultural extension in Assam.

Null hypothesis of the study –

There will be no significant differences in the overall perceptions of the selected KVK professionals towards cyber agricultural extension in Assam with the selected variables.

MATERIALS AND METHOS

With the ever-changing landscape of cyber-agriculture extension tools, the TAM model was used to understand KVK professionals' perspectives on the convenience and usefulness of incorporating cyber tools into their agriculture work.

Population of the study

This study's population includes Subject Matter Specialists (SMS) from all 26 Krishi Vigyan Kendras in Assam managed by ICAR, SAU, and NGOs during the years 2023-24.

Sample of the study

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The study's sample comprised a total of eighty-six SMS from each of the selected 23 KVK, which are administratively run by the State Agriculture University of Assam only.

Construction of the research tool

The researcher developed a structured questionnaire in English to assess SMS perceptions of cyber-agricultural extension. The questionnaire, based on pilot results and relevant literature, included questions about demographics, the uses of cyber agricultural extension tools, a knowledge assessment, a digital competency scale, perceptions measures, and an attitude scale. Additionally, a Google Form was created for data collection.

Validity, Reliability and Pre-testing of the Research Tools

The research tool was validated by seven experts, and expert feedback was used to evaluate the tool's effectiveness in terms of relevance, logical order, language use, and response system, resulting in necessary modifications.

The Cronbach's Alpha coefficient test was used to determine the research tool's reliability which demonstrated high internal consistency ($\alpha = 0.848$), indicating tool was reliable, significant, and suitable for further research.

The questionnaire was pre-tested with ten subject matter experts from various KVKs to assess language clarity and determine the time required to complete the survey. To improve simplicity and comprehension, complex or ambiguous terms were removed. Participants took an average of 12-15 minutes to complete the research tool.

Ethical approval by the IECHR Committee

The study received ethical approval from the IECHR committee on October 13th, 2023, and was assigned the number IECHR/FCSc/M.Sc./10/2023/11.

Procedure for Data Collection

Between November 2023 and January 2024, the research tool, a questionnaire, was distributed to the selected 107 SMS via a variety of methods, including in-person meetings, speed post, email, Google Form, and WhatsApp. Data was collected both in person and online using Google Forms, with the form link shared via email and WhatsApp.

Data were calculated using descriptive and inferential statistics.

RESULTS AND DISCUSSION

1) Profile of the respondents

The majority of the Subject Matter Specialists (SMS) at KVK, Assam (49%) were in the age range of 31 to 35. Of them, just over half (53.5%) have a postgraduate degree. The majority (57%) have worked at KVK for two to seven years, which is considered modest work experience. The vast majority of respondents (74%) said they had received sufficient organizational support for agricultural extension through cyberspace. Digital competency was shown by the majority (62.8%), while 37.2% showed less proficiency.

50% of respondents are familiar of cyber tools used in agricultural extension efforts, while 50% are not. This indicates an equitable distribution of knowledge.

2) Overall perceptions of the respondents towards Cyber Agricultural Extension

The vast majority of respondents (79%) had a favorable perception of cyber agricultural extension technologies, whereas just 20.9% expressed a negative persption.
Variable-wise, people with middle-aged age (34.88%), educated SMS (40.69%), moderate experience (44.18%),

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sufficient organizational support (58.13%), and digital competency (48.83%) had favorable perceptions about these tools, irrespective of their level of expertise (39.53%).

Overall perceptions were not significantly different according to age, educational background, job experience, organizational support, digital proficiency, or cyber-agricultural extension knowledge. However, comparable results also showed that a large majority of respondents had generally favorable perceptions about the instruments used for cyber agricultural extension. Therefore, it may be concluded that most respondents had favorable opinions on the application of technology in agriculture. Additionally, it may be concluded that KVK's readiness SMS in Assam indicates their willingness to embrace agricultural innovations and new technology.

