

# Expanding the Technology Acceptance Model to Predict ICT Utilization in Agricultural Extension in Isabela, Philippines

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**Abstract**— With the advent of information and communications technology, the diffusion of modern farming technologies and information could be enhanced. The Technology Acceptance Model (TAM) developed by Davis is one of the widely used models to utilization of information systems such as ICT tools and resources for agriculture. In addition to the original model that measures the influence of Perceived Usefulness and Perceived Ease of Use towards the use of technology; intrinsic factors, extrinsic factors, and socio-demographic characteristics were added to test its relationship with other TAM components. Data collected through survey among agricultural extension workers (AEWs) and analyzed through descriptive and inferential statistics. Results showed that most AEWs have access to ICTs. AEWs frequently use the Rice Crop Manager, Binhing Palay App, and MOET App. The utilization of apps is seasonal or as need arises. The result shows the extent of utilization of the Binhing Palay App is significantly influenced by accessibility (0.38) and user interface (0.34) and the Leaf Color Computing App has significant relationship with accessibility (0.34). In terms of Institutional Support, the fund allocation for the office internet recorded a significant influence on the use of majority of the ICT tools. The education degree or course graduated by the AEWs has significant influence with the Perceived Usefulness of the ICTs with p-value of 0.0075.

**Keywords**— Agricultural extension, Electronic extension, ICT for agriculture, Information and Communications Technology, Technology Acceptance Model

## I. INTRODUCTION

Information and communications technology (ICT) “has great potential to accelerate human progress (United Nations, 2015).” ICT has the capability to accelerate, scale-out and -up, or enhance the rate of diffusion of a very wide range of modern technologies, applications, and platforms. It can assist low-income nations to make

significant development milestones while fostering economic growth. More importantly, ICTs can significantly lower the costs of service delivery (Sachs & Modi, 2015).

According to the International Food Policy Research Institute (IFPRI), “agricultural extension (also known as agricultural advisory services) plays a crucial role in

promoting productivity, increasing food security, improving rural livelihoods, and promoting agriculture as a pro-poor economic growth (IFPRI, 2022).” Agricultural extension has been one of the priority programs of the government to bring rural development. The Food and Agriculture Organization of the United Nations defined extension as “systems that should facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices” (Christoplos, 2010). Agricultural extension is also described as the provision of knowledge and information to rural people to boost their productivity and sustainability of their production systems and improve their livelihoods and quality of life as a whole (Natural Resources Institute, 2014). In the Philippines, the extension services is defined in the Agriculture and Fisheries Modernization Act (AFMA) of 1997 as “the provision of training, information, and support services by the government and non-government organizations to the agriculture and fisheries sectors to improve the technical, business and social capabilities of farmers and fisherfolk” (Official Gazette, 2022). Under AFMA, extension services shall cover major services such as (1) training services, (2) farm or business advisory services; (3) demonstration services; and information and communication support services through tri-media.

The Local Government Code of 1991 devolved the agricultural extension services and other delivery of basic services to local communities to the Local Government Unit. In June 2021, Executive Order No. 138 mandates the national government to fully devolve the functions of the executive branch to local governments as specified in the Local Government Code of 1991 by 2024.

However, issues arising from the devolution were enumerated (Ani & Correa, 2016), some of it are as follows: (1) Lack of funding support. The shortage of funds limits the mobility of the agricultural extension workers. (2) Human resources development issues. Extension workers have become “jack of all trades, master of none” since they have to address all agricultural related issues in their respective localities. Because funds are limited, extension workers were

transformed from commodity or subject matter specialists into generalists.

In the Philippines, ICT is being utilized to advance agricultural extension and communication programs (Obed, 2019). The Department of Agriculture (DA) has been developing ICT tools that provide users access to information channels and decision support tools across the value chain.

The Agricultural Training Institute (ATI) of the Department of Agriculture is mandated to conduct training of all agricultural extension worker and other agri-fishery clients. The ATI offers (1) technical courses which covers production and postharvest technologies, and farming systems; and (2) social technologies that deals with extension delivery system, communication skills, and facilitation and presentation skills. In 2007, the DA through Administrative Order No. 03.s2007 designated ATI as the lead agency for the provision of e-Extension Services.

Furthermore, different attached agencies of the DA have also their own Extension Support, Education, and Training Services (ESETS) unit. For example, the Philippine Rice Research Institute is one of the pioneering institutions to use and develop ICT tools for rice extension services. It is important for agricultural extension workers to have access information on rice production. Local R&D can improve extension services by developing knowledge management system through ICT. Among the strategies include exploring the use of internet, regular updating of rice technology websites, and provision of technical assistance through call and text centers (Bordey, 2010).

