RESEARCH ARTICLE Agricultural Science Digest, Volume 45 Issue 6: 1058-1064 (December 2025)

ICT in Public Extension: Constraints and Suggestions Through the Lens of Extension Functionaries

Sweta Sahoo[1], Bibudha Parasar[1], Manoranjan Dash[2], Gbenga Akomolafe[3]

10.18805/ag.D-6359

ABSTRACT

Background: Information and communication technology being one of the key drivers in present agricultural system. Whilst public extension system play a pivotal role to bridge between the research and the roots, it is paramount for its functionaries to be well versed with latest development and stay upto date with every new means and ways of information dissemination.

Methods: The study was conducted in Bhadrak, Balasore, Cuttack and Jajpur districts of Odisha to determine the constraints impairing extension functionaries while using ICT in agriculture. Purposive sampling was used for selection of the districts and all the agricultural extension functionaries like CDAO, ADO, BAO, AAO, BTM and ATM were selected total adding up to 248 respondents. A pre-tested interview schedule was prepared and data was collected using interview method. Garrett's ranking technique was performed to analyse the challenges as perceived by officials under technological, organisational, capacity-related, socio-psychological and infrastructural dimensions.

Result: Lack of technical assistance for troubleshooting was the most urgent limitation among the technological issues,in organizational front biggest restriction (Rank 1) was the low priority given to ICT skill enhancement, inadequate training in ICT use is the most severe limitation in terms of capacity-related constraints, fear of making mistakes when using ICT was the most prevalent socio-psychological limitation,the most important constraint on the infrastructural front was determined to be a lack of infrastructure with a Mean Garrett Score of 66.14, 58.50, 60.47, 59.66 and 54.21 respectively. Suggestions as perceived by the respondents in order to increase the utilisation of ICT's included Regular hands-on training on emerging ICT tools and digital platforms,refresher courses to keep up with rapid technological changes, setting up ICT resource centres at block and district levels *etc*. All these constraints and suggestions could be analysed by stakeholders for making extension functionaries run at par with the global extensionists and create a sustainable and robust farming community.

Key words: Constraints, Extension functionaries, Garret ranking, ICT, Public extension system.

INTRODUCTION

In developing nations like India, where agriculture is the main economic sector, agricultural extension is essential in developing the farming systems. The speed at which ICT is being used in every industry worldwide has led to its adoption in agriculture sector to help farmers, extension services and other industry participants obtain information quickly (Nyarko and Kozari 2021). As there is a need to feed 143 crores people, the newer technologies have to be trickled down to the farmers (Sangapate *et al*., 2024). Farmers' information and communication demands could be met by ICTs significantly more quickly and accurately than in the past (Daum, 2018). Over the past ten years, the agriculture industry has undergone a new technological revolution. This new technological revolution has the ability to properly and quickly respond to farmers' requirements in comparison to a decade ago (Wolfert *et al*., 2017). Information and Communication Technologies (ICT) streamlines processes, improves accessibility and accelerates innovation in agriculture (Haqyar *et al*., 2025).

ICT applications have great opportunities to improve technology transfer between research and extension systems and subsequent dissemination to end users (Nirmalkar *et al*., 2022) and (Effiong *et al*., 2024). The empowerment of rural communities may be made possible *via* ICT-based agricultural extension, which offers legitimate prospects (Saravanan, 2010). Although ICTs are widely promoted, extension functionaries are still far from making the most of them. According to Ezeh (2013), a lack of operational literacy causes a significant gap in the extension agents' operational knowledge. Yakubu (2013) discovered that state extension staff did not fully utilize the advantages of ICTs.

[1]Institute of Agricultural Sciences, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar-751 030, Odisha, India.
[2]Institute of Business and Computer Studies, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar-751 030, Odisha, India.
[3]Federal University of Lafia, Nigeria.

Corresponding Author: Sweta Sahoo, Institute of Agricultural Sciences, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar-751 030, Odisha, India.
Email: swetasahoo735@gmail.com
ORCIDs: https://orcid.org/0000-0001-5049-1053, https://orcid.org/0000-0003-3886-6945, https://orcid.org/0000-0001-6767-1982

How to cite this article: Sahoo, S., Parasar, B., Dash, M. and Akomolafe, G. (2025). ICT in Public Extension: Constraints and Suggestions Through the Lens of Extension Functionaries. Agricultural Science Digest. **45(6):** 1058-1064. doi: 10.18805/ag.D-6359.

