

Date	Submitted	Accepted	Published
	18 th October 2023	23 rd August 2024	18 th November 2024

THE CONCEPT OF ICT ON AGRICULTURAL INPUT INFORMATION: A FRAMEWORK DESIGN

Fosu A^{1*}and N Giba-Fosu¹



Agyei Fosu

*Corresponding author email: afosu@wsu.ac.za

¹Walter Sisulu University, East London, South Africa



ABSTRACT

Information is a critical farming input as it serves as a tool to enable farmers to make well-informed farming production decisions such as: best planting time, and best farming practices which in turn contributes to farming higher productivity. Small-scale farmers in developing nations' rural areas are major contributors to food security in developing nations' rural areas. Given the importance of small-scale farming in developing nations' rural areas, developing nations' rural small-scale farmers timely access to relevant agricultural information will assist the farmers to make right decisions towards pursuing sustainable, value-added agriculture and long-term growth to ensure developing nations' rural areas food security. Existing literature reveals that small-scale farmers in developing nation rural areas are disadvantaged by imperfect information to make well informed decisions. Information and Communication Technologies (ICT) applications in agriculture become the easier way for rural small-scale farmers to access well rounded agricultural knowledge. As a result of ICT, various online platforms and websites that cater to the information needs of small-scale farmers exist. As farmers' usage of information and ICT tools are influenced by the source and perceived gain from ICT. A model designed to enhance developing nations' rural small-scale farmers' uptake of ICT through the understanding of intervening variables of individual characteristics explicated by case studies of selected rural small-scale farmers in Wenchi Municipal Assembly, Ghana is the aim of the current study. Purposive sampling technique was used to select 70 participants for the case study. Using open and closed-ended questionnaires, empirical data were collected to determine the intervening variables of the selected farmers' communication. The identified intervening variables in the farmers' seeking of information revealed that the farmers search for information through verbal communication. Thus, the study recommends the use of ICT platforms that promote oral or verbal communications such as automated voice messages to stream agricultural input information to the farmers in the study area to realize an effective utilization of ICT by the farmers to access agricultural input information. The study proposed framework becomes a tool to assist stakeholders concerned with implementing ICT application to enhance rural small-scale farming to gather knowledge to design tailor-made solutions.

Key words: Agricultural input information, developing nations, ICT, productivity, rural areas, small-scale farmers

INTRODUCTION

Information is one of the key components of farming input. Farmers require information to manage the various stages of farming such as selecting the farming site, type of crops to plant, and animals to breed [1, 2]. The information then becomes a critical tool to guide farmers' decision-making processes. In this regard, farmers' access to external information on latest research outputs and farming or agricultural development is paramount for farmers to improve their capacities. However, over the years developing nations have depended on extension services personnel presence to deliver such knowledge to deeply isolated rural farming communities [3], which results most of the time in inequalities of access. This, therefore, creates a gap in developing nations' rural small-scale farmers' capacity development about modern sustainable farming practices. Streaming agricultural input information to enhance developing nations' rural small-scale farmers' farm management capacity in the contemporary era requires the farmer's uptake of Information and Communication Technologies (ICT). Some conditions create a need for information among farmers as well as propel farmers to use specific medium [4] and sources to seek their information need. Agricultural scholars have highlighted that farmers' use of information and ICT are influenced by sources of information and perceived gain from the use of ICT [4, 5].

This calls for an understanding of farmers' information needs, ways, and channels farmers use to seek information as well as their perceptions on the use of various sources of obtaining information ICT present in the contemporary era, so that necessary and specific interventions can be implemented to ensure farmers uptake of necessary ICT tools to access vital information they require on time amid the digital age. Rural small-scale farmers need agricultural input information to enhance their farming management capacity to boost production.