Among these ICT tools include the PhilRice Text Center (PTC), a SMS-based service provides rice information such as varietal characteristics, pests and diseases management, nutrient management, rice machines, and seeds availability at PhilRice stations. The Pinoy Rice Knowledge Bank (pinoyrice.com) is a one-stop information shop that makes rice knowledge available and accessible in different formats. Moreover, the agency also developed an android-based smartphone application that features a catalogue of all released rice varieties in the Philippines. The Binhing Palay (BP) App can be used by AEWs in providing seed quality and varietal information to farmers. Meanwhile, eDamuhan, is an app that recognizes weed images through artificial intelligence. It provides weed management information and can work offline.

In 2008, the International Rice Research Institute (IRRI), University of the Philippines Los Banos and the Department of Agriculture developed the Nutrient Manager for Rice (NMR) using the site-specific nutrient management (SSNM) principle. It was designed and deployed from 2008 to 2013 with AEWs as intended users. The NMR is a useful tool for AEWs in providing fertilizer recommendations to farmers after answering series of questions about their field and farming practices. The first version of the NMR was distributed through CDs and can be operated with MS Access. Later, it became web-based wherein interviews were sent to a cloud-based calculator utilizing SSNM-based algorithms (IRRI, 2021).

In 2013, the NMR evolved in the now Rice Crop Manager (RCM) which provides not only fertilizer recommendation but it also includes crop management recommendations. In 2018, it evolved into RCM Advisory Services (RCMAS) which include other functions such as farmer and field registration. Today, the RCMAS is now fully managed by the Department of Agriculture through the Philippine Rice Research Institute since it was transferred by IRRI on July 16, 2022.

The RCM has now an Android app version and can generate recommendation even without internet connection. The ATI together with the DA Regional Field Offices are conducting series of trainings for AEWs and other para-extension workers.

The use of ICT is now a popular extension modality in different countries. In Uganda, they utilized radio, mobile SMS messages, and village-based video screenings to enhance the knowledge of farmers on the management of fall armyworm (FAW) (Tambo, et al., 2019). On an impact assessment conducted, the result showed that ICT-based extension campaign significantly increased the knowledge of farmers on FAW and triggered the adoption of agricultural technologies and practices for the management of the pest. The study also revealed that the used of complementary ICT channels that repeat and reinforce messages are effective in translating awareness and knowledge into behavioural change. In Mali, public extension workers acknowledge that their current ration to farmers limits dissemination of extension services to farmers. Hence, they are also utilizing ICT based extension. However, in a study conducted, one of the challenges in the adoption of ICT base extension among public extension workers is age. Informants said that younger officers

tend to adopt more quickly the older ones. In addition, a good government policy will positively affect the adoption of ICT (Kante, 2021). The use of ICT among the agricultural extension officers in Lesotho significantly improved their access to information. Moreover, the awareness of extension officers on ICT had a significant positive on their use of ICT tools. Meaning, if the extension officers are aware of the importance of ICT tools, the more they will use of it in their professional work (Akintunde & Oladele, 2019). On the other hand, the study found that some of the constraints to the use of ICT include: perceived high cost, failure of service, inability to maintain ICT, absence of skilled operators, shortage of electricity, fake and substandard products, insufficient service providers in the country, illiteracy, poor basic infrastructure, and non-availability of technical personnel. In Ethiopia, non-governmental organizations provided agricultural extension and advisory services to farmers (Benson, 2022). These include the provision of technology and inputs, training on how to use ICT in agriculture and mass education. The study of Benson (2022) found out that ICT, through mobile phones, helps small-scale farmers to market their produce and enhance their livelihoods. They also used ICT in promoting farming information and knowledge. However, Mahon et al. (2019) as mentioned by Benson (2022), said that the lack of access to ICT infrastructure hindered the national and regional sharing and exchange of knowledge and information generated by research centers.

Undeniably, the information and communication technology revolution provide new options for accessing information by providing it directly to farmers and extension workers. ICTs offer more opportunities to reach more people and to carry out various extension functions more effectively and efficiently.

The Philippine Department of Agriculture has been aggressive in promoting the utilization of its ICT tools among Agricultural Extension Worker (AEWs), farmers, intermediaries and other stakeholders. However, there have not been a single study looking into the extent of the utilization of these ICT tools among AEWs. Just like any other app, these ICT tools have features that may either encourage or discourage their use by AEWs.

The Technology Acceptance Model (TAM), developed by Davis (1989) to explain and predict computer technology adoption is one of the widely used models in studies on information technologies utilization

(Alambeigi & Ahangary, 2015). The TAM model uses two variables as fundamental determinants of user acceptance: perceived usefulness; and perceived ease of use (Davis, 1989). Perceived Usefulness (PU) is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance,” while Perceived Ease of Use (PEOU) refers to “the degree to which person believes that using particular system would be free of effort (Davis, 1989).

Through the years, the TAM expanded to include other variables that could directly affect or mediate utilization of ICT. These include the TAM 2 work by Venkatesh and Davis which include social factors and results-oriented aspects in the framework. While TAM 3 was proposed by Venkatesh and Bala wherein self-efficacy, external control, anxiety, playfulness, perceived enjoyment, and usability are determinants of PEOU (Castiblanco Jimenez et al, 2021).

Succeeding researchers have proposed several different extensