



Access and use of ICT-mediated rice technologies among farmers and agricultural extension workers in Caraga, Philippines

Christina A. Gabrillo¹ and Florencia G. Palis²

¹Department of Development Communication, Visayas State University Visca, Baybay City, Leyte, Philippines

²Department of Social Sciences, University of the Philippines Los Baños, Laguna, Philippines

ABSTRACT

Information and Communication Technologies (ICTs) provide easy access and use of rice technologies among farmers and agricultural extension workers (AEWs). This paper analyzed how both farmers and AEWs access and use ICT-mediated rice technologies. It also ascertained their socio-demographics and whether or not farmers' and AEWs' access have influenced their use of ICT-mediated rice technologies. The study had a survey of 300 randomly selected farmers and 49 AEWs. Results showed that farmers were aged 40-59 years old, attained some or full high school education, with a mean income of Php45,360 every cropping season depending on their farm size. Farmers applied for loans for them to plant rice in the next cropping season. On the other hand, the AEWs were older than the farmers for they belonged to the 51-60 years old (44%) bracket, mostly males, married, and had finished a BS degree in agriculture/agribusiness. Their monthly income ranged from below Php10,000 to a maximum of Php 20,000 at the time of research. Moreover, farmers accessed the Nutrient Manager for Rice (NMRice) through their mobile phones. The AEWs also accessed *Palay Check* through the *Pinoy Rice Knowledge Bank* from their office computers or at the cooperative office that they assisted. A slight difference was found between the AEWs' and farmers' level of access and use of ICT-mediated rice technologies. This could be because farmers considered AEWs as their conduits or intermediaries in adopting innovative ICT-mediated rice technologies.

KEYWORDS: *Access and Use of ICT-mediated rice technologies, NMRice Mobile, Palay Check, Rice farmers, Agricultural Extension Workers, CARAGA*

1 INTRODUCTION

Many years ago, there was a huge disconnect of rural areas from the greater world. Today, networks of information and communication technologies (ICTs)

entangle the globe and represent a transformational opportunity for rural populations, both as producers and consumers (World Bank, 2011). However, in modern societies like Singapore and Taiwan, many of their senior citizens still need the necessary academic skills and social network support for easier access to those ICTs. These ICT-mediated smart city services made their senior citizens secure their privacy and attain higher quality of life (Tan & Chan, 2018; Yeh, 2018). Moreover, Pradhan and colleagues (2021) pointed out that a stable economic growth in rich countries depends on a vibrant transportation system in place with a strong ICT infrastructure. Likewise, Doong and Ho (2012) mentioned that access to ICT plays a great role in defining the global digital divide even for parenting efficacy among the youth (Jang et al, 2017) and disabled people (Hersh, 2014).

The UNESCO (2022) defines ICTs as a wide range of technology resources and techniques used to create, store, distribute, and exchange information. These technological resources and tools consist of computers, the Internet (websites, blogs, and emails), live broadcasting technologies (radio, television, and webcasting), recorded broadcasting technologies (podcasting, audio and video players and storage devices), and telephony (fixed or mobile, satellite, video-conferencing). Farmers have accessed ICT-mediated rice technologies in the field that pertain to the Nutrient Manager for Rice (NMRice) Mobile through their mobile phones. On it, farmers could get advice on nutrient management on the optimal timing, amount, and type of fertilizer to apply to their rice crop to maximize production and profit, and reduce waste through the hotline *2378 for globe and smart subscribers. On the other hand, AEWs have accessed the *Pinoy Rice Knowledge Bank* (PRKB) via the Internet as launched by the IRRI, PhilRice, and the DA-ATI. It contains a dynamic rice crop management system that presents the best key technology and management practices as Key Checks. This pertains to the one-stop-source of information on rice and rice-based farming via the Internet. In similar studies of Kiiza and Pederson (2012), they suggest a massive campaign on promoting ICT-

mediated market information on agricultural seed technologies to enhance food security and farmers' income. In the study of Dube, et al (2020), farmers in rural villages that are exposed to the eKutir ecosystem have consumed more fruits and vegetables than those with unexposed communities. The eKutir provides agricultural information, inputs, and market linkages at household and community level, which was followed by integrating other micro-entrepreneurs along the value chain.