Farmers' management capacity development, effectiveness, and efficiency can be enhanced in the contemporary era with ICT uptake and use [4, 5]. However, evidence from scholarly studies [5, 6, 7] has shown that the benefits of ICT in the context of socio-economic development amid the digital revolution are not automated. This notion is echoed in the agricultural sector [8], especially in developing nations' rural farmers' uptake, and use of ICT to access agricultural input information. Despite ICT tools such as websites' ability to capture and store information in various formats including text, pictures, audio and video and at the speed of a press of a button one can access a wide range of information across the globe. Such features of ICT tools make them an ideal solution to the problem posed by long distances in communicating developmental information to rural communities. A caution is given by Diechamnn, Goyal and Mishra [9] that in trying to promote ICT uptake and use among developing nations farmers call for first addressing certain

factors. Various factors such as; educational background, perceptions, cost, and culture have been highlighted in the literature [5, 10, 11] to affect individual technology uptake and use. Literature acmes [9, 12, 13] that although several gains have been made in terms of developing nations' ICT application in the agricultural input information, there is a greater need for investigation of factors affecting developing nations' deeply isolated rural small-scale farmers' uptake, and use of ICT to access agricultural input information. Hence, the design of this model is to assist in guiding how to effectively, through the application of ICT, disseminate agricultural information input to developing nations' deeply isolated rural farming communities. In cognizance of the above discussions, a key question arises "What components should conceptualization of a framework to unmask ICT uptake and use strategies among developing nations' deeply isolated rural farming communities capture?" To answer the question, the researchers believe an investigation into developing nations' rural farmer's information searching patterns, ICT tools available to them, and how they are used to seek information are essential. Furthermore, their perception of seeking information from ICT sources of obtaining information will give insights into specific intervention designs to enhance the farmer's uptake of ICT to achieve effective dissemination of agricultural input information through the use of ICT.

Various existing frameworks such as Social Network Theory (SNT), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Diffusion of Innovation Theory (DIT) have been used to study rural small-scale farmers' adoption of technology. For instance, DIT was used [14] to investigate rural small-scale farmers uptake of ICT. A study Kabbiri, Dora, Kumar, Elepue and Gellyncka [15] adopted TAM to study factors that deter Africa sub-Saharan farmers uptake of mobile phones. Studies carried out in southern parts of Zambia [17] employed UTAUT frameworks to examine the effects of ICT applications on productivity of agriculture. However, several scholars [17, 18, 19] have highlighted various shortcomings with the use of models such as SNT, TAM, DIT, and UTAUT in the study of rural small-scale farmers' adoption of ICT. The authors highlight the following:

- Much as the DIT is relevant to examine rural small-scale farmers ICT adoption due to its elucidation of the leading role of network in assisting the use of ICT, the weakness various scholars identify with the use of DIT is its operative restrictions and lack of a social-cultural context.
- The SNT is critiqued for only focusing on the social extents that influence adoption of ICT.
- Although the TAM focuses on characters such as ease of use and perceived usefulness in explaining issues that affect adoption of ICT. The TAM is critiqued

for focusing on the technical viability of the ICT without a regard to other determinants such as social, and legal that can influence ICT adoption.

The study framework design which infers variables such as age, level of literacy, access to ICT, awareness and willingness to use ICT sources of obtaining information to reveal behavioral intention, and usage of certain ICT will contribute knowledge on how developing nations rural small-scale farmers individual characteristics affect usage of certain ICT in the digital age.

Formulating the study problem and the model

Understanding farmers' search for information, sources, and channels or mediums used in seeking information is useful for agricultural extension services in developing strategies to effectively disseminate agricultural knowledge to the farmers [13].

Based on factors that affect information searching patterns, and perceptions of ICT, to propose a model for effectively using ICT to disseminate agricultural input information to developing nations 'deeply isolated rural farming communities is the main aim of the current study. The study assesses to identify the intervening variables that will reveal the barriers to the study participants' uptake of ICT to seek information. The study used small-scale farmers in rural Wenchi Municipal Assembly of Ghana (WMA) as a case study. Wenchi Municipal Assembly of Ghana is mainly rural with small-scale farming as the main source of income for its rural population [20]. Thus, increasing the productivity of small-scale farming is critical to WMA's economic growth.

Literature review

To grasp how to assist small-scale farmers in developing nations rural areas to access agricultural input information on time through ICT application to improve productivity and efficiency requires an insight into small-scale farmers in rural areas information needs [5] which have the potential to scale up their uptake of ICT application to seek information need. Two conditions that create the need for information among small-scale farmers are given [16]. First, the farmer seeks advice because of the farmer starting a new farm. Secondly, the farmer encounters a new challenge never encountered before such as new farming diseases and pests. A study carried out in Kiring County Kenya [21] found that the main information needs of small-scale rice farmers were paddy seed varieties availability and packaged rice prices information.

On the challenges of rural small-scale farmers' ICT adoption, studies [18, 19] have identified challenges such as weak internet connectivity, meager ICT infrastructure, and lack of electricity connectivity as some of the factors that cause low ICT adoption among Africa's rural small-scale farmers. For instance, it was revealed that low literacy levels among African rural small-scale farmers serve as a challenge to their

adoption of ICT [19]. Several frameworks have emerged in recent times in an attempt to unpack factors affecting rural small-scale farmers' adoption of ICT to seek their agricultural information needs. Based on Roger and Shoemaker's work that reveals how innovation spreads within social systems over time via channels, a model was proposed to establish the important links between information sources and their effects on farmers with emphasis on the critical role played by the channel that conveys the message [22]. The model [22] highlights that farmers' messages or information have sources that their information originates from. Secondly, there are specific channels for sending information which can be enhanced by ICT tools. The Technology Acceptance Model was used to study factors that prevent African sub-Saharan farmers from uptake of mobile phones [15]. Issues such as cost, perception, culture, and others were identified as challenges.

The current study contributes to the quest for developing frameworks to try and unearth factors affecting developing countries' rural small-scale farmers' uptake of ICT in the contemporary era to access agricultural information.

Defining the constructs underpinning the proposed model

There is no explicit definition of information as a term with the reason emanating from the fact that its meaning is derived from the context. The field information being studied also influences its definition therefore resulting in countless underlying connotations and viewpoints for the term [22]. The current study defines information to be a physical commodity that can be produced, accessed, and purchased [23].

1st construct: Profiling of the farmers in the context

Several factors such as individual literacy level, financial status, culture, geographical location, and information system awareness, for example, affect individual wants of information [24, 25, 26]. Again, in developing a framework to exhibit how ICT applications can broadcast information to specific rural communities showed that the rural communities' perceptions of ICT usefulness [5, 13], and individual characteristics influence individual use of ICT to access information. Thus, profiling the farmers in context will assist in determining the ICT application approaches to be used in disseminating the agricultural input information to the farmers which gives precedence to communication.

2nd construct: Identification of the intervening variables

The need for individuals to seek information is facilitated by two situations [26]:

- The existence of a genuine aim for wanting the required information.
- A belief that seeking the required information will satisfy the aim.

Therefore, the identification of the intervening variables which in this case is the assessment of the farmer's information needs, and ICT media used in seeking

information will give insights into potential barriers to small-scale farmers in rural areas ICT uptake in seeking information needs.

The researchers believe that profiling the farmers in context and identifying the intervening variables will reveal the barriers to the farmer's uptake of ICT in seeking agricultural input information from which specific interventions can be designed to enhance the farmer's uptake of ICT. Thus, Figure 1 below is the study's proposed framework.

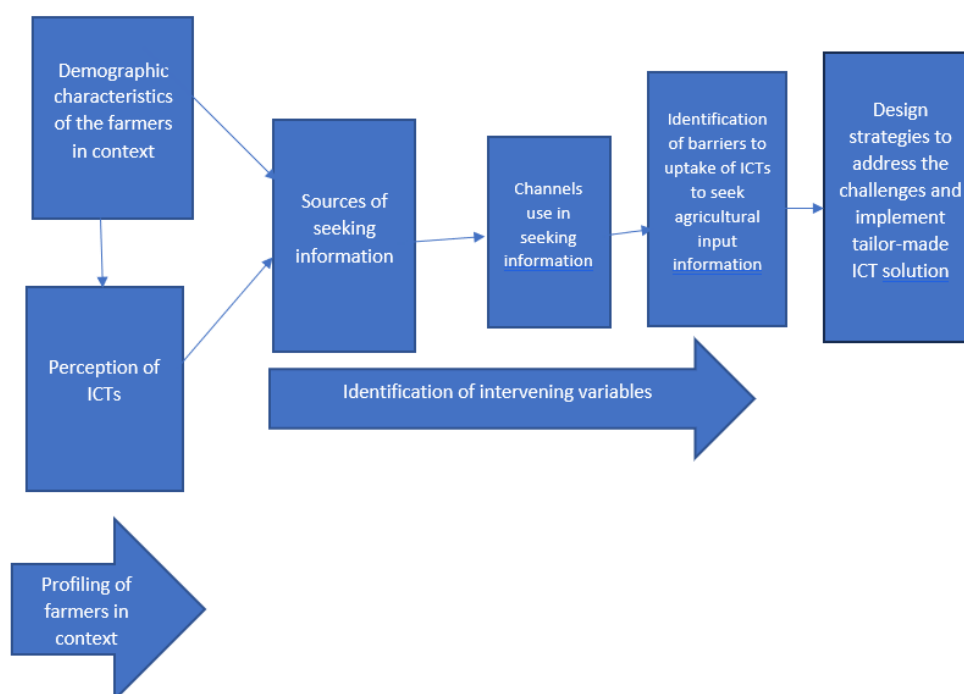


Figure 1: Proposed framework for the study

The case study of selected rural small-scale farmers

This section presents the case study that was carried out among selected small-scale farmers in the rural Wenchi District of Ghana to elucidate the proposed model. The section covers the background of the study area, the questions that guided the study, the study approaches, empirical findings, and discussions as well as the conclusions and recommended specific intervention design.

Target population for the study

Wenchi Municipal Assembly attained its municipal status in 2007 after its formation in 1988 as a district. The municipality is located in the northeastern part of the new Bono Region with a total land area of about 1,296.60 square kilometers and a population projection of 113,956. Wenchi, Nchiraa, Subinso, Awisa, and Asuogya are the five zonal councils that constitute the Wenchi Municipal Assembly. The municipality is largely a rural population and agrarian as the predominant economy

[20, 27]. Enhancing rural small-scale farming is vital to the municipality citizens living in rural areas.

Survey research design

Due to the challenge of no existing municipal database on rural small-scale farmers within the area of study, the study, therefore, used a purposive sampling technique [28] where a researcher uses his or her subjective knowledge to identify participants that best fit the study to approach 70 participants who were willing to be part of the study. Using open and closed-ended questionnaires, empirical data was collected for the study.

The research questions

The following questions were posed as research questions to the study participants in the case study to assist the researchers to gather empirical data to validate the proposed framework:

1. Do participants require information to assist them in their farming activities?
2. What type of information do participants require?
3. Do participants own any ICT tools?
4. How do participants normally use the ICT tools they own to seek the information they require?
5. Are participants aware that the information they require can be found on ICT sources like YouTube, the internet, and web blogs?
6. Do participants search for information on these ICT sources?
7. Given an opportunity will participants use these ICT sources to search for their agricultural information needs?

RESULTS AND DISCUSSION

Demographic characteristics of the study participants

The demographic of the study participants in terms of level of literacy, and age was assessed, and the findings are presented in Table 1.

The findings in Table 1 indicated that the age group with the high percentage of 25.71% was 48 – 53 followed by 54 – 59 with a percentage of 22.86%. The age group 30 – 35 had 14.29%. The 59 and above age group had a percentage of 11.43% and the 18 – 23 age group had the lowest percentage of 2.86%. The literacy level of study participants showed a low level of literacy with 51.43% indicating a primary school educational level. Studies [4, 6, 29] have shown the influence a farmer's age, gender, and literacy level have on their adoption of modern technology and farm practices. Thus, the current study findings of low literacy and older age groups among the farmers highlight a potential challenge that could serve as a barrier to Wenchi Municipal Assembly small-scale farmers' adoption of ICT to seek agricultural input information.

Information needs and type of information required by the study participants

Respondents were asked to indicate in closed-ended questions on the questionnaire whether they require information to assist their farming activities. Table 2 gives the findings. The findings in Table 2 support the notion put forward by scholars [4, 10, 13] that farmers require information to make critical farming decisions. Thus, information can be considered as farming input. For instance, from Table 2 all the study participants (100%) indicated they require information to assist their farming activities.

ICT tools available to participants and how they are used to seek information

The contemporary era dictates the ownership or use of some form of ICT tools, for example, to communicate or seek information. Scholars [29, 30] have highlighted the use of modest and conventional technologies by small-scale farmers. The study investigated to establish ICT tools available to respondents as well as the ones normally used to seek their information needs. Table 3 gives the findings. The results in Table 3 reveal that ICT devices available to the farmers are the conventional ICT tools: mobile phones (91.14%), radio (78.57%), television (65.71%), laptop, PC, and mobile router (2.86%). For instance, none of the respondents own modern farming technological tools like soil monitoring devices. The findings also revealed an interpersonal source of seeking needed information as 91.14% of respondents indicated their use of mobile phones for verbal and written communication purposes of seeking information from people. The findings also affirm studies [16, 29, 30, 31], that revealed small-scale farmers normally use modest and conventional technologies. However, scholars [33] have highlighted that to achieve sustainable farming in the contemporary era, farmers need to adopt modern technologies to enhance their efficiency.

Awareness of ICT sources of obtaining information and willingness to use them if given the opportunity

Participants were asked about their awareness of ICT sources like websites, YouTube, and web blogs that one can obtain information from as well if they will be willing to search for information from these sources if given the opportunity to use these sources to seek information they require. Table 4 presents the findings. The findings in Table 4 are vital because they reveal that the majority (76.85%) of the study participants are not aware of the benefits ICT presents in the contemporary era. Secondly, more than half (58.0%) of respondents indicated their unwillingness to use ICT sources if given the opportunity. Predispositions such as the lack of individual interest in new ICT or the phobia of ICT termed as lack of psychological access of ICT [32] creates a lack of digital opportunities. Thus, these findings reveal a potential for barriers that can hinder any effort of the government to empower or

create opportunities for the study area: rural small-scale farmers through the digital space could be met with unwillingness to use such opportunities.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The study set out with the aim of developing a framework for guiding the design of specific interventions in achieving effective use of ICT by rural small-scale farmers to access their agricultural input information in the contemporary era. The profiling of the demographics of the farmers in context revealed an older age group and low literacy which needs to be addressed because of its potential to serve as a barrier to ICT uptake among the farmers. The identified intervening variables in the farmers' seeking of information highlighted the farmers' search for information through verbal communication therefore it was not surprising that the study participant's ownership of ICT tools showed ICT devices that facilitate verbal communication.

The study therefore, recommends the use of ICT platforms that promote oral or verbal communications such as automated voice messages to stream agricultural input information to the farmers in the study area to realize an effective utilization of ICT by the farmers to access agricultural input information. A critical look into variables such as cultural practices that influence communication and ICT adoption will be the area of further study.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to Walter Sisulu University Research Directorate for their financial support in paying for the article processing costs.

Conflict of Interest

The authors declare that there is no existing competing interest.