Submitted: 01-05-2025 **Accepted:** 09-06-2025 **Online:** 30-06-2025

The degree of ICT adoption in agriculture is also significantly influenced by technical limitations, such as the accessibility of infrastructure, technical expertise and support services (Patra *et al*., 2020). Chiazoka *et al*. (2021) found that village extension workers faced issues like lack of training on use of ICT (14.96%), high cost of ICT tools (14.73%) and high cost of internet subscription (12.05%). Limitations when using ICT include poor service, a lack of technical expertise, trouble finding pertinent information, higher internet data requirements, inappropriate and incomprehensible content, poor response, irrelevant posts, anxiety about the security of personal information on social media, a language barrier when using a mobile device, ignorance of how gadgets work and inadequate tools (Patel *et al*., 2022).

Extension functionaries face constraints like administrative, operational, general, infrastructural, technical and financial (Pandey *et al*., 2024). Gad *et al*., (2021) found that the most important problems that impede the use of information technology and communication in extension work was lack of financial allocations for training in this field and lack of motivation for workers to use information technology and communication. Anim-Dankwa (2018) discovered that poor reception, language barriers and content limits were the primary obstacles faced by the farmers in the study.

Additionally, adequate infrastructure and funding for ICTs are prerequisites (Panda *et al*., 2023). According to Umar *et al*. (2015), extension staff should be encouraged to use ICTs by providing them with stable power and ICT facilities, as well as by developing their ICT usage skills. Government funding is required to enhance the delivery of extension services using supplemental ICTs (Tata *et al*., 2018). Annor-Frempong *et al*. (2006) discovered that in order to improve the use of ICTs in extension, extension agents require infrastructure, financial resources, technical support and ICT training opportunities.

Sa'adu *et al*. (2022) recommended that governments should design a policy that will focus on awareness, training, access to ICTs among the extension agents, provide an alternative source of power, this will enable them to remain within the system and increase their usage of ICTs in extension service delivery. According to Idrisa *et al*. (2013), basic infrastructure like power should be made available in rural regions and extension agents should be urged to improve their educational backgrounds and ICT proficiency. Ganpat *et al*. (2016) suggested that employers increase the entry-level criteria for new officers and give those currently in the system in-service training in ICTs and other contemporary communication tools and methodologies.

MATERIALS AND METHODS

The study was carried out in four districts, including Jaipur, Cuttack, Balasore and Bhadrak of Odisha, India. The districts were selected by purposive sampling as they represent a combination of somewhat interior and coastal regions, offering diversity in agricultural practices, ICT infrastructure, extension activities and ICT penetration. This allows a comprehensive representation of ICT utilisation patterns and constraints faced across varied contexts within Odisha's public extension system. Also, the coastal districts were chosen purposively as they are more prone to disaster (Jayasingh *et al*., 2024). A higher degree of coastal vulnerability is indicated by the Odisha coast's geoclimatic setting, which is vulnerable to natural disasters such cyclones, storm surges, flooding and sea level change (Hazra *et al*., 2022). So, information dissemination becomes vital related to pre-disaster management of crops,post-disaster management etc. For the study, each block in every district was chosen. 43 blocks were taken in total. The study included 248 respondents, including agricultural extension functionaries such as the Chief District Agricultural Officer (CDAO), Agricultural District Officer (ADO), Block Agricultural Officer (BAO), Assistant Agricultural Officer (AAO), Block Technology Manager (BTM) and Assistant Technology Manager (ATM). By obtaining a duly signed No Objection Certificate from Institute of Agricultural Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha the data was collected from the public extension functionaries of Office of Chief District Agricultural Officer, Bhadrak, Balasore, Jajpur and Cuttack. The constraints were divided into five categories: technological, organizational, capacity-related, socio-psychological and infrastructural. A detailed map of the state with the selected districts was prepared using QGIS software and has been provided in the Fig 1. Prior to the final interview schedule being created, the questionnaire was pretested on 10% of the sample size, or six respondents chosen at random from each district. Testing phase input helped improve the questionnaire. Workplace interviews were used to obtain data, encouraging candid and open responses. Using an ex-post facto design, this process took place between July to September of 2024.

The goal of the interview was to find out more about the difficulties extension functionaries of public extension system encounter when utilizing ICT for official work. In view of the specified limitations, respondents were asked to rate the constraints that were prepared on various dimensions. Utilizing the Garrett Ranking Technique, the final ranking of limitations was presented as numerical ratings. It offers an advantage over a simple frequency distribution since it numerically distributes the limits based on their significance to the respondents. This suggests that two or more limitations with the same number of responders may be given different ranks.

According to the data in Table 1, Garrett's algorithm Garrett (1969) was used, the ranks were transformed into percentages as follows:

$$\text{Per cent position} = \frac{100 * (Rij - 0.5)}{Nj}$$

Where,

Rij = Rank given for i^{th} constraint by j^{th} individual.

Nj = Number of constraints ranked by j^{th} individual.

The percentage positions were then converted into scores using Garrett's table. For each constraint dimension with same rank they were made an average in order to calculate the final score.

RESULTS AND DISCUSSION

From Table 2, It was found that Lack of technical assistance for troubleshooting was the most urgent limitation among the technological issues (Rank 1), with a Mean Garrett Score of 66.44. This suggests that functionaries find it difficult to fix technical issues as a result of insufficient support mechanisms, which has a direct impact on their ability to use ICTs confidently and effectively. Compatibility problems between platforms and devices came in second, illustrating the difficulties brought on by offices' non-standard hardware and software. The fact that outdated software and hardware came in third underscores the continued prevalence of technical obsolescence in extension offices. Regular outages and inadequate internet access came in fourth and fifth place, respectively.

From Table 3, It was found that with a Mean Garrett Score of 58.50, the organization's biggest restriction (Rank 1) was the Low priority given to ICT skill enhancement. This suggests that institutional attention on methodically improving ICT competencies is still lacking, despite the growing significance of digital extension. The second-ranked factor was excessive workload, which leaves little time for ICT use. This suggests that officials frequently overwork with traditional responsibilities, which leaves little time for digital practice or learning. Ranking third, inadequate funding for ICT development exacerbates the problem even further. Fourth place went to the restricted availability of ICT tools for field work, which suggests that many of the tools available are office-centric and pay little attention to the requirements of extension activities at the field level. The organizational limitation with the lowest priority was the lack of explicit ICT usage policies and procedures.

