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Digital Literacy Development Among Farmers: Evidence from the Digital Farmers Program in Davao City, Philippines

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Abstract

The study examined the effectiveness of the Digital Farmers Program (DFP) in enhancing the Digital Literacy of Farmers. It also sought the factors influencing the Digital Literacy of Farmers. A quantitative research design and random sampling were employed to select 48 DFP-trained farmers. Primary data were collected using a structured questionnaire and were analyzed using the test of difference and multiple linear regression. The result revealed that the digital farmers program significantly improved the digital literacy level of farmers. The mean score of the digital literacy level showed a significant improvement from a mean score of 2.22 before the training to 3.73 after the training. Location, educational attainment, digital tool ownership, and internet connectivity were found to be the significant facilitating factors of the digital literacy level. Those in the urban areas have a higher digital literacy level than those in the rural areas. College graduate farmers with access to digital tools and internet connectivity were found to have a higher digital literacy level than other farmers. On the other hand, the age of the farmer was found to be a significant hindering factor influencing the digital literacy level. It indicates that older farmers have low digital literacy level than young farmers. Thus, there is a significant difference in the digital literacy level of farmers before and after the Digital Farmers Program. Also, the farmers' demographic profile significantly affects the digital literacy of farmers

Keywords: Digital Farmers Program, Digital Literacy, Extension, Farmers, Training.

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INTRODUCTION

Agricultural extension is important for development and poverty alleviation, capacitating farmers with the innovative technologies and skills necessary to address farming challenges (Maulu et al., 2021). The integration of Information and Communication Technologies (ICTs) offers a transformative approach to traditional extension services (Spielman et al., 2021). In Uganda, ICT modalities such as radio, SMS, and video significantly enhance farmer knowledge and technology adoption compared to traditional methods (Tambo et al., 2019). However, a persistent digital divide remains a major obstacle, particularly in developing nations where only 44% of the population has reliable internet access (International Telecommunication Union, 2023). In the Philippines, the Department of Agriculture had launched an agenda called the "One DA" in June 2021, a strategic framework built on four pillars, including modernization of the sector through ICT. While agencies like PhilRice have developed tools such as the Binhing Palay app, digital inclusivity remains hindered by infrastructure gaps, limited technology access, and a lack of digital literacy among farmers (Alip, 2022). To address these barriers, the SMART Communications, Inc. and Agricultural Training Institute (ATI) launched the Digital Farmers Program (DFP) in 2019. This capacity-building initiative aims to advance farmers' digital proficiency through two primary levels: DFP 101, which covers digital basics and social media marketing, and DFP 102, which introduces advanced applications and e-commerce. The program has scaled rapidly; from January to June 2023 alone, 56 trainings reached nearly 2,000 participants. By September 2023, the program had rolled out 312 sessions, benefiting 8,506 Filipino farmers nationwide (Smart.com, 2023). In Davao Region, the Agricultural Training Institute XI implemented the program throughout the region, benefiting the farmers, and training of trainers (TOTs) for the Digital Farmers Program was facilitated in which Learning Site for Agriculture (LSA) and Agricultural Extension Workers (AEWs) from the different Local Government Units (LGUs) were trained to disseminate and roll out training for farmers. In Davao City, the ATI-RTC XI and the City Agriculturist Office have trained 54 farmers between 2019 and 2024 (City Agriculturist Office, 2024). Despite these initiatives, existing research often focuses on the factors that influence the adoption of these technologies rather than the enhancement of the digital literacy of farmers (Aliduo et al., 2024). Although the DFP has been active in Davao City for four years, there is currently no formal assessment of its impact on enhancing local farmers' digital literacy. By evaluating the program's efficacy in capacitating farmers, this research also seeks to determine the factors affecting the digital literacy of farmers.