In today's digital world, technology is so pervasive that it is now regarded as essential in many different fields. This trend is further supported by research findings that indicate agricultural scientists from KVK in Rajasthan and Gujarat have positive opinions about ICT and cyber extension, as reported in a study by Kale (2015b). It suggests a generally favorable perspective among the respondents on the use of technology in agriculture, suggesting a favorable environment for its incorporation in KVK throughout Assam. To address these issues, KVK of Assam can invest in digital literacy for extension staff, promote collaboration, and tailor training programs on behavior change communication. Problems with adoption must be resolved, and more research must be done, in order to maximize the advantages of technology in agricultural extension and innovation.

The variable-wise overall perceptions showed that middle-aged respondents had a more favorable perception of cyber agricultural extension than older (>35 years) respondents. This suggests that age may influence favorable perceptions of agricultural technology advancements. Both types of educational qualifications nearly equally indicated favorable perceptions in the context of education, demonstrating the universality of positive perspectives toward cyber-agricultural extension among SMS of KVK, Assam with different degrees of academic background. Additionally, those with modest job experience had positive perceptions, which may be explained by a connection between their professional expertise and exposure to contemporary technology-based educational systems, which could encourage a positive tendency to adopt technology. Nearly all of the respondents who stated that they got sufficient organizational support had a favorable perception on cyber agricultural extension. This suggests that while accepting and using contemporary technology, KVK professionals—especially SMS in agricultural extension services—place a great priority on the support and resources provided by their employers. In contrast, respondents who were digitally competent had a favorable perception of cyber agricultural extension, according to the digital competence variable. This indicates that these knowledgeable cohorts were able to see the possible advantages of utilizing technology in agriculture. Regarding the cyber agricultural extension knowledge variable, respondents in the less-knowledgeable and knowledgeable groups expressed an equal percentage of a favorable perception of cyber agricultural extension.

The respondents' overall perceptions about cyber agricultural extension in KVK, Assam, did not significantly differ according to their age, level of education, work history, organizational support, digital competency, or familiarity with cyber agricultural extension tools. Therefore, it can be inferred from the above findings that those who are young, middle-aged, or older, educated or highly educated, experienced or less experienced, have inadequate or adequate organization support, or know little or nothing about cyber agricultural extension tools all have a similar perception of the potential efficacy and usefulness of cyber agricultural extension for expanding the country's agricultural aspect. The relevant null hypotheses, which claimed that there were no appreciable differences in respondents' opinions about cyber agricultural extension according to their variables—age, educational background, work experience, organizational support, and familiarity with cyber agricultural extension tools—are thus accepted. The aforementioned results also suggest that, despite variations in demographic factors such as age, education, work experience, digital competency, and knowledge, the opinions of Subject Matter Specialists (SMS) at Krishi Vigyan Kendra (KVK) in Assam regarding cyber agricultural extension are consistent. The standard operating procedures used by government organizations like KVK may be the cause of this resemblance. The results of the current study on work experience are consistent with those of the study on the ICT use behavior of scientists at Krishi Vigyan Kendra (2014) by Raghava and Punna, which found that because modern technology is used so extensively in daily life and for agricultural extension, people's experiences may have converged. Similar to recent research findings, Gultom and Gitosaputro (2018) and Dzakiroh, D. (2021) found no significant correlation between formal education and the extension worker's emotional attitude toward the cyber extension. The probable reason for the demographic results above, which

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show no discernible variations, is that all of the respondents, who are employed by government-based organizations and are based at KVKs throughout Assam, may have similar organizational patterns, have been exposed to various forms of technology training, and have seen technology integrated into their daily lives. As a result, they may have similar opinions about it.

3) Perceptions of the respondents as per the Technology Acceptance Model constructs and with Variables

Most respondents (72.09%) consider cyber agricultural extension is helpful, and 63.95% think it's simple to use.

In terms of variable analysis, respondents who were middle-aged (36.04%), educated (38.37%), had moderate experience (55.4%), receiving adequate educational support (55.81%), digitally competent (76.97%), and knowledgeable (39.53%) all found cyber agricultural extension to be beneficial.

In contrast, middle-aged SMS users (32.55%), respondents with moderate experience (37.20%), those with sufficient organizational support (48.83%), those who are digitally literate (43.02%), respondents with less education (34.88%), and respondents with no formal education (33.72% each for educated and highly educated) found it easy to use. The aforementioned results showed that while a lesser and equal percentage of respondents had negative perceptions, the vast majority of respondents thought cyber agricultural extension technologies were helpful and simple to use. This is ascribed to the tools' intuitive design, logical interfaces, and unambiguous instructions. These a favourable perception are also influenced by elements like prior experience with comparable technology and effective training and assistance.

According to the TAM constructs of usefulness, both variable-wise and category-wise findings indicate that middle-aged respondents with moderate work experience, high levels of education, and adequate organizational support were digitally competent and knowledgeable about cyber agricultural extension. They also believed that using cyber agricultural technology was beneficial or useful in agriculture. The likely cause may be familiarity with intermediate experience, school-based critical thinking skills, and flexibility. Adequate support guarantees a plan of action, and computer literacy enables efficient navigation.

According to the TAM construct of ease of use, respondents in the middle age groups, with a range of educational backgrounds (from educated to higher educated), moderate experience, those with sufficient organizational support, those with digital competency, those with less knowledge about cyber agricultural extension, and those maintaining an upbeat mindset all said that cyber agricultural extension technology was straightforward and easy to use in agriculture. This perspective may be influenced by a positive outlook and support networks. Notwithstanding disparities in understanding, people who are flexible, practice, and optimistic might see technology as straightforward, allowing for effective use in both personal and professional contexts. Thus, it suggests that KVK organizations might increase output and efficiency by giving priority to training, assistance, and a positive outlook, enabling people to comfortably use technology interfaces.

4) Suggestions of the respondents to promote the use of cyber agricultural extension

Every respondent (100%) stated that increasing the use of cyber agriculture extension tools should be accomplished by enhancing technical and digital literacy, enhancing communication infrastructure, granting access to facilities with technological assistance, extending the network to local languages, involving farmers in digital education initiatives, and setting aside sufficient funds for cyber agricultural extension tools. Further, following recommendations are offered thru the present study, to increase the efficiency of agricultural cyber extension initiatives.

- To build Capacity and Digital Training Courses - Organize frequent training sessions that emphasize cyber extension technologies like e-Choupal, smartphone applications, AI-based advisories, and IoT-based precision agricultural equipment. To improve extension workers' digital literacy, incorporate region-specific information in regional languages (such as Assamese or Bodo).

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- To enhance the KVKs' Digital Infrastructure, promote the establishment of cloud-based knowledge repositories and fast internet at every KVK. Provide real-time problem-solving assistance to both experts and farmers by setting up technical help centers for cyber extension technologies.

- Use of The Models of Participatory Technology Development (PTD) - Prior to widespread implementation, encourage KVKs to implement farmer-participatory cyber extension experiments that use mobile-based solutions to evaluate usability and relevance.

CONCLUSION

To sum up, the research study's conclusions offer important new information on how KVK experts see cyber agricultural extension. Based on the research study's findings on SMS members' perceptions of KVK Assam's cyber agricultural extension, it can be concluded that the KVK community generally favors the usage of these technologies.

The Technology Acceptance Model (TAM) framework, in particular the elements of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), has a huge influence on how KVK experts see cyber agricultural extension.The findings show a moderate level of knowledge and generally positive perceptions of cyber extension, with KVKs of Assam SMSs acknowledging its potential to improve decision support, real-time problem-solving, and farmer outreach. Language obstacles, a lack of technical skills, a lack of digital infrastructure, and opposition to change—particularly in remote and tribal areas—were some of the limitations that were noted. The study identifies possible biases in self-reported data and recommends institutional assistance, localized digital solutions, and capacity-building programs. Policymakers, academics, and extension organizations working to close the digital divide in India's agricultural sector would find this research useful as it provides a region-specific analysis within the larger conversation on digital agriculture.

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