With the current trend of tapping ICTs for improving agriculture particularly in rice farming, there is a need to understand how farmers and AEWs differ in their access and use of ICT-mediated rice technologies.

Furthermore, results of the study can help determine if the conventional delivery system of extension from research stations to farmers' fields is still effective. However, it might be that farmers and AEWs use the knowledge networks such as new ICTs like the mobile phone and Internet just to strengthen and not necessarily replace the traditional mode of communicating to farmers like face-to-face or interpersonal communication. Nevertheless, farmers' access and use of ICT-mediated rice technologies can shed light on whether or not mobile phones are indeed effective tools for improving farmers' access to rice technologies. This can debunk the popular notion that ICTs play a big role in agricultural extension if the findings indicate that after all farmers and AEWs do not have access to ICT-mediated rice technologies.

2 MATERIALS AND METHODS

Research Design and Study Areas

Creswell and Creswell (2018) pointed out that a survey research design analyzes a sample of a population to find connections between variables and provides a quantitative description of its trends, attitudes, and views of the respondents. In this study, 300 randomly sampled farmers and 49 AEWs with 5% margin of error and 95% confidence level served as study respondents. The study was conducted in Agusan del Norte. It is one of the five provinces of the Caraga Region in the Philippines. It has a land area of 273,024 hectares. It comprises 1 city, 10 municipalities, and 167 barangays. Its economy is predominantly agriculture and one of the nation's leading producers of rice.

The study was conducted in Butuan City, Remedios T. Romualdez (RTR), and Buenavista as shown in Table 1. The one city and two municipalities were among the pilot sites of the IRRI's and PhilRice's PRKB and NMRice Mobile. These criteria made these areas of Agusan del Norte qualify as the research sites because it involved farmers and AEWs who have accessed and used ICT-mediated rice technologies.

Respondents of the Study

Male farmers were busy working in their rice fields at the time of the survey and their wives were the ones left at home preparing for their food prior to joining their husbands in the farm. Hence, survey respondents were mostly wives of the farmers. It was also found that farmers' wives were the ones using ICT-mediated rice technologies through their mobile phones on behalf of their husbands.

Composition of farmer-participants.

More than one-third (45.3%) of the rice farmers belonged to Brgy. Sto. Nino of Butuan City which is one of the biggest rice producing *barangays* in Butuan City (Fig. 1).

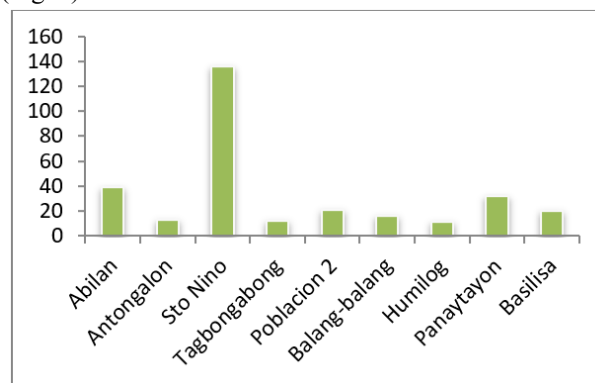


Figure 1. Distribution of farmer-participants by barangay

Since rice farmers were so busy working in their rice fields at the time of the study, majority of the farmer-participants were wives of the farmers (64.7 %) followed by the farmers themselves (22.3%), and farmers' elder sons/daughters (11.0%) who helped in farm activities in that order (Fig. 2).

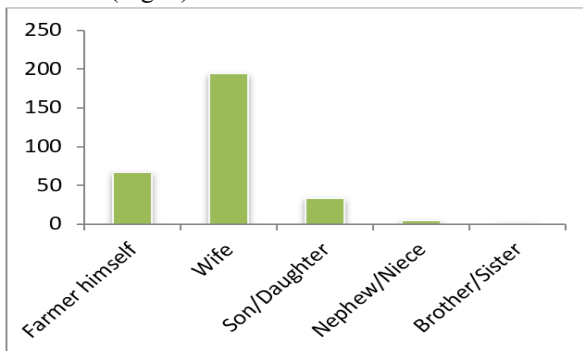


Figure 2. Distribution of farmer-participants in the study

On the other hand, Figure 3 shows all five provinces that belonged to the Caraga region, namely: Agusan Norte, Agusan Sur, Surigao Norte, Surigao Sur, and Dinagat Island. These provinces comprised the 49 randomly selected agricultural extension workers (AEWs) as other participants of the study. They all came from the various agriculture offices of the different Local

Table 1. Distribution of farmers by municipality

Location	Frequency	Percentage
Buenavista	39	13.0
Butuan	149	49.7
RTR	112	39.3
TOTAL	300	100.0

Government Units (LGUs) of the said provinces in Region 13. More than half of them belonged to Agusan Norte. They continued to assist the rice farmers for almost 35 years already. Their average years of service was 16 years.