METHODOLOGY

This study was conducted in Davao City, Philippines, where the farmers who attended the Digital Farmers Program trainings conducted by the Agricultural Training Institute XI and Davao City Agriculturist Office were the respondents of this research. To determine the variables affecting digital literacy and assess how well the Digital Farmers Program (DFP) has improved farmers' digital literacy in Davao City, a quantitative approach was used. The primary data were collected using a structured questionnaire as a gathering instrument to collect quantitative data. The questionnaire underwent validation from the pool of experts and was pilot tested on 10 farmers in Davao City and other neighboring provinces who were trained in the Digital Farmers Program. Simple random sampling technique was adopted in which allows the random selection of the respondents for the study (Noor et. al, 2022). A list of farmers that participated in the DFP training was obtained from the ATI-RTC XI and Davao City Agriculturist Office. A total of 48 farmers were interviewed in which was computed using the Yamane formula. The study used inferential statistics to analyze the quantitative data. The inferential statistics, T-test and ANOVA were used to test the difference in the digital literacy level of farmers before and after the DFP training. Digital literacy level of farmers was measured through a 5-point likert scale; 1-Strongly Disagree, 2-Disagree, 3-Neither Agree nor Disagree, 4-Agree, and 5-Strongly Agree. The responses were processed through averaging and was interpreted through the scoring category derived from dividing the perfect score 5-Strongly Agree. The scores of the Likert Scale were interpreted as follows: 1.0-1.8 Very Low; 1.81-2.6 Low; 2.61-3.40 Moderate; 3.41-4.20 High; and 4.21-5.0 Very High (Yunlu and Ozenc, 2025). Moreover, using the Statistical Package for Social Sciences (SPSS), multiple linear regression was utilized to identify facilitating and hindering factors that affect farmers' digital literacy.

The dependent variable for the regression was the overall average of the digital literacy level of the farmers. The following was the model for the multiple linear regression showing the dependent variable and independent variables:

Digital Literacy level= $\beta_0+\beta_1$(Age)$+\beta_2$(Gender)$+\beta_3$ (Gross Annual Income)$+\beta_4$(Location)$+\beta_5$(Education)$+\beta_6$(Years in Farming)$+\beta_7$ (Digital Tool Ownership)$+\beta_8$(Internet Connectivity)$+ \varepsilon$

Where: Y = Digital Literacy Level, β_0= Intercept (constant), $\beta 1, \beta 2, \ldots, \beta 8$= Independent variables, ε = Error term

RESULTS

Table 1 presents the overall mean scores of the farmers' digital literacy levels before and after participating in the Digital Farmers Program (DFP) training. The mean score of the digital literacy level before the training was 2.22, which can be interpreted as Low Digital Literacy Level. There was a significant improvement from a mean score of 2.22 before the training to 3.73 after the training, which can be interpreted as a High Digital Literacy Level (Yunlu and Ozenc, 2025). This represents a mean difference of -1.50, indicating a notable increase in the participants' confidence and ability to use digital tools. The paired sample t-test yielded a t-value of -15.341 and p-value of 0.000, which confirms that the difference in digital literacy level is statistically significant. This suggests that the null hypothesis that there is no significant difference in the digital literacy level of farmers before and after the DFP training is rejected. In other words, the DFP training had a positive and meaningful impact on enhancing the digital literacy level of the farmers. This increase suggests that the training effectively enhanced the participants' understanding and use of digital tools, which is especially important in digital farming.

Table 1. Digital literacy level of farmers before and after DFP training

Digital Literacy Level	Mean Before DFP	Mean After DFP	N	Mean Difference	t-value	p-value
Digital Literacy Level	2.2274	3.7300	48	-1.50260	-15.341	.000

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Access	2.1667	3.6625	48	-1.49583	-11.699	.000
Manage	2.1042	3.4575	48	-1.35333	-9.584	.000
Integrate	2.0277	3.6185	48	-1.59083	-11.327	.000
Communicate	2.3906	3.9323	48	-1.59083	-12.261	.000
Create	2.2188	3.6094	48	-1.39063	-10.612	.000
Evaluation	2.3583	3.9625	48	-1.60417	-12.835	.000

Moreover, Table 2 showed that the multiple linear regression model is statistically significant with F=18.69 and a p<0.001, indicating that the independent variables are predictors of the dependent variable. The regression model explains approximately 75% of the variance in digital literacy level, as indicated by the adjusted R2 squared value of 0.75. The findings provide strong statistical evidence that at least one of the demographic characteristics is significantly affecting the digital literacy levels of farmers. As a result, the study rejected the null hypothesis that demographic characteristics have no significant relationship with the digital literacy level of farmers.