Table 1: Study participant's age and level of literacy

Age	Frequency	Percentage
18 – 23	2	2.86
24 – 29	5	7.14
30 – 35	10	14.29
36 – 41	7	10.0
42 – 47	4	5.71
48 – 53	18	25.71
54 – 59	16	22.86
59 and above	8	11.43
The literacy level of the participants		
Primary school education level	36	51.43
Secondary school education level	27	38.57
College level of education	5	7.14
University level of education	2	2.86

Table 2: information needs, and type of information required by respondents

Statements	Yes	No
I do require information to assist me in my farming activities	100%	
I do require information to decide which crops to plant	71%	29%
I do require information on the start of the rainy season to plan my land preparation	68%	32%
I do require information on market prices of farm produce to determine which market to sell my farm produce	85%	15%
I do require information on stores where agricultural chemicals and tools are cheaper	53%	47%
I do require information on seasonal pests, diseases, and the best approach/chemicals to protect my crops	94%	6%
I do require information on how best to get more produce from my crops	89%	11%

Table 3: Type of ICT tools available to respondents and how they are normally used to seek information

Type of ICT tools owned by participants	Frequency	percentage
Mobile phone	68	91.14
Radio	55	78.57
Television	46	65.71
Laptop/personal computer (PC)	2	2.86
Mobile router	2	2.86
How they are normally used to seek information		
ICT device	How is used to search for information	Percentage
Mobile phone	Voice calls, SMS, use of social media platforms to seek information needed from colleagues and friends	91.14
Radio and television	Listening/watching programs to gather information needed.	88.37
Laptop/PC/mobile router	Search information on websites	2.86

Table 4: Awareness of ICT sources of obtaining information and willingness to use it if given the opportunity

Responses	Percentage
Awareness of ICT sources for obtaining information	
Yes	23.15
No	76.85
Do you search for information from these sources?	
Yes	7.14
No	92.86
Willingness to use ICT sources if given the opportunity	
Yes	19.25
No	58.0
Not sure	22.75

REFERENCES

1. **Aker JC, Ghosh I and J Burrell** The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics*. 2016; **47**: 35–48.
2. **Mittal S, Gandhi S and G Tripathi** Socio-economic impact of mobile phones on Indian agriculture (No. 246). New Delhi: Indian Council for Research on International Economic Relations. 2010.
3. **Phillips D, Waddington H and H White** Better targeting of farmers as a channel for poverty reduction: A systematic review of Farmer Field Schools targeting. *Development Studies Research*. 2014; **1(1)**: 113–136.
4. **Adio EO, Abu Y, Yusuf SK and S Nansoh** Use of agricultural information sources and services by farmers to improve productivity in Kwara State. *Library Philosophy and Practice* (e-journal) 2016.
<http://digitalcommons.unl.edu/libphilprac/1456>. Accessed February 2023.
5. **Okon UA** ICT for rural community development: Implementing the Communicative Ecology framework in the Niger Delta Region of Nigeria. *IT for Development*. 2015; **21(2)**: 199-205.
6. **Adegbidi A, Mensah R, Vidogbena F and D Agossou** Determinants of ICT use by rice farmers in Benin: from the perception of ICT characteristics to the adoption of the technology. *J Res. Int. Bus Manage*. 2012; **2(11)**: 273–84.
7. **Heeks R** Development implications of digital economies, DIODE Network Paper, Centre for Development Informatics, University of Manchester, Manchester, England. 2018.
8. **Abegunde VO, Sibanda M and A Obi** Determinants of the adoption of climate-smart agricultural practices by small-scale farming households in King Cetshwayo district municipality, South Africa. *Sustainability*. 2020; **12(1)**: 1–27.
9. **Deichmann U, Goyal A and D Mishra** Will digital technologies transform agriculture in developing countries? *Agricultural Economics* (United Kingdom). 2016; **47**: 21–33.
10. **Selwyn N** Apart from technology: Understanding people's non-use of information and communication technologies in everyday life. *Technology in Society*. 2003; **25(1)**: 85-94.