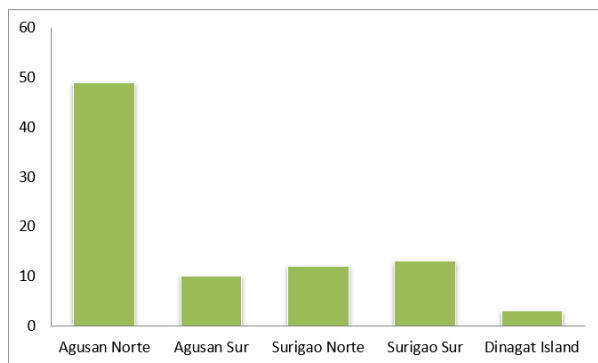


Figure 3. Distribution of AEWs by province

Data Gathering Method, Instrument Used and Data Analysis

A pretested survey questionnaire in English was used among 49 AEWs and its Cebuano version for 300 farmers in the field survey. The content included questions on AEWs’ and farmers’ socio-demographic characteristics; their access variables such as their type of ICTs (mobile phone and Internet); kind of rice technologies, place and time, frequency and total length of accessing; their reasons for accessing/not accessing these rice technologies. Their use of ICT-mediated rice technologies was also measured using 15 statements with a 5-point Likert scale (1 *fully adopted*, 2 *partially adopted*, 3 *modified/adapted*, 4 *not adopted*, and 5 *no answer*) indicating the degree that best described their opinions. The researcher and trained enumerators gathered the data in a face-to-face manner. Then, the survey data were coded, encoded and analyzed using the Statistical Package for Social Sciences (SPSS) Version 22. Results are presented in tabular and graphical formats. Descriptive statistics like frequency counts and percentage distributions, means, and ranges were used to organize and describe the data (Frankfort-Nachmias & Leon-Guerrero, 2011) for AEWs’ and farmers’ access and use of ICT-mediated rice technologies. Pearson correlation for continuous variables and Spearman’s rank correlation coefficient was used for ordinal variables to determine the relationship between the dependent and independent variables. When the instrument was subjected to the Omega reliability test, it indicated more

than 91 percent reliability. This means that the instrument was reliable.

3 RESULTS AND DISCUSSION

Table 2 shows the socio-demographic characteristics from both farmers and AEWs. Then, their ways in accessing ICT-mediated rice technologies is presented in Table 3. The relationship between farmers’ and AEWs’ access and use of ICT-mediated rice technologies is analyzed to determine whether their access has influenced or not their use of ICT-mediated rice technologies (Table 4). Finally, a comparison between farmers’ and AEWs’ access and use of ICT-mediated rice technologies is shown in the last part (Fig. 4) of the discussion.

Farmers’ Socio-demographic Characteristics

Almost three-fourths (72%) were female farmers. In this study, women farmers, as part of the farming households are the ones accessing and using the ICT-mediated rice technologies through their mobile phones. However, in Kiiza and Pederson’s study (2012), access to ICT-mediated market information is lesser with female-headed households. Rice farmers’ age ranged from 15 years old as the youngest, usually sons/daughters of the farmers, and 76 as the oldest. Most (56%) were aged 40 to 59 with the mean age of 45. A great majority were married (82%). This could be attributed to The Asean Post (2020), wherein twelve million girls under the age of 18 are married annually. In a minute, that works out to 23 girls. Nearly half (47%) had some or fully completed with their high school education. This shows that this group of rice farmers is relatively better educated than the earlier generation of farmers who usually have had some or finished only their elementary education. Their main income from rice per cropping season was about P10,00 to P50,000 (67%), with the mean income of P45,360 wherein they would earn it twice a year and with higher yield during the dry cropping season. This is also supported by the study of Mendonca et al (2015) that the inequality of ICT access and use depends on the users’ age, education, employment status, household type and income distribution. Farmers had other sources (69%) of income aside from planting rice. The rice farmers also grew other cash crops like vegetables and raised some livestock like chicken, goat and swine. They also tended small *sari-sari* (variety) stores for immediate and ready cash. An overwhelming majority (98%) were members of farmers’ organizations, cooperative, and rice seeds