Table 2 Analysis of variance (ANOVA) for the multiple linear

	Sum of squares	df	Mean Square	F	Sig.	Adjusted R squared
Regression	27.539	8	3.442	18.69	.000	0.751
Residual	7.183	39	0.184			
Total	34.722	47				

Note: Independent variables - age, gender, location, educational attainment, annual income, years in farming, gadget ownership, and internet connectivity;
Dependent variable - Digital Literacy Level

Furthermore, the result in Table 3 indicates that three of the independent variables namely age, digital tool ownership, and internet connectivity are the factors that have a significant relationship with the digital literacy of farmers. The coefficient showed the amount of change in the digital literacy level for each 1 unit change in the independent variables.

Table 3 Relationship between demographic Profile and Digital Literacy

Independent Variables	**Coefficients**	**t-value**	**P-value**
Age (Continuous)	-0.020	-2.559	0.014
Gender (1-Male, 0-Otherwise)	0.042	0.327	0.746
Location (1-Urban, 0-Rural)	0.391	2.040	0.048
Educational Attainment (1-College graduate, 0-otherwise)	0.478	2.183	0.035
Gross Annual Income (continuous)	-5.837	-0.007	0.995
Years in Farming (continuous)	0.003	0.542	0.591
Digital Tools Ownership (1-yes, 0-No)	0.679	3.077	0.004
Internet Connectivity (1-yes, 0-No)	0.764	2.580	0.014

The result showed that age has a p-value 0.014, which indicates that it significantly influences the level of digital literacy of farmers. The coefficient of -0.020 indicates that there is a negative relationship between age and digital literacy level, which means that as the age increases, the digital literacy level decreases. Also, location is significant with p-value 0.048 and coefficient of 0.391, which suggests that location significantly influences the digital literacy of farmers. This means the farmers' digital literacy in the urban areas is much higher than those farmers in the rural areas. It was also found that educational attainment is also a significant predictor with a p-value 0.035 with a coefficient of 0.478. This suggests that the digital literacy of those farmers who are college graduate are 0.478 higher than those who are not. Additionally, digital tool ownership with coefficient of 0.679 is significant (p=0.004), signifying a positive relationship, which means that those farmers who owned digital tools such as smartphones and computers tend to have significantly higher digital literacy level. Lastly, internet connectivity with a p-value of 0.014 and a coefficient of 0.764 indicates a significant positive influence in the digital literacy of farmers. It suggests that those farmers who have access to the internet are more digitally literate.

DISCUSSION

Through the results of the study, we can see that the Digital Literacy Level of farmers improved in all of the categories of digital literacy. It can be compare which components of the digital literacy of farmers need improvement. Looking at the result of the post-training mean scores, it showed that the farmers experienced the most significant growth in the Evaluate category, which means

