Journal of Agricultural Extension

Vol. 28 (1) January 2024

ISSN(e): 24086851; ISSN(Print): 1119944X

Website: https://www.journal.aesonnigeria.org; https://www.ajol.info/index.php/jae

Email: editorinchief@aesonnigeria.org; agricultural.extension.nigeria@gmail.com

Relationship between Social Media Use and Development of Crop Production Skills in Saudi Arabia

https://dx.doi.org/10.4314/jae.v28i1.3

Dabiah, Abdulaziz Thabet
Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.
Email: adabiah@ksu.edu.sa
ORCID: https://orcid.org/0000-0002-9540-1127.

Alotibi, Yahya S.
Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.
Email: yalotibi@ksu.edu.sa
ORCID: https://orcid.org/0000-0002-4939-1538.

Azeem, Muhammad Imran
Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.
Email: miazeem@ksu.edu.sa
ORCID: https://orcid.org/0000-0001-6744-2557.

Submitted: 21 May 2023
First Request for Revision: 23 June 2023
Revisions: 23 June, 1st August, 22nd September 2023
Accepted: 15th October 2023
Published: 9th January 2024
Cite as: Dabiah, A. T., Alotibi, Y.S., Azeem, M. I. (2024), Relationship between Social Media Use and Development of Crop Production Skills in Saudi Arabia, *Journal of Agricultural Extension Vol 28(1) 19-* https://dx.doi.org/10.4314/jae.v28i1.3
Keywords: social media, agricultural skills
Conflict of interest: The authors declare no potential conflict of interest.
Acknowledgement: The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at King Saud University for supporting the work through the College of Food and Agriculture Sciences research centre.
Funding agency: The research was funded by the Deanship of Scientific Research at the King Saud University.
Authors' contributions:
ATD: (40%) Conceptualization; Methodology; Writing - original draft.
YSA (30%): Conceptualization; Methodology; Data collection and analysis; Resources and funding acquisition.
MIA (30%): Data analysis and software; Writing - review & editing.

Abstract

The current study examined the information preferences of the subscribers of various agricultural content accounts on social media as well as the perceived impact of social media on crop production skills in Saudi Arabia. Data were collected from the subscribers of the agricultural content accounts of Saudi Arabia on social media using an online survey with the help of a structured questionnaire and a convenient sampling methodology. Both descriptive statistics and Pearson correlation analysis were run to analyse the data. The majority (81%) of the respondents preferred agricultural information in the form of videos, followed by photos (75%). Moreover, a moderate to high impact was reported by the respondents on their various agricultural skills. Trust in social media had a significant negative correlation with respondents' perceived impact on their crop production skills. The respondents' preferences for a particular type of information had a significant positive correlation with the perceived impact of social media on their crop production skills. We conclude that subscribers' trust in social media and their preference for agricultural information in the form of videos are the critical factors that may shape their behaviour positively.

Introduction

The world population is increasing at an alarming rate. It is projected that by the end of 2050, it will reach around 9.7 billion, and by the end of this century, it will be around 10.9 billion. Much of this population growth will be in Asian and African countries, where Human Development Index (HDI) is already quite low (De Wrachien, Schultz, & Goli, 2021; United Nations, 2019). Such an increase in the global population has serious implications for agriculture. On the one hand, it will reduce the cultivated agricultural land by negatively affecting food production in many countries. On the other hand, it will exert more pressure on limited land and water resources to meet the rising food demands of the global population. As prospects for increasing the area for agricultural cultivation are low, we have to considerably increase food production per unit of area. Simultaneously, climate change has emerged as a serious threat to global food security. It is thought to be the key driver of the food crisis in many countries, and it is also projected to have negative effects on food production systems across the globe, including all four dimensions of food security (Das & Ansari, 2021; Food and Agriculture Organization et al., 2018; Intergovernmental Panel on Climate Change, 2022; Karavolias et al., 2021; Molotoks, Smith, & Dawson, 2021).

Over the last few decades, awareness about the importance of natural resources for any nation and concerns of the people for their conservation have grown substantially (Gebeyehu, 2019; Kumar, Meena, & Jhariya, 2020). Now, national governments particularly emphasize the judicious use, protection, and conservation of natural resources by employing a set of sustainable and climate-smart agricultural practices. These practices have been developed to address the ongoing issue of climate change as well as to ensure food security in the long run (Barasa et al., 2021; Jamil et al., 2021; Mensah et al., 2021; Mishra et al., 2021; Zougmoré, Läderach, & Campbell, 2021). However, a key factor in farmers' adoption decisions about the uptake and use of a particular practice or a set of practices is that they are aware of these practices and also possess technical knowledge about how to apply them in the field at their agricultural farms.