11. **Venkatesh V, Morris MG, Davis GB and FD Davis** User acceptance of information technology: Toward a unified view. *MIS Quarterly* 2003; 425-478.
12. **Food and Agriculture Organisation (FAO)**. Information and Communication Technology (ICT) in Agriculture 2017: A Report to the G20 Agricultural Deputies.
13. **Benard R and F Dulle** Application of ICT tools in communicating information and knowledge to artisanal fishermen communities in Zanzibar. *Knowledge Management & E-Learning* 2017; **9(2)**: 239-253.
14. **Aleke B, Ojiako U and DW Wainwright** ICT adoption in developing countries: Perspectives from small-scale agribusinesses. *Journal of Enterprise Information Management*. 2011; **24 (1)**: 68–84.
15. **Kabbiri R, Dora M, Kumar V, Elepue G and X Gellyncka** Mobile phone adoption in the agri-food sector: Are farmers in sub-Saharan Africa connected? *Technological Forecasting & Social Change*. 2018; **131**: 253-261.
16. **Misaki E, Apiola M and S Gaiani** Technology for small-scale farmers in Tanzania: A design science research approach. *Electronic Journal of Information Systems in Developing Countries*, 2016; **74(4)**: 1-15.
17. **Nkandu P and J Phiri** Assessing the Effect of ICTs on Agriculture Productivity Based on the UTAUT Model in Developing Countries. Case Study of Southern Province in Zambia. *Open Journal of Business and Management*. 2022; **10**: 3436-3454.
18. **Maldonado S** Antecedents of technology adoption in agriculture in developing nations. Master's Dissertation, University of Pretoria, 2021.
19. **Awuor F, Raburu G, Onditi A and D Rambim** Building e-agriculture framework in Kenya', *Journal of Agricultural Informatics*. 2016; **7(1)**: 75–93.
20. **Ayibani IT** Ghana: Bono Regional Coordinating Council Inaugurated in Sunyani. 2019. <https://allafrica.com/> Accessed 12th November 2021.
21. **Nzongo D and H Mogambi** An analysis of communication and information technologies adoption in irrigated rice Production in Kenya. *International Journal of Education and Research*. 2016; **4(12)**: 295-316.

22. **Nwafor CU, Ogundeji AA and C van der Westhuizen** Adoption of ICT-Based Information Sources and Market Participation among Smallholder Livestock Farmers in South Africa. *Agriculture* (Switzerland) 2020; **10(2)**.
<https://10.390/agriculture10020044>
23. **Diemer N, Staudacher P, Atuhaire A, Fuhrmann S and J Inauen** Smallholder farmers' information behavior differs for organic versus conventional pest management strategies: A qualitative study in Uganda. *Journal of Cleaner Production*. 2020; **257**: 120465.
24. **Leckie GJ, Pettigrew KE and C Sylvain** Modeling the information seeking of professionals: a general model derived from research on engineers, health care professionals, and lawyers. *Library Quarterly*. 1996; **66(2)**: 161-193.
25. **Mugwisi T** *The information needs and challenges of agricultural researchers and extension workers in Zimbabwe*. Unpublished Doctoral thesis. University of Zululand, Durban, South Africa 2013.
26. **Derr RL** A conceptual analysis of information need. *Information Processing & Management*. 1983; **19(5)**: 273-278.
27. **Wenchi Municipal Assembly**. District medium-term development plan, 2010–2013. Ghana: Wenchi.
28. **Creswell JW and JD Creswell** Research design: qualitative, quantitative, and mixed methods approach. 5th Ed. Los Angeles: Sage Publications 2018.
29. **Musa NS, Githeko JM and K El-Siddig** The adoption and use of ICT by small-scale farmers in Gezira State, Sudan: *Research Application Summary* 2014: 625 – 633.
30. **Vodafone**. India: The Impact of Mobile Phones. Moving the debate forward. *The Policy Paper Series*, Number 9, January 2009.
31. **Shemfe OA** Evaluation of small-scale farmers' use of information communication technology for farm management in Mahikeng Local Municipality. Unpublished master's thesis. University of North-west, Mahikeng, South Africa 2018.
32. **Van Dijk J and K Hacker** The digital divide as a complex, dynamic phenomenon. *The Information Society*. Geneva 2003.

33. **Adenle AA, Azadi H and L Manning** The era of sustainable agricultural development in Africa: Understanding the benefits and constraints. *Food Reviews International*. 2017.
<https://doi.org/10.1080/87559129.2017.1300913>