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that the farmers have the most improvement in their ability to judge agricultural information for its relevance, quality, and usefulness. While the least improvement is Manage, the ability of farmers to collect, sort, store, and track agricultural information. An important gap in the training design and implementation is highlighted by this discrepancy between high evaluation gains and lower gains in manage. The development of practical digital skills may require more focus, even though cognitive and analytical skills were successfully improved. More guided exercises on digital recordkeeping, farm management application use, and step-by-step demonstrations catered to the farmers' context could be included in future training programs to address this. These abilities could also be strengthened over time by follow-up support systems like coaching, peer learning groups, or help from extension workers. Moreover, the facilitating and hindering factors indicate that age, location, educational attainment, digital tool ownership, and internet connectivity are the significant factors influencing digital literacy level of farmers. The findings of this study are aligned with existing literature that age has a significant influence in the ability of farmers to understand and apply digital technologies. Kansiime et al. (2019) suggest that the age of farmers has a negative relationship to digital literacy level because older farmers have less experience in using digital tools. Their study highlights that the digital literacy level of farmers is low primarily because of their less exposure and experience with digital tools and technologies. Location is also a facilitating factor influencing digital literacy of farmers. In accordance with the study's findings, farmers in urban areas are more digitally literate than those in rural areas. This result is in line with recent research showing how a person's location affects their level of digital literacy. For instance, Sabado (2024) found that there was a disparity in digital awareness on how to use mobile applications among people from the upland and lowland areas. Similarly, Torino (2025) found that the digital literacy of individuals from urban areas is better compared to those in rural areas due to the infrastructure gaps like internet connectivity. In addition, supporting the result of this study is the recent study of Alant and Bakare (2021) in South Africa, suggesting that the education level of smallholder farmers had a positive relationship with ICT literacy, implying that farmers with higher educational levels are more proficient in using ICT tools. In this study, the alignment of these findings strengthens the argument that those farmers who have a college degree of educational attainment have advanced level of digital literacy than other farmers. Those farmers with higher educational attainment possessed foundational skills such as reading comprehension, critical thinking, and familiarity with structured learning environments, and have higher adoption and effective use of digital tools. It suggests that the digital farmers program implementation must focus more on the farmers with lower educational attainment.

Moreover, farmers who have access to digital tools have higher digital literacy level. The finding of the study is consistent with the current research of Krell (2020), in which the factors influencing farmers' willingness to utilize mobile services in central Kenya was investigated. According to their findings, smartphone ownership has a significant effect on farmers' use of mobile phone-based agricultural information services. It is clear that smartphone ownership and accessibility are essential to farmers' ability to use and benefit from agricultural digital services. This literature further supports the idea that increasing smartphone access and guaranteeing its effective use are crucial strategies for developing digital literacy in rural farming communities. It emphasizes how important it is to promote user competence in addition to offering the digital tools in order to enhance the advantages of digital agriculture. Lastly, internet connectivity is also a facilitating factor of digital literacy of farmers. The result proves that being connected online gives the farmers more exposure to digital platforms and opportunities to use digital tools. This finding is reinforced by Abdulai et al. (2023), who found that while many farmers owned mobile phones, just a small percentage had internet access, primarily via cellular data. Poor network coverage and high cost of data were among the barriers that affected utilization. Similarly, according to PhilRice (2021) that the 2021 Rice-Based Farmers Household Survey (RBFHS) found that only 21% of rice farmers accessed information online, indicating that digital anxiety, limited exposure to ICTs, and a preference for interpersonal contact continue to limit digital participation. Overall, while internet access has a positive effect on digital literacy, it must be complemented by initiatives to increase affordability, infrastructure, and farmers' digital literacy.

While these five factors were found to significantly influence digital literacy, on the other hand, gender, gross annual income, and years in farming are factors that are not statistically significant. However, the gender and years in farming have a positive relationship with digital literacy level. While, gross annual income has negative relationship with digital literacy level.

CONCLUSION

Thus, the Digital Farmers Program had a favorable and significantly impacted the farmers' digital literacy level. The t-test result showed that the null hypothesis was rejected, indicating that farmers' levels of digital literacy before and after the training varied significantly. The training is particularly effective in enhancing the participants' skills and confidence in using digital tools for agricultural applications. Therefore, the study indicates that the relationship of the level of digital literacy and the demographic profile are significantly. Age, location, educational attainment, digital tool ownership, and internet connectivity are all significant factors of digital literacy. The facilitating factors affecting digital literacy level are location, educational attainment, digital tool ownership, and internet connection. Those farmers in the urban areas have a higher digital literacy level than those in the rural areas. Farmers who are college graduates have a higher digital literacy level than those who are not. Those farmers who own digital tools and have internet connection have higher digital literacy level than those who farmers who don’t own digital tools and don’t have access to internet connection. However, the age of farmers is a hindering factor because it is negatively correlated with their level of digital literacy. Older farmers have a lower digital literacy level than young farmers. These findings are consistent with prior literature and highlight the need to target support toward bridging the digital divide in rural farming areas. It also provides insights on how to effectively implement the Digital Farmers Program and other digital literacy trainings for farmers. Thus, there is a significant difference in the digital literacy level of farmers before and after the Digital Farmers Program. Also, the farmers' demographic profile significantly affects the digital literacy of farmers.

REFERENCES

1. Abdulai, A. R., Fraser, E. D. G., & Glaros, A. (2023). Is agricultural digitization a reality among smallholder farmers in Africa? Unpacking farmers' lived realities of

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DOI: 10.5281/zenodo.19809288

engagement with digital tools and services in rural Northern Ghana. *Agriculture & Food Security*. https://doi.org/10.1186/s40066-023-00416-6