Agricultural extension is used as an institutional tool to create awareness among farmers, and to educate and train them about sustainable agricultural practices (Norton & Alwang, 2020). The development of advanced information and communication technologies (ICTs) and their deployment in agricultural extension has changed the delivery of extension and advisory services. Now, most of the organizations and agencies that are involved in the provision of extension services use social media platforms in order to serve their clients by sharing their knowledge and ideas using a variety of audio-visual materials (Maja et al., 2018; Spielman et al., 2021; Steinke et al., 2021). Social media offers two-way communication opportunities; not only extension service providers can provide extension services to their users, but the users can also share their useful feedback that can be used to further improve extension services. Moreover, these tools are highly efficient in connecting and serving large number of farmers spread over vast geographical distances using minimum time, money and effort (Lubell & McRoberts, 2018; Spielman et al., 2021; Tata & McNamara, 2018).

In Saudi Arabia, ICT infrastructure and facilities are much better than other developing countries (Ministry of Communications and Information Technology, 2023). Agricultural extension organizations involved in extension provision have their

social media accounts that they use to serve their thousands of followers across the country. However, there is a dearth of literature that documents social media platforms' impact on the development of crop production skills in its followers and subscribers in Saudi Arabia. This study examined the following research objectives:

1. identify the type of information preferred by the followers;
2. determine the relationship of trust in social media and the perceived impact of agricultural skills; and
3. determine relationship between preferred type of information and perceived impact on agricultural skills

Methodology

The present study was conducted using a cross-sectional survey as a research design. The population of the study constituted all the users of the agricultural content accounts on Twitter. An appropriate sample size of the respondents was computed using the following equation (Charan & Biswas, 2013; Naing et al., 2022; Taherdoost, 2017):

$$\text{Sample size } (n) = \frac{\frac{z^2 \times P(1-P)}{e^2}}{1+\left(\frac{z^2 \times P(1-P)}{e^2 N}\right)}$$

$$n = \frac{\frac{1.96^2 \times 0.5(1-0.5)}{0.05^2}}{1+\left(\frac{1.96^2 \times 0.5(1-0.5)}{0.05^2 \times 456{,}600}\right)} = 385$$

Where Z represents the value of Z-score; its value at 95% confidence level is 1.96.
P is standard deviation (0.5).
e is the margin of error (5%).
N is population size (456,600).

In order to collect data from the respondents, a convenience sampling technique was employed based on the respondents' willingness to participate in the survey. The research questionnaire was reviewed by a group of subject experts from the King Saud University's College of Food and Agriculture Sciences and Iowa State University's College of Agriculture and Life Sciences. The research instrument was found to be valid in terms of its face and content validity. Before initiating the process of pilot testing of the research instrument, formal approval of the Research Ethics Committee at the King Saud University was sought. The pilot study was conducted involving around 40 respondents. The Cronbach's Alpha coefficient of reliability was used in order to estimate the internal consistency of the Likert scale items used in the research instrument. The value of the Alpha was 0.93, which indicates a high level of internal consistency of the scale.

Data were collected using an online survey with the help of a pre-tested structured questionnaire. The first section of the questionnaire contained questions related to the respondents' demographic and socio-economic variables. These variables included: level of education, monthly income, gender, current working status, and region or area. These variables were measured at nominal and ordinal scales. The second section consisted of questions related to respondents' preferred type of information. These questions were measured using a 3-point Likert scale (1 = least preferred; 2 = moderately preferred; 3 = highly preferred). The last section of the

questionnaire contained questions related to social media's perceived impact on the agricultural skills of the respondents. These questions were measured using a 3-point Likert scale (1 = low; 2 = moderate; 3 = high). About 383 respondents returned the completed questionnaires. However, data about some of the variables were missing in about eight questionnaires. These incomplete questionnaires were not included in the final data analysis. Therefore, the total number of the questionnaires that were complete in all respects and used in the formal analysis was 375.

Both descriptive and inferential statistics were used for data analysis. Frequency and percentages were used to summarize the data. Pearson correlation was used in order to determine relationship between trust status on social media, preferred type of information, and perceived impact on agricultural skills. Moreover, multiple regression analysis was also run for predicting the impact of these variables on agricultural skills of the respondents. Statistical Package for Social Sciences (SPSS v27.0) was used for analyzing the data.