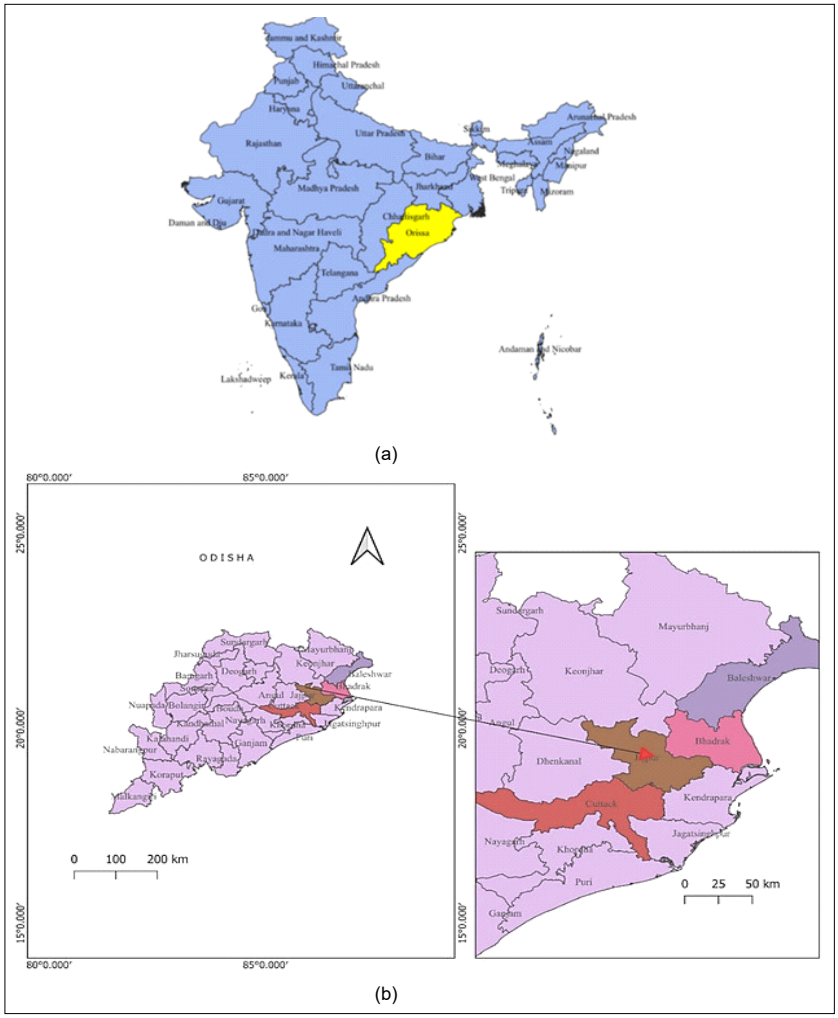


Fig 1: (a) Political map of India. (b) Map of the study area.

From Table 4, It was found that with a Mean Garrett Score of 58.02, insufficient training on ICT use is the most severe limitation (Rank 1) in terms of capacity-related constraints. This indicates a serious lack of organized capacity building programs, which leaves officials ill-equipped to use the ICT resources at their disposal. The second-highest ranking is lack of digital skills (technical know-how), which suggests that even fundamental operating and troubleshooting abilities are frequently lacking. The fact that extension staff are not routinely exposed to new technologies and their uses in extension work is further supported by the third-ranked lack of exposure to new ICT tools and platforms.

From Table 5, It was found that with a Mean Garrett Score of 59.66, fear of making mistakes when using ICT was the most prevalent socio-psychological limitation (Rank 1). This demonstrates a lack of self-assurance and a fear of failing, which severely limits proactive ICT tool utilization. The second-highest ranking was resistance to switching from traditional ways, indicating that comfort with traditional tactics and ingrained work cultures continue to be obstacles to the digital transformation. Furthermore, the belief that ICT makes labour harder rather than easier comes in third, indicating a lack of knowledge of how ICT can streamline extension procedures. The need for focused behavioural change interventions is further demonstrated by the fourth and fifth-place rankings for low motivation to use ICT and fear or lack of confidence in using ICT, respectively.

From Table 6, It was found that with a Mean Garrett Score of 54.21, the most important constraint (Rank 1) on the infrastructure front was determined to be a lack of infrastructure. This demonstrates the ongoing failure to provide extension offices with a strong ICT infrastructure. The second ranked constraint was inadequate ICT tools, highlighting the restricted availability of necessary gadgets for efficient ICT use. Lastly, the third-place ranking of the digital divide between rural and urban extension offices indicates notable disparities in ICT access and capabilities between rural and urban areas.

Suggestions as perceived from extension functionaries for better utilisation of ICT tools and techniques-from the, It was found that the suggestions as perceived from the extension functionaries varied according to the hierarchy of their job role in their organisation. The senior level officials included CDAO, ADO and BAO, Mid-level officials were AAO and the junior level officials were BTM and ATM. Senior level officials suggested that Refresher courses to keep up with the rapid technological changes and appointment of dedicated ICT personnel at district/block level for technical support could lead to better utilisation. Mid-level officials suggested that regular hands-on training on emerging ICT tools and digital platforms, setting up ICT resource centres

Table 1: Evaluation of per cent and score of five types of constraints.

Formula	Per cent	Score
C1 (Technological constraints)		
100(1-0.5)/5	10	75
100(2-0.5)/5	30	60
100(3-0.5)/5	50	50
100(4-0.5)/5	70	39
100(5-0.5)/5	90	24
C2 (Organizational constraints)		
100(1-0.5)/5	10	75
100(2-0.5)/5	30	60
100(3-0.5)/5	50	50
100(4-0.5)/5	70	39
100(5-0.5)/5	90	24
C3 (Capacity-related constraints)		
100(1-0.5)/4	12.5	73
100(2-0.5)/4	37.5	56
100(3-0.5)/4	62.5	43
100(4-0.5)/4	87.5	27
C4 (Socio-psychological constraints)		
100(1-0.5)/4	12.5	73
100(2-0.5)/4	37.5	56
100(3-0.5)/4	62.5	43
100(4-0.5)/4	87.5	27
C5 (Infrastructural constraints)		
100(1-0.5)/3	16.6	69
100(2-0.5)/3	50	50
100(3-0.5)/3	83.3	31

Table 2: Distribution of functionaries on the basis of technological constraints.