2. Ahsan, M., Leifeng, G., Azam, F.M., Xu, B., Rayhan, S., Kaium, A., Wensheng, W. (2023). Barriers, challenges, and requirements for ICT usage among Sub-Assistant Agricultural Officers in Bangladesh: Toward sustainability in agriculture. *Sustainability*, *15*(1), 782. Retrieved April 3, 2026 from https://doi.org/10.3390/su15010782
3. Alant, B.P., Bakare, O. (2021). A case study of the relationship between smallholder farmers' ICT literacy levels and demographic data w.r.t their use and adoption of ICT for weather forecasting. Retrieved March 9, 2024 from https://www.sciencedirect.com/science/article/pii/S2405844021005089
4. Alidou, S., Akueson, A., Yabi, A.J., Akossou, A.Y. (2024). Adoption factors of digitalization in cotton farming in the municipality of Banikoara in Northwestern Benin. Retrieved February 22, 2025 from https://typeset.io/papers/adoption-factors-of-digitalization-in-cotton-farming-in-the-4xqp1b09g1.
5. Alip, J.A (December 2022). *Inclusion and digital transformation in agriculture*. Manila Bulletin. Retrieved Mar 3, 2024from https://mb.com.ph/2022/12/05/inclusion-and-digital-transformation-in-agriculture/
6. Bohara, A., Gurung, Y. (2024). Digital Literacy of Rural Farmers in Western Hills of Nepal: A Case of Riching Rural Municipality. Asian Journal of Population Sciences. Retrieved March 4, 2025 from https://www.researchgate.net/publication/387988163_Digital_Literacy_of_Rural_Farmers_in_Western_Hills_of_Nepal_A_Case_of_Rishing_Rural_Municipality
7. Caulfield, J. (2023). *How to Do Thematic Analysis, Step-by-Step Guide & Examples*. Scribbr. Retrieved March 3, 2024 from https://www.scribbr.com/methodology/thematic-analysis/#:~:text=Thematic%20analysis%20is%20a%20method,meaning%20that%20come%20up%20repeatedly.
8. Chateauvieux, C., Baddache, F. (2024, October 21). Digital Tools: Empowering Smallholder Farmers. KSAPA. Retrieved February 8, 2025 https://ksapa.org/digital-tools-empowering-smallholder-farmers/
9. City Government of Davao (2023, October 17). Barangays in Paquibato Get Internet Connection. City Government of Davao official website. Retrieved September 30, 2025 from https://www.davaocity.gov.ph/social-services/barangays-in-paquibato-get-internet-connection/
10. Department of Agriculture (2021). *The One DA Reform Agenda: Eighteen (18) Key Strategies*. Retrieved March 3, 2024 from https://www.da.gov.ph/the-one-da-reform-agenda-eighteen-18-key-strategies/
11. Dominguez, P., Muñoz, D., Diez, E., Mesa, J. (2023). *Digital inclusion for social inclusion: Case study on digital literacy*. Frontiers Media S.A. retrieved Mar ch 6, 2024 from https://www.frontiersin.org/articles/10.3389/fcomm.2023.1191995/full
12. Dujali, I., Inutan, S., Bacus, M., Pqgutayao, A., Sarita, V. (2025). Transforming Agricultural Extension in the Digital Age: A Review of ICT-Based Approaches and Innovations. International Journal of Research and Scientific Innovations. Retrieved April 3, 2026 from https://rsisinternational.org/journals/ijrsi/articles/transforming-agricultural-extension-in-the-digital-age-a-review-of-ict-based-approaches-and-innovations/#
13. Engle, C., Stone, N. (1990). *Aquaculture Development and Coordination Program: A Review of Extension Methodologies in Aquaculture.* United Nations Development Program. Food and Agriculture Organization. Retrieved March 3, 2024 from https://www.fao.org/3/T8654E/t8654e02.htm#TopOfPage
14. Everett, R. (1962). *Diffusion of Innovation*. The Free Press. A Division of Macmillan Publishing Co., Inc. Retrieved March 6, 2024 from https://teddykw2.files.wordpress.com/2012/07/everett-m-rogers-diffusion-of-innovations.pdf
15. Food and Agriculture Organization (2018). *Agricultural services and digital inclusion*. Food and Agriculture Organization of the United Nations. Retrieved March 3, 2024 from https://www.fao.org/3/i7361en/I7361EN.pdf
16. Global System for Mobile Communications Association (2024). Mobile Connectivity Index. Retrieved March 8, 2024, from https://www.mobileconnectivityindex.com/index.html#year=2024
17. Guay, C., Esteban, J., Bacus, M., Pagutayao, A. (2025). Factors Influencing Farmers' Adoption of Digital Extension Services in Kibanggay, Lantapan, Bukidnon, Philippines. International Journal of Research and Innovation in Social Science (IJRISS). Retrieved July 15, 2025 from https://rsisinternational.org/journals/ijriss/articles/factors-influencing-farmers-adoption-of-digital-extension-services-in-kibanggay-lantapan-bukidnon-philippines/
18. International Telecommunication Union (2023). *Digital Inclusion for all.* Retrieved March 3, 2024 from https://www.itu.int/en/mediacentre/backgrounders/Pages/digital-inclusion-of-all.aspx
19. Jamias, et. al (2022). Digital Literacy Enhancement of Rural Women in Luna, Apayao, Philippines. Siliman Journal. Retrieved March 3, 2025 from https://sillimanjournal.su.edu.ph/index.php/sj/article/view/62
20. Joel, A., Bamidele, J., Oyediji, B., Olaitan, M. (2024). Effectiveness of ICTs in Extension Service Delivery among Smallholder Farmers in Kwali Area Council, Abuja, Nigeria. Global Academic Journal of Agriculture and Bio Sciences. Retrieved September 18, 2025 from https://www.gajrc.com/media/articles/GAJAB_71_8-17.pdf
21. Kansiime, M., Alawy, A., Allen, C., Subharwal, M., Jadhav, A., Parr, M.(2019). *Effectiveness of mobile agri-advisory service extension model: Evidence from Direct2Farm program in India*. World Development Perspectives. Volume 13. Science Direct. Retrieved March 7, 2024 from

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DOI: 10.5281/zenodo.19809288