Results and Discussion

Regional Distribution of the Respondents

Table 2 shows respondents' distribution according to their respective regions of Saudi Arabia. Almost half (48%) of the respondents belonged to central regions. About 30% of them were from western regions, which includes Makkah and Madinah regions. The respondents who belonged to northern regions were almost 14%. There were relatively less respondents from southern and eastern regions: about 7% from southern regions and approximately 2% from eastern regions.

The Kingdom of Saudi Arabia is divided into several regions for administrative purposes. Some of these regions hold high agricultural importance, mainly based on their climatic and soil conditions that are conducive to agricultural and animal production. The Qassim and Madinah regions are particularly important in terms of agricultural production as much of the agricultural activities in the Kingdom are concentrated in these areas, and they have a crucial role in the food security of Saudi Arabia (Al-Wabel et al., 2020; Alotaibi et al., 2023). A relatively higher proportion of the respondents from central and western regions who benefit from agricultural content accounts on social media also suggests that agriculture is a major business enterprise in these regions.

Table 1: Regional distribution of the respondents

Region	Percent
Central regions (Riyadh, Qassim)	48.0
Western regions (Makkah, Madinah)	29.6
Northern regions (Hail, Jouf, Tabuk, Northern Borders)	13.6
Southern regions (Jazan, Al-Baha, Asir, Najran)	7.2
Eastern region	1.6

n = 375.

Preferred Type of Information

Table 3 provides the results of the respondents' preferences for each type of information. About 81% of the respondents stated that they highly preferred agricultural information in the form of videos. Like videos, agricultural information in the form of photos was also highly preferred by almost 75% of the respondents. About 42% of the respondents indicated their high preference for agricultural information in the form of infographics. Unlike videos and photos, information in the form of plain text was highly preferred by a relatively low proportion (49%) of the respondents.

The respondents' preference for information in the form of videos and photos suggests that these modes of information and knowledge transfer may be more effective due to facilitations in the learning process. Videos and photos serve as an effective and convenient learning resource. Users can replay a video many times to acquire and polish a skill as well as can save it for future reference. Videos are also great in capturing the attention of its viewers, and hence can further enhance the learning process. Videos are widely used in agricultural extension for practical demonstrations. Besides government agricultural agencies involved in extension work, progressive farmers could also make videos for educating and training other farmers. If videos are made in a proper professional way, they offer a huge potential for developing agricultural skills in remote rural areas (Chivers et al., 2021; Ibeawuchi et al., 2021; Thakur & Chander, 2018; Thomas, Bowling, & Brewer, 2018). Besides videos, information in the form of photos was also preferred. However, information in the form of plain text and infographics was relatively less preferred by the respondents. Generally, organizations preferably share information, knowledge, and ideas in the form of videos or photos rather than plain text. This suggests that official agricultural accounts should preferably share information and ideas in those forms, like videos and photos that can be useful for the followers on social media.

Table 2: Respondents' preferred type of information

Type of Information*	Mean	Standard Deviation
Videos	2.81	0.53
Photos	2.70	0.52
Infographics	2.22	0.76
Text	2.39	0.65

* (1 = least preferred; 2 = moderately preferred; 3 = highly preferred)

Perceived Impact of Social Media on Agricultural Skills

Table 4 depicts the results of perceived impact of social media on agricultural skills of the respondents. About 44% of the respondents indicated that social media had moderate impact on their compositing and fertilizer mixing skills, whereas high impact was reported by almost 40% of the study participants. About 39% of the respondents reported high impact on their ability to determine different types of soils, whereas moderate impact was reported by approximately 44% of the respondents. Regarding fertilizer application skills, about 42% of the respondents reported moderate impact, whereas 39% of them indicated a high impact. Nearly 46% of the

respondents mentioned that social media had moderate impact on their skills regarding using irrigation systems effectively contrary to other 36% of the respondents who reported high impact. About 46% of the respondents reported moderate impact on their ability to apply proper seeding distance and depth for sowing. About half (50%) of the respondents perceived moderate impact on their skills related to harvesting methods, whereas low impact was reported by almost 25% of them.

The advancements in ICTs have revolutionized the way we generate, process, and transmit information for various purposes. It has also greatly improved learning opportunities and experiences for independent learners. A variety of customizable tools are available for generating, sharing, and storing information, knowledge and ideas with ease and efficiency. Modern agriculture employs ICT applications in many forms in order to remain productive and competitive (Ali et al., 2019; Ayim et al., 2020; Bucci, Bentivoglio, & Finco, 2019; Chowhan & Ghosh, 2020). Moreover, a considerable increase in the accessibility of internet to the general public has further facilitated the flow of information over wide geographical distances. Use of social media has substantially increased over the last decade. Now, a vast majority of people who have access to smartphones and internet use multiple social media platforms like Twitter, Facebook, YouTube, and Instagram (Auxier & Anderson, 2021). In the Kingdom of Saudi Arabia, Twitter is more popular and widely used than other social media platforms. Several government institutions, private organizations, and well-known national figures frequently use Twitter to communicate and interact with other people, based on their particular interests and objectives (Mohammed & Ferraris, 2021). Organizations that have their official social media accounts have become more careful in posting different kinds of information in the form of videos, photos, and text due to greater user awareness as well as their ability to quickly detect false information and post their feedback and comments. Most of the official accounts, especially the government related publish accurate information to inform the public in general (Chen et al., 2020; Mansoor, 2021).

Overall, participants perceived moderate to high impact of social media on the development of their agricultural skills. A relatively high impact was perceived on: compositing and fertilizer mixing, determining various types of soils, and fertilizer application. It may be because these agricultural skills are relatively easy to learn. A moderate effect was perceived on “use of effective irrigation systems,” and “harvesting methods.” The information and knowledge on social media regarding these skills might not be sufficient due to their relatively complex nature. The information providers on the social media should reflect on that different skills need specialized knowledge in various forms and should carefully undertake an effective approach to share their ideas and information regarding a particular theme or skill. Social media is widely used in several Asian and African countries for sharing knowledge and building farmers’ networking. However, its full potential need to be fully exploited by the extension and development agencies by tailoring it to the actual needs of the farmers and growers (Skaalsveen, Ingram, & Urquhart, 2020; Thakur & Chander, 2018).

Table 3: Perceived impact of social media on agricultural skills

Agricultural Skills	Respondents' Perceived Impact			Mean	Standard Deviation
	Low (%)	Moderate (%)	High (%)		
Compositing and fertilizer mixing	16.5	44.0	39.5	2.23	0.71
Determining soil types	17.3	43.5	39.2	2.22	0.72
Fertilizer application	18.9	42.4	38.7	2.20	0.73
Using effective irrigation systems	18.4	45.9	35.7	2.17	0.71
Proper distance between seeds	18.9	46.1	34.9	2.16	0.72
Proper seeding depth	21.9	46.7	31.5	2.10	0.73
Harvesting methods	25.1	50.4	24.5	1.99	0.71

n = 375.

Relationship between Trust in Social Media, Preferred Type of Information, and Perceived Impact on Agricultural Skills

Table 5 shows the results of Pearson correlation between respondents' trust in social media, preferred type of information, and social media's perceived impact on the development of agricultural skills. The results of the Pearson correlation analysis revealed that there was a significant negative correlation between respondent's trust in social media and perceived impact on agricultural skills. The correlation analysis also revealed a significant positive relationship between respondents' preference for videos, photos, and text with their perceived impact of social media on agricultural skills. However, there was no significant correlation between preference for infographics and social media's impact on agricultural skills. The analysis of the values of Pearson correlation coefficients for each variable indicated an overall weak correlation.

A significant negative relationship between respondents' trust in social media and perceived impact on their agricultural skills suggests that the participants who trust in social media are more likely to perceive a higher impact on their agricultural skills. Although correlation is weak, it suggests that trust in potential information providers is a key factor for convincing the users to benefit from the information and ideas. Moreover, information and ideas in the form of videos and photos are relatively more effective than plain text and infographics.

Table 4: Relationship between trust in social media, preferred type of information, and perceived impact on agricultural skills

Independent Variables	Perceived Impact on Agricultural Skills[c]
Trust in Social Media[a]	-0.199**
Preferred Type of Information[b]	
Videos	0.258**
Photos	0.210**
Infographics	0.098
Text	0.206**

[a] (1 = trust; 2 = no trust). [b] (Each type of information was measured using a 3-point Likert scale: 1 = least preferred; 2 = moderately preferred; 3 = highly preferred). [c] (1 = low; 2 = moderate; 3 = high). **Significant at the 0.01 level (2-tailed).

Conclusion and Recommendations

Respondents prefer agricultural information and knowledge mainly in the form of videos, followed by photos. Agricultural and other organizations, both governmental and non-governmental, which are involved in the provision of extension services in the Kingdom of Saudi Arabia should preferably use videos and photos in order to disseminate agricultural knowledge on social media platforms. Trust in social media is another important factor that may positively influence the behaviour of its consumers. The relevant organizations should strive hard to build trust among its subscribers by providing accurate and up-to-date information, which is potentially useful and caters to the needs of the users. Due to widespread use of social media platforms, this tool can be efficiently used for disseminating agricultural information, knowledge, and idea to a large number of people. Lastly, each agricultural skill is unique in its own sense as it requires specific knowledge and experience. To disseminate certain skills, a lot of organized information in multiple ways may be needed, especially for the agricultural skills that are complex in nature. Agricultural information and service providers on social media, therefore, should carefully evaluate different aspects of a particular skill while designing the instructional and educational materials for publishing on the social media.

References

Al-Wabel, M. I., Sallam, A., Ahmad, M., Elanazi, K., & Usman, A. R. (2020). Extent of climate change in Saudi Arabia and its impacts on agriculture: a case study from Qassim region. *Environment, climate, plant and vegetation growth*, 635-657.

Ali, M., Mubeen, M., Hussain, N., Wajid, A., Farid, H. U., Awais, M., Hussain, S., Akram, W., Amin, A., & Akram, R. (2019). Role of ICT in crop management. In *Agronomic crops* (pp. 637-652). Springer.

Alotaibi, B. A., Abbas, A., Ullah, R., Azeem, M. I., Samie, A., Muddassir, M., Dabiah, A. T., Raid, M., & Sadaf, T. (2023). Dynamics and Determinants of Farmers' Perceptions about Causes and Impacts of Climate Change on Agriculture in Saudi Arabia: Implications for Adaptation, Mitigation, and Sustainability. *Atmosphere*, *14*(6), 917.

Auxier, B., & Anderson, M. (2021). Social media use in 2021. *Pew Research Center*, *1*, 1-4.

Ayim, C., Kassahun, A., Tekinerdogan, B., & Addison, C. (2020). Adoption of ICT innovations in the agriculture sector in Africa: A Systematic Literature Review. *arXiv preprint arXiv:2006.13831*.

Barasa, P. M., Botai, C. M., Botai, J. O., & Mabhaudhi, T. (2021). A review of climate-smart agriculture research and applications in Africa. *Agronomy*, *11*(6), 1255.