Table 2. Socio-demographic characteristics of both Farmers and AEWs

Characteristics	Categories	Farmers (n=300)	%	AEWs (n=49)	%
Gender	Female	215	72	21	43
	Male	85	28	28	57
Age	21-30	--	--	7	16
	31-40	10	3	10	20
	41-50	80	27	10	20
	51-60	169	56	22	44
	61-70	41	14	--	--
Civil Status	Married	246	82	33	68
	Single	28	9	5	10
	Widowed	22	7	7	14
	Separated	4	2	4	8
Educational Attainment	Elementary	93	31	--	--
	High School	140	47	--	--
	BS Level/graduate	--	--	--	--
	With MS units	6	22	43	88
	MS graduate	--	--	5	10
	Others	--	--	1	2
Income	<10,000	43	14	6	12
	10,001-50,000	201	67	43	88
	50,001-90,000	30	10	--	--
	>90,001	26	9	--	--
Source of Income	Extension/rice alone	208	69	38	78
	W/ livestock and sari-sari store	92	31	10	20
	w/ book keeping	--	--	1	2
Membership in organization	Yes	295	98	46	96
	No	92	2	3	4

associations, etc. This indicates rice farmers' propensity to be members of organizations as this has been the more common approach of extension work in the country.

AEWs' Socio-demographic Characteristics

As opposed to the female farmers, the AEWs were mostly males (57%). It is a fact that extension work is usually regarded as strenuous and risky. Most agricultural extension workers (AEWs) belonged to the 51-60 years old (44%) bracket. This means that the majority of the AEWs are relatively older and hence, they could be more experienced in the field. However, in Vicente's (2022) study, the elderly are less likely to use the ICTs especially on getting advice from their medical doctors regardless of their experience with those ICTs. As regards marital status, the majority were married (68%). Considering that many of the AEWs were in the 51-60 years old, then, it is but normal for them to be already married at this stage. A great majority (88%) of the AEWs had finished BS degrees in agriculture, agribusiness, etc. This is expected

since the minimum requirements for their hiring need them to have a BS Agriculture or other related fields. When it comes to their monthly income, the majority (78%) of the AEWs were receiving P10,000 to P20,000 in 2011. Others were getting below P10,000 a month. This means that most of the AEWs are getting a rather low salary compared to similar jobs in other branches of government and the private sector at the time of the study. Due to their relatively low income, the AEWs revealed that it was hard for them to raise their families and meet their daily needs. Majority (78%) just relied on their main income as AEWs. This is understandable since their employment as AEWs of the government is considered a full time job. However, others (20%) tried to have other sources of income such as venturing into livestock production and opening a small variety store. Only a few (2%) were engaged in a part-time job like bookkeeping. A great majority (94%) of AEWs were members of agriculture-oriented organizations such as cooperatives. This could be attributed to the nature of their job that

requires them to have a broad social network and contacts.

Farmers' Access to ICT-mediated rice technologies

All farmers (100%) accessed the rice technologies using the mobile phones. None of them used the Internet. This shows that mobile phones are the only gadget they can truly access for rice technologies. Voss et al (2021) also argued that in using the phone-based voice messaging, there was an increase in technology update in Senegal coupled with participatory trials in the field. Moreover, ICT-mediated market information comes from the mobile phones and FM radio (Kiiza & Pederson, 2012). With minimal access to computer and Internet connection, online ICT-mediated rice technologies could not effectively be reached by farmers. The ICT-mediated rice technologies mostly accessed by farmers using the mobile phone was on nutrient management (37%), with harvest management (7%) at the tail end. It was evident that farmers tried to know more about nutrient management that involves the right amount and proper timing of fertilizer application. As to access points, majority of the farmers accessed the rice technologies right at their own homes or in their rice farms using the mobile phone. Some also mentioned that they went to Open Academy for Philippine Agriculture (OPAPA) by PhilRice (13%), Farmers' Information and Technology Services (FITS) center of the Local Government Unit (LGU) of Remedios T. Romualdez and Caraga Consortium for Agriculture Forestry Resources Research and Development (CCARRD). This shows that the proliferation of mobile phones allows access to rice technologies even at a geographical distance and overcomes limits of space and time (World Bank, 2011). Farmers would usually access ICT-mediated rice technologies in the morning (36%) or the least at noontime (6%). However, they said that they access these ICT-mediated rice technologies anytime they feel it is necessary (40%). When asked on their frequency of accessing ICT-mediated rice technologies, most farmers answered that they did it on a daily basis (30%). These findings suggest that farmers already make it a daily habit to access and use ICT-mediated rice technologies through mobile phones as part of their life's routine.

With regard to the length of time spent in accessing ICT-mediated rice technologies in a day, farmers revealed that their access to ICTs would last from 2-10 minutes (56%). This means that within that period, farmers can already have answers to their queries on ICT-mediated rice technologies or from their AEWs/fellow farmers. Farmers said that ICT-mediated rice technologies have solved their problems in the field (22%) like knowing the right amount of fertilizer to apply in their farms and linking them with *palay* buyers as well. Gollakota (2008) revealed that Internet kiosks with computer access and a web portal are provided in rural India on a one-stop-shop

of goods and information for both farmers and other members of the rural community.

AEWs' Access to ICT-mediated rice technologies

Among the ICTs, mobile phones were the ones accessed by the majority (91%) of the AEWs. This shows that despite the prevalence of computers, these are still not highly accessed by AEWs. The AEWs considered mobile phones as basic in their extension work for 24 hours a day. With mobile phones, they could easily contact other government and allied agencies from which they could ask for help in terms of ICT-mediated rice technologies like IRRI, PhilRice, and ATI-Caraga. Most (38%) of the AEWs accessed nutrient management using their mobile phones. This tells us that the problems they have been receiving from farmers could be more on fertilizer inputs and proper amount and right timing of fertilizer application in the rice fields. When it comes to where the AEWs accessed the ICT-mediated rice technologies, more than half (51%) went to the farmers' cooperative offices where they usually hold special meetings and assemblies. This means that the cooperative offices have the Internet and are good access points as these are usually within the AEWs' reach and assigned areas of work. Majority of the AEWs (70%) accessed these ICT-mediated rice technologies in the morning and afternoon. This indicates a relatively big extent of use of the ICT-mediated rice technologies particularly those accessed via cellular phones. AEWs also accessed the ICT-mediated rice technologies as the need arises (66%). This implies a high frequency of access to ICT-mediated rice technologies among AEWs. When it comes to the AEWs' duration of accessing ICT-mediated rice technologies in a day, the majority (74%) spent an hour or less using the mobile phone. The percentage goes lower as the duration spent goes higher (18% for 2-5 hours and 2% for 16-20 hours) on the internet. Compared to cellular phones, duration of access through the internet is expected to be shorter because of the higher cost involved. AEWs gave a number of reasons why they accessed rice technologies using the mobile phone or the Internet. Majority (64%) gave the combined reasons of being able to solve problems referred to them by the farmers; they themselves are also gaining knowledge and enhancing their skills on rice farming; and the ease of linking with *palay* buyers or local traders in marketing of the farmers' harvest.

Relationship between Farmers' access and use of ICT-mediated rice technologies

Using the Spearman's rho correlation, a strong relationship was found between farmers' use of ICT-mediated rice technologies and their perceived usefulness, perceived ease of use, their attitude towards using these rice technologies and their behavioral intention of using these ICT-mediated rice technologies.

Table 3. Farmers' and AEWs' ways of accessing to ICT-mediated rice technologies

Variable	Farmers (n=300)	%	AEWs (n=49)	%
Type of ICTs Accessed				
Mobile phone	300	100	45	91
Internet	0	0	4	9
Rice Technologies Accessed				
Nutrient Management	34	11	18	38
Pest Management	24	8	11	22
Land Preparation	37	12	6	12
Crop Establishment	110	37	5	10
Variety and seed selection	26	9	4	8
Harvest Management	47	16	3	6
Water Management	22	7	2	4
Access Points				
Farmer's Cooperative	195	65	25	51
OPAPA by PhilRice & IRRI Office	42	14	15	31
House/Internet Cafe	40	13	6	12
FITS by CCARRD	15	5	2	4
	8	3	1	2
Time of Access				
Morning	107			
Noon	19			
Afternoon	34			
Evening	22			
Morning and afternoon	0			
Anytime				
Frequency of Access				
Daily	89			
Weekly	88			
Monthly	34			
Every cropping season	20			
As the need arises	69			
Duration of Access (hrs/day)				
1 and less			36	74
2-5			9	18
6-10			3	6
11-15			0	0
16-20			1	2
10 and less	169	56		
11-60	125	42		
61 and above	6	2		
Reasons for accessing				
Solve problems in the field	67	22	7	14
Gain knowledge on rice farming	36	12	6	12
Enhance skills in rice farming	33	11	4	8
Link with <i>palay</i> buyers	9	3	1	2
All of the above	155	52	31	64
Reasons for stopping access				
Expensive load/No signal	286	95	46	94
Don't know how to use the ICTs	11	4	3	6
No answer	3	1	0	0

Table 4. Relationship between farmers’ and AEWs’ access and use of ICT mediated rice technologies using TAM variables

Independent Variable	Dependent Variable	Farmers Value of r_s	Significance	AEWS Value of r_s	Significance
Perceived Usefulness	Use of ICT-mediated rice technologies	.211	HS	.285	S
Perceived Ease of Use		.320	HS	.435	HS
Attitude		.313	HS	.340	S
Behavioral Intention		.225	HS	.289	S

S – Significant ($p = .05$); HS – Highly significant ($p = .01$)

Moreover, this supports the theoretical framework on the Technology Acceptance Model (TAM) of Davis (1989) and as proven and tested by Afari-Kumah and Achampong (2010) and Glauz, Rimer & Viswanath (2008). As a general rule, the more favorable farmers’ attitude and the greater was their perceived usefulness and ease of use in those new ICTs, the stronger would be the farmers’ intention to perform the behavior in question—actual utilization of ICT-mediated rice technologies.

Relationship between AEWs’ access and use of ICT-mediated rice technologies

Using the Spearman’s rho correlation, a strong influence was found between AEWs’ perceived ease of use of the mobile phone. The rest of the access variables like their perceived usefulness, their attitude towards using these rice technologies and their behavioral intention had a significant influence on their actual use of these ICT-mediated rice technologies. These findings suggest that TAM’s access variables have influenced the AEWs’ use of the ICT-mediated rice technologies.

Comparison between AEWs’ and Farmers’ Access and Use of ICT-mediated rice technologies

As regards the comparison between farmers’ and AEWs’ access and use of ICT-mediated rice technologies, it could be noted that there is only a slight difference between the two study respondents when it comes to their levels of access and use of ICT-mediated rice technologies. Thus, AEWs and farmers have almost the same level of access and use of ICT-mediated rice technologies. This means that the AEWs have truly influenced the farmers’ behavior and are indeed working closely with the farmers. Moreover, the investment on AEWs can yield a better outcome when it comes to farmers’ access and use of ICT-mediated rice technologies.

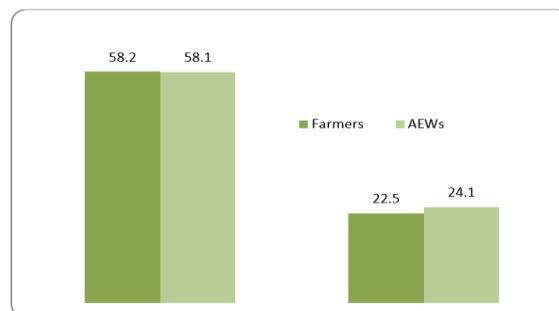


Figure 4. Comparison between farmers’ and AEWs’ access and use of ICT-mediated rice technologies

4 CONCLUSIONS

Both farmers and AEWs slightly differ on their access and use of ICT-mediated rice technologies. The AEWs have a slightly higher level of use of ICT-mediated rice technologies. Essentially, however, they both exhibit the same pattern of accessing and using ICT-mediated rice technologies. This is because farmers deemed the AEWs as their conduits or intermediaries when it comes to their adoption of innovative ICT-mediated rice technologies. This is the reason why this research considered both of them as study respondents. However, it is equally important to pay attention to the nuances of the AEWs' role in agricultural extension as it is to farmers, who are the main drivers of agriculture's long-term growth and development as well as its ultimate partners in rural development.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

Afari, E., & Achampong, A. (2010). Modeling computer usage intentions of tertiary students in a developing country through the Technology Acceptance Model. *International Journal of*

- Education and Development using ICT*, 6(1), 102-116.
- Asian Development Bank (2009). *Poverty in the Philippines: Causes, constraints, and opportunities*. Mandaluyong City, Philippines.
- Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. **Sage publications**.
- Doong, S. H., & Ho, S. C. (2012). The impact of ICT development on the global digital divide. *Electronic Commerce Research and Applications*, 11(5), 518-533.
- Dubé, L., McRae, C., Wu, Y. H., Ghosh, S., Allen, S., Ross, D., ... & Moore, S. (2020). Impact of the eKutir ICT-enabled social enterprise and its distributed micro-entrepreneur strategy on fruit and vegetable consumption: A quasi-experimental study in rural and urban communities in Odisha, India. *Food Policy*, 90, 101787.
- Frankfort-Nachmias, C., Wagner, W. E., & Francis, G. S. (2011). BUNDLE: Frankfort-Nachmias Social Statistics for a Diverse Society 6e+ Wagner Using IBM SPSS Statistics for Social Statistics and Research Methods 3e+ Francis STATLAB Online.
- Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). Health behavior and health education: theory, research, and practice. *John Wiley & Sons*.
- Gollakota, K. (2008). ICT use by businesses in rural India: The case of EID Parry's Indiagriline. *International Journal of Information Management*, 28(4), 336-341.
- Hersh, M. (2014). Evaluation framework for ICT-based learning technologies for disabled people. *Computers & Education*, 78, 30-47.
- Jang, J., Hessel, H., & Dworkin, J. (2017). Parent ICT use, social capital, and parenting efficacy. *Computers in Human Behavior*, 71, 395-401.
- Kiiza, B., & Pederson, G. (2012). ICT-based market information and adoption of agricultural seed technologies: Insights from Uganda. *Telecommunications Policy*, 36(4), 253-259.
- Mendonça, S., Crespo, N., & Simões, N. (2015). Inequality in the network society: An integrated approach to ICT access, basic skills, and complex capabilities. *Telecommunications policy*, 39(3-4), 192-207.
- Official Website of Agusan Del Norte Province (2022). Retrieved from <http://www.agusandelnorte.gov.ph/index.php>
- Pradhan, R. P., Arvin, M. B., & Nair, M. (2021). Urbanization, transportation infrastructure, ICT, and economic growth: A temporal causal analysis. *Cities*, 115, 103213.
- Tan, K. S., & Chan, C. M. (2018). Unequal access: Applying Bourdieu's practice theory to illuminate the challenges of ICT use among senior citizens in Singapore. *Journal of Aging Studies*, 47, 123-131.
- Statistical Package for social sciences (SPSS) online (2022). Retrieved from <https://www.ibm.com/products/spss-statistics>
- Tashakkori, A., & Creswell, J. W. (2007). The new era of mixed methods. *Journal of Mixed Methods Research*, 1(1), 3-7.
- The Asean post (2020). Issue on Ending Child Marriage in the Philippines. Retrieved from <https://theaseanpost.com/article/ending-child-marriage-philippines>
- Vicente, M. R. (2022). ICT for healthy and active aging: The elderly as first and last movers. *Telecommunications Policy*, 46(3), 102262.
- UNESCO. (2022). Retrieved from <http://uis.unesco.org/en/glossary-term/information-and-communication-technologies-ict>
- Voss, R. C., Jansen, T., Mané, B., & Shennan, C. (2021). Encouraging technology adoption using ICTs and farm trials in Senegal: Lessons for gender equity and scaled impact. *World Development*, 146, 105620.
- World Bank (2011). e-Sourcebook on ICT in Agriculture: Connecting smallholders to knowledge, networks, and institutions. Washington, D.C.
- Yeh, H. (2017). The effects of successful ICT-based smart city services: From citizens' perspectives. *Government Information Quarterly*, 34(3), 556-565.