Constraints	C1 (Technological constraints)											
	Rank given by respondents										Mean Garret score	Rank
	1st (F)	(%)	2nd (F)	(%)	3rd (F)	(%)	4th (F)	(%)	5th (F)	(%)		
Frequent power cuts	01	0.40	43	17.33	35	14.11	40	16.12	129	52.01	36.53	5th
Outdated hardware/software	24	9.67	34	13.70	115	46.37	57	22.98	18	7.25	49.37	3rd
Compatibility issues between devices/platforms	52	20.96	52	20.96	97	39.11	47	18.95	0	0	55.25	2nd
Lack of technical support for troubleshooting	165	66.53	45	18.14	01	0.40	31	12.5	06	2.41	66.44	1st
Poor internet connectivity	06	2.41	74	29.83	0	0	73	29.43	95	38.30	40.39	4th

at block and district levels and developing a common digital platform for all extension functionaries could lead to more utilsation of ICT by extension functionaries. The junior level officials suggested that easy availability and accessibility of ICT tools in offices,Inclusion of ICT usage in performance appraisal and career growth and encouraging participatory content creation like blogs, vlog making, video making could lead to better utilisation of ICT's. It was concluded

Table 3: Distribution of functionaries on the basis of organisational constraints.

C2 (Organisational constraints)												
Constraints	Rank given by respondents										Mean garret score	Rank
	1st (F)	(%)	2nd (F)	(%)	3rd (F)	(%)	4th (F)	(%)	5th (F)	(%)		
Low priority given to ICT skill enhancement	78	31.45	111	44.75	01	0.40	31	12.50	27	10.88	58.50	1st
Inadequate budget for ICT development	14	5.64	02	0.80	158	63.70	24	9.67	50	20.16	45.51	4th
Absence of clear ICT usage policy/guidelines	02	0.80	17	6.85	54	21.77	132	53.22	43	17.33	40.22	5th
Excessive workload, leaving less time for ICT use	119	47.98	02	0.80	34	13.70	58	23.38	35	14.11	55.36	2nd
Limited provision of ICT tools for field work	35	14.11	116	46.77	01	0.40	03	1.20	93	37.50	48.38	3rd

Table 4: Distribution of functionaries on the basis of Capcity-related constraints.

C3 (Capacity-related constraints)										
Constraints	Rank given by respondents								Mean Garret score	Rank
	1st (F)	(%)	2nd (F)	(%)	3rd (F)	(%)	4th (F)	(%)		
Insufficient training on ICT use	120	48.38	75	30.24	0	0	53	21.37	58.02	1st
Lack of digital skills (Technical know-how)	53	21.37	59	23.79	76	30.64	60	24.19	48.63	3rd
Limited exposure to new ICT tools and platforms	75	30.24	113	45.56	01	0.40	59	23.79	54.18	2nd
Fear or lack of confidence in using ICT	0	0	01	0.40	171	68.95	76	30.64	38.14	4th

Table 5: Distribution of functionaries on the basis of Socio-psychological constraints.

C4 (Socio-psychological constraints)										
Constraints	Rank given by respondents								Mean Garret score	Rank
	1st (F)	(%)	2nd (F)	(%)	3rd (F)	(%)	4th (F)	(%)		
Fear of making mistakes while using ICT	132	53.22	70	28.22	0	0	46	18.54	59.66	1st
Resistance to change from traditional methods	46	18.54	64	25.80	70	28.22	68	27.41	47.53	3rd
Perception that ICT increases workload rather than reducing it	70	28.22	114	45.96	0	0	64	25.80	53.31	2nd
Low motivation to use ICT	0	0	0	0	178	71.77	70	28.22	38.48	4th

Table 6: Distribution of functionaries on the basis of Infrastructural constraints.