Bucci, G., Bentivoglio, D., & Finco, A. (2019). Factors affecting ICT adoption in agriculture: A case study in Italy. *Calitatea*, *20*(S2), 122-129.
Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian journal of psychological medicine*, *35*(2), 121-126.
Chen, Q., Min, C., Zhang, W., Wang, G., Ma, X., & Evans, R. (2020). Unpacking the black box: How to promote citizen engagement through government social media during the COVID-19 crisis. *Computers in human behavior*, *110*, 106380.
Chivers, C.-A., Bliss, K., de Boon, A., Lishman, L., Schillings, J., Smith, R., & Rose, D. C. (2021). Videos and podcasts for delivering agricultural extension: achieving credibility, relevance, legitimacy and accessibility. *The Journal of Agricultural Education and Extension*, 1-25.
Chowhan, S., & Ghosh, S. R. (2020). Role of ICT on agriculture and its future scope in Bangladesh. *Journal of Scientific Research and Reports*, *26*(5), 20-35.
Das, U., & Ansari, M. A. (2021). The nexus of climate change, sustainable agriculture and farm livelihood: contextualizing climate smart agriculture. *Climate Research*, *84*, 23-40. https://doi.org/10.3354/cr01648
De Wrachien, D., Schultz, B., & Goli, M. B. (2021). Impacts of population growth and climate change on food production and irrigation and drainage needs: A world-wide view. *Irrigation and Drainage*, *70*(5), 981-995.
Food and Agriculture Organization, UNICEF, WHO, WFP, & IFAD. (2018). *The State of Food Security and Nutrition in the World 2018: Building climate resilience for food security and nutrition*.
Gebeyehu, M. N. (2019). Remote sensing and GIS application in agriculture and natural resource management. *International Journal of Environmental Sciences & Natural Resources*, *19*(2), 45-49.
Ibeawuchi, B., Adisa, P., Gbede, O., Bilisuma, K., Derara, S., & Aminu, H. (2021). REVIEW OF THE USE OF VIDEO IN AGRICULTURAL EXTENSION TO INCREASE THE ADOPTION OF AGRICULTURAL INNOVATION. *JCCR| Journal of Community & Communication Research*, *6*(2), 110-118.
Intergovernmental Panel on Climate Change. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/wg3/
Jamil, I., Jun, W., Mughal, B., Raza, M. H., Imran, M. A., & Waheed, A. (2021). Does the adaptation of climate-smart agricultural practices increase farmers' resilience to climate change? *Environmental Science and Pollution Research*, *28*(21), 27238-27249.
Karavolias, N. G., Horner, W., Abugu, M. N., & Evanega, S. N. (2021). Application of Gene Editing for Climate Change in Agriculture. *Frontiers in Sustainable Food Systems*, *5*, Article 685801. https://doi.org/10.3389/fsufs.2021.685801
Kumar, S., Meena, R. S., & Jhariya, M. K. (2020). *Resources use efficiency in agriculture*. Springer.
Lubell, M., & McRoberts, N. (2018). Closing the extension gap: Information and communication technology in sustainable agriculture. *California Agriculture*, *72*(4), 236-242.
Maja, C., Marko, C., Boris, K., & Ana, Z. (2018). Farmer innovativeness and its impact on internet and social media adoption. *Economics of Agriculture*, *65*(1), 243-256.
Mansoor, M. (2021). Citizens' trust in government as a function of good governance and government agency's provision of quality information on social media during COVID-19. *Government Information Quarterly*, *38*(4), 101597.
Mensah, H., Ahadzie, D. K., Takyi, S. A., & Amponsah, O. (2021). Climate change resilience: Lessons from local climate-smart agricultural practices in Ghana. *Energy, Ecology and Environment*, *6*(3), 271-284.
Ministry of Communications and Information Technology. (2023). *Saudi Arabia ICT Sector Strategy 2023: A Summary*. Ministry of Communications and Information Technology. Retrieved 15 July from https://www.mcit.gov.sa/sites/default/files/ict_strategy_summary.pdf
Mishra, A., Ketelaar, J. W., Uphoff, N., & Whitten, M. (2021). Food security and climate-smart agriculture in the lower Mekong basin of Southeast Asia: evaluating impacts of system of rice intensification with special reference to rainfed agriculture. *International Journal of Agricultural Sustainability*, *19*(2), 152-174.
Mohammed, A., & Ferraris, A. (2021). Factors influencing user participation in social media: Evidence from twitter usage during COVID-19 pandemic in Saudi Arabia. *Technology in Society*, *66*, 101651.
Molotoks, A., Smith, P., & Dawson, T. P. (2021). Impacts of land use, population, and climate change on global food security. *Food and Energy Security*, *10*(1), e261.

Naing, L., Nordin, R. B., Abdul Rahman, H., & Naing, Y. T. (2022). Sample size calculation for prevalence studies using Scalex and ScalaR calculators. *BMC Medical Research Methodology*, *22*(1), 1-8.

Norton, G. W., & Alwang, J. (2020). Changes in agricultural extension and implications for farmer adoption of new practices. *Applied Economic Perspectives and Policy*, *42*(1), 8-20.

Skaalsveen, K., Ingram, J., & Urquhart, J. (2020). The role of farmers' social networks in the implementation of no-till farming practices. *Agricultural Systems*, *181*, 102824.

Spielman, D., Lecoutere, E., Makhija, S., & Van Campenhout, B. (2021). Information and communications technology (ICT) and agricultural extension in developing countries. *Annual Review of Resource Economics*, *13*, 177-201.

Steinke, J., van Etten, J., Müller, A., Ortiz-Crespo, B., van de Gevel, J., Silvestri, S., & Priebe, J. (2021). Tapping the full potential of the digital revolution for agricultural extension: an emerging innovation agenda. *International Journal of Agricultural Sustainability*, *19*(5-6), 549-565.

Taherdoost, H. (2017). Determining sample size; how to calculate survey sample size. *International Journal of Economics and Management Systems*, *2*.

Tata, J. S., & 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.

Thakur, D., & Chander, M. (2018). Use of social media in agricultural extension: Some evidences from India. *International Journal of Science, Environment and Technology*, *7*(4), 1334-1346.

Thomas, J. L., Bowling, R., & Brewer, M. J. (2018). Learning experiences in IPM through concise instructional videos. *Journal of Integrated Pest Management*, *9*(1), 2.

United Nations. (2019). *World population prospects 2019: Highlights*.

Zougmoré, R. B., Läderach, P., & Campbell, B. M. (2021). Transforming food systems in Africa under climate change pressure: Role of climate-smart agriculture. *Sustainability*, *13*(8), 4305.