https://www.sciencedirect.com/science/article/pii/S2452292917300711
22. Klerkx, L., Begemann, S. (2020). Supporting food systems transformation: The what, why, who, where and how of mission-oriented agricultural innovation systems. *Agricultural Systems*, 184, 102901. https://doi.org/10.1016/j.agsy.2020.102901
23. Kumar, K. (2021, October 19). *Digital Literacy to Improve Agriculture*. CXO Outlook. Retrieved Mar 30, 2024 from https://www.cxooutlook.com/digital-literacy-to-improve-agriculture/
24. Liu, B., Zhou, J. (2023). Digital Literacy, Farmer's Income Increase and Rural Internal Income Gap. Multidisiplinary Digital Publishing Institute. Sustainability. https://doi.org/10.3390/su151411422
25. Maulu, S., Hasimuna, O., Mutale, B., Mphande, J., Siankwilimba, E. (2021). *Enhancing the Role of Rural Agricultural Extension Programs in Poverty Alleviation: A Review*. Cogent Food and Agriculture. Volume 7:1. Retrieved March 30, 2024 from https://tinyurl.com/5y62defd
26. Magesa, M., Jonathan, J., Urassa, J. (2023). Digital Literacy of Smallholder Farmers in Tanzania. MDPI. Retrieved March 30, 2024 from https://www.mdpi.com/2071-1050/15/17/13149
27. Nikolopoulou, K. (2023, March 16). What is Recall Bias?. Scribbr. Retrieved June 25, 2025 from https://www.scribbr.com/research-bias/recall-bias/
28. Pesci, S., Galt, R., Durant, J., Manser, G., Asprooth, L., Pinzon, N. (2023). A digital divide in direct market farmers' online sales and marketing: Early pandemic evidence from California. Journal of Rural Studies. Volume 101. Retrieved April 3, 2026 from https://doi.org/10.1016/j.jrurstud.2023.103038.
29. Philippine Rice Research Institute (2021). Digital Agriculture-how can we make it work?. Rice Science for Decision makers. Vol. 9. Retrieved March 8, 2024 from https://www.philrice.gov.ph/wp-content/uploads/2021/06/RS4DM_Digital-Agriculture-GREEN.pdf
30. Rajkhowa, P., Qaim, M. (2021). Personalized digital extension services and agricultural performance: Evidence from smallholder farmers in India. PloS ONE. Retrieved September 25, 2025 from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0259319#sec020
31. Sabado, W. (2024). The Application of Digital Technologies in Precision Farming. University of Makati. Universitas. Retrieved April 2, 2025 from https://journals.umak.edu.ph/universitas/article/view/245
32. Savitri, S, Rafani, I. (2024). The presence of Digital Literacy to Improve Agricultural Extension Program in Indonesia. Food and Fertilizer Technology Center Agricultural Policy Platform. Retrieved September 30, 2025 from https://ap.fftc.org.tw/article/3537
33. Sen, L.T.H., Phuong, L.T.H., Chou, P., Dacuyan, F., Nyberg, Y., Wetterlind, J. (2025). The Opportunities and Barriers in Developing Interactive Digital Extension Services for Smallholder Farmers as a Pathway to Sustainable Agriculture: A Systemic Review. Sustainability. Retrieved September 30, 2025 from https://www.mdpi.com/2071-1050/17/7/3007#metrics
34. Sen, L., Chou, P., Dacuyan, F., Nyberg, Y., Wetterling, J. (2024). Barriers and enablers of digital extension services' adoption among smallholder farmers: the case of Cambodia, the Philippines and Vietnam. *International Journal of Agricultural Sustainability*, *22*(1). Retrieved April 3, 2026 from https://doi.org/10.1080/14735903.2024.2368351
35. Serafica, R., Francisco, K., Oren, Q.C. (2023). Making Broadband Universal: A Review of Philippine Policies and Strategies. Philippine Institute for Development Studies. Retrieved March 8, 2024 from https://pidswebs.pids.gov.ph/CDN/document/pidsdps2331.pdf
36. Shrabony, S.M, Laszlo, B. (2023). *Determinant Factors of Digital Inclusion of Digital Divide Groups: A Tale of Smallholder Farmers of Bangladesh*. Gradus. Retrieved March 7, 2024 from https://gradus.kefo.hu/archive/2023-2/2023_2_ECO_008_Shrabony.pdf
37. Soliva, M. (2019). *Digital Farmers Program 101 held in Bohol*. Kaugmaran October-December 2019 the official publication of ATI in Central Visayas Volume 3 No.4. Retrieved March 2, 2024 from https://ati2.da.gov.ph/ati-7/content/sites/default/files/2023-11/2019%20KAUGMARAN%204th%20Quarter.pdf
38. Sufian, F., Nico, G., Azzarri, C. (2023). Examining the Gender Digital Divide. Gender, Climate Change, and Nutrition Integration Initiative (GCAN). Retrieved March 3, 2024 from https://gcan.ifpri.info/files/2023/10/GCAN-Note-15_Bangladesh_web.pdf
39. Tambo, J., Aliamo, C., Davis, T., Mugambi, I., Romney, D. (2019). The impact of ICT-enabled extension campaign on farmers' knowledge and management of fall armyworm in Uganda. National Library of Medicine. PubMed. Retrieved March 20, 2024 from https://pubmed.ncbi.nlm.nih.gov/31433814/
40. Sen, L., Chou, P., Dacuyan, F., Nyberg, Y., Wetterling, J. (2024). Barriers and enablers of digital extension services' adoption among smallholder farmers: the case of Cambodia, the Philippines and Vietnam. *International Journal of Agricultural Sustainability*, *22*(1). Retrieved April 3, 2026 from https://doi.org/10.1080/14735903.2024.2368351
41. Torino, MJ. (2025). Bridging the Digital Divide: A Systematic Review of Digital Literacy and Economic Participation in Developing Economies. Psychology and Education: A Multidisciplinary Journal. Retrieved October 20, 2025 from https://10.5281/zenodo.14749185
42. Umali, A. M. (September, 2023). *PLDT, Smart. DA-ATI continue to uplift Filipino farmers through inclusive tech*. Department of Agriculture-Agricultural Training Institute. Retrieved March 3, 2024 from https://ati2.da.gov.ph/ati-main/content/article/angelica-marie-t-umali/pldt-smart-da-ati-continue-uplift-filipino-farmers-through-inclusive
43. Ugpat, A., Ojeda, J.D., Bacus, M., Pagutayao, A., Sarita, V. (2025). Farming the Future: Review of Agricultural Extension's Role in Digital and Smart Farming Technologies in Davao Oriental, Philippines. International Journal of Research and Scientific Innovation. Retrieved July 20, 2025 from