C5 (Infrastructural constraints)								
Constraints	Rank given by respondents						Mean garret score	Rank
	1st (F)	(%)	2nd (F)	(%)	3rd (F)	(%)		
Inadequacy of ICT tools	135	54.34	24	9.67	89	35.88	53.52	2nd
Lack of infrastructure	113	45.56	77	31.04	58	23.38	54.21	1st
Digital divide between rural and urban extension offices	0	0	147	59.27	101	40.72	42.26	3rd

from the recommendations gathered that hierarchy-based requirements and attitudes were prevalent. Senior officials' interest for long-term ICT integration and sustainability was demonstrated by their focus on policy-level interventions such as refresher training and the hiring of ICT personnel. Mid-level officials emphasised on training and infrastructure, demonstrating their need for coordination tools and real-world expertise.

As a reflection of their current operational constraints and motivational factors, junior officials prioritize career incentives while seeking accessibility. Extension functionaries might be more inclined to utilize ICT tools if they are connected to real career rewards, according to the proposal to incorporate ICT usage into performance reviews and career development. The focus placed by officials on blogs, vlogs and video production demonstrated a move away from traditional one-way communication and toward interactive, participatory digital extension.

CONCLUSION

According to the study, extension workers encounter several obstacles when it comes to using ICT. The most significant of these are capacity-related problems (inadequate training), technology problems (no troubleshooting assistance) and organizational limits (Low priority given to ICT skill enhancement). Moreover, sociopsychological obstacles including a fear of making mistakes and inadequate infrastructure impede the successful adoption of ICT.To increase ICT adoption at all levels, administrators and policymakers should concentrate on a multi-tiered ICT strategy. The policies should cover mid-level facilitation (training, shared platforms, resource centers), bottom-up participation (incentives, accessibility, content creation) and top-down support (appointments, refresher courses). Other important suggestions included making sure that infrastructure was accessible and fortifying technical support services. By addressing these limitations with focused interventions, extensionists will be more confident, effective and efficient in addition to being more ICT friendly. The public extension system's bottom-up approach must be strengthened with a well-equipped, tech-savvy extension workforce, which will ultimately result in more effective and responsive agricultural advisory services.

ACKNOWLEDGEMENT

Authors are grateful to the Department of Agricultural Extension and Communication,Institute of Agricultural Sciences, Siksha 'O' Anusandhan Deemed to be University and the respondents extension functionaries serving in public sector for providing support and facilities to conduct the research. Further no financial support has been received from any institute/organisation.

Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal Care and Handling Techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

REFERENCES

Anim-Dankwa, W. (2018). Socio-economic determinants of ICT usage among rural crop farmers in the Northern Region of Ghana (Doctoral dissertation).

Annor-Frempong, F., Kwarteng, J., Agunga, R. and Zinnah, M.M. (2006). Challenges and Prospects of Infusing Information Communication Technologies (ICTs) in Extension for Agricultural and Rural Development in Ghana. In Proceedings of the Annual Conference of the International Association of Agricultural and Extension Education. **22:** 36-46.

Chiazoka, E., Olayemi, S.S., Annirejuoritse, T.O. and Halidu, M.K. (2021). Exploring the use of information and communication technologies (ICTs) among village extension agents in federal capital territory, Nigeria. *Technology.* **2(8):** 78-84.

Daum, T., Buchwald, H., Gerlicher, A. and Birner, R. (2018). Smartphone apps as a new method to collect data on smallholder farming systems in the digital age: A case study from Zambia. *Computers and Electronics in Agriculture.* **153:** 144-150.

Effiong, J.B. and Iheme, M.N. (2024). Effectiveness of new media technologies on agricultural production among rural households in Akwa Ibom State, Nigeria. Agricultural Science Digest. **44(6): 1050-1055.** doi: 10.18805/ag.DRF-361.

Ezeh Ann, N. (2013). Extension agents access and utilization of information and communication technology (ICT) in extension service delivery in South East Nigeria. *Journal of Agricultural Extension and Rural Development*. 5(11): 266-276.

Gad, M.G. and Shair, S.G. (2021). The Use of Information and Communication Technology (Ict) by Extension Agents in Agricultural Extension Work in Menoufia Governorate. *Alexandria Science Exchange Journal.* **42(4):** 2331-2352.

Ganpat, W.G., Ramjattan, J. and Strong, R. (2016). Factors influencing self-efficacy and adoption of ICT dissemination tools by new extension officers. *Journal of International Agricultural and Extension Education.* **23(1):** 72-85.

Garrett, H.E. and Woodworth, R.S. (1969). Statistics in Psychology and Education. Vakils, Feffer and Simons Private Ltd, Bombay.

Haqyar, Z., Rohila, A.K., Malik, J.S. and Kumar, A. (2025). Usage pattern of information and communication technology Tools among University Faculty Members. Indian Journal of Extension Education. **61(1):** 108-112.

Hazra, S., Ghosh, A., Ghosh, S., Pal, I. and Ghosh, T. (2022). Assessing coastal vulnerability and governance in Mahanadi Delta, Odisha, India. *Progress in Disaster Science.* **14:** 100223. https://doi.org/10.1016/j.pdisas.2022.100223.

Idrisa, Y.L., Ogunbameru, B.O. and Shehu, H. (2013). Use of information and communication technology (ICT) among extension Workers in Borno State, Nigeria. *Journal of Agricultural Extension*. **17(1):** 69-77.

Jayasingh, D.K., Mishra, B., Behera, K. and Pattanaik, S. (2024). Navigating challenges: Exploring challenges to occupational diversification amongst the farmers in Odisha. *Agricultural Science Digest.* **44(5):** 962-969. doi: 10.18805/ag.D-5998.

Nirmalkar, C., Lahiri, B., Ghsoh, A., Pal, P., Baidya, S., Shil, B. and Kurmi, R.K. (2022). Perceived knowledge and attitude of fisheries extension professionals on usage of ICTs in Tripura. *Indian Journal of Extension Education*. **58(2):** 58-64. https://epubs.icar.org.in/index.php/IJEE/article/view/122755.

Nyarko, D.A. and Kozári, J. (2021). Information and communication technologies (ICTs) usage among agricultural extension officers and its impact on extension delivery in Ghana. *Journal of the Saudi Society of Agricultural Sciences.* **20(3):** 164-172.

Panda, P., Tiwari, R., Kumari, M., Singh, K. and Dutt, T. (2023). Information source utilization by veterinarians with special reference to ICT tools. *Haryana Vet.* **62(1):** 64-67.

Pandey, M., Solanki, D., Upadhyay, R. and Negi, R. (2024). Constraints faced by the extension personnel with the existing transfer of technology system of state department of agriculture.

Patel, P.K. and Mallappa, V.K.H. (2022). Predictive factors for farmers' knowledge of social media for sustainable agricultural development. *Indian Journal of Extension Education.* **58(4):** 55-59.

Patra, S., Mukhopadhyay, S.D., Raj, R.K. and Mishra, J.R. (2020). Perceived use of computer in extension activities by the extension officials. *Indian Journal of Extension Education.* **56(3):** 83-87.

Sa'adu, M., Norsida, M., Jasmin, A.S., Nitty, H.K. and Ahmadu, A.T. (2022). Factors affecting use of information communication technologies among extension agents in North-East, Nigeria. *Journal of Agricultural Extension.* **26(1):** 36-43.

Sangapate, P., Sarasit, N., Sanpan, H. and Mekwian, J. (2024). Mathematical model for optimum temperature and humidity determination of mashed mushroom in greenhouses by using smart farm technology and Innovation. *Agricultural Science Digest.* **44(6).** doi: 10.18805/ag.DF-575.

Saravanan, R. (Ed.). (2010). ICTs for Agricultural Extension: Global Experiments, Innovations and Experiences. New india Publishing.

Tata, J.S. and McNamara, P.E. (2018). Impact of ICT on agricultural extension services delivery: Evidence from the Catholic Relief Services SMART skills and Farmbook project in Kenya. *The Journal of Agricultural Education and Extension.* **24(1):** 89-110.

Umar, S., Musa, M.W., Olayemi, Y.T. and Suleiman, R. (2015). Awareness and use of information and communication technologies among extension agents in Kaduna State of Nigeria. *Journal of Agricultural Extension.* **19(1):** 66-76.

Wolfert, S., Ge, L., Verdouw, C. and Bogaardt, M. J. (2017). Big data in smart farming- A review. *Agricultural Systems.* **153:** 69-80. https://doi.org/10.1016/j.agsy.2017.01.023.

Yakubu, D.H., Abubakar, B.Z., Atala, T.K. and Muhammed, A. (2013). Use of information and communication technologies among extension agents in Kano State, Nigeria. *Journal of Agricultural Extension.* **17(1):** 162-173.