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DOI: 10.5281/zenodo.19809288

https://rsisinternational.org/journals/ijrsi/digital-library/volume-12-issue-5/319-337.pdf
44. Verges, A. (2022). On the Desirability of Social Desirability Measures in Substance Use Research. Journal of Studies on Alcohol and Drugs. Retrieved June 25, 2025 from https://www.jsad.com/doi/10.15288/jsad.2022.83.582
45. Vidal, C.B., Vidal, J.S., De Los Reyes, C., Ancheta, R., Capuno, R.(2022). Digital Literacy Skills and Extent of Engagement on Digital Classroom Tools of General Education Teachers in an Inclusive Setting. Journal of Positive School Psychology. Retrieved March 10, 2024 from https://journalppw.com/index.php/jpsp/article/view/7259
46. Xing Bu (2025). Digital LIteracy and Farmers' Income Level: A difference Analysis Based on K-prototypes Clustering. Retrieved February 20, 2025 from https://dl.acm.org/doi/abs/10.1145/3708036.3708199
47. Yildirim, T., Ozturk, D. (2023). A Mixed Method Research on Digital Literacy of Middle School Students. International Journal of Education of Literacy Students. Retrieved March 4, 2024 from https://www.aiac.org.au/journals/index.php/IJELS/article/view/7678
48. Yunlu, E., Ozenc, E. (2025). The Predicting Power of Digital Reading Attitudes of Primary School Teacher Candidates' Digital Reading Attitudes On Their Digital Literacy. Çukurova Üniversitesi Eğitim Fakültesi Dergisi. Retrieved July 24, 2025 from https://dergipark.org.tr/en/pub/cuefd/issue/91658/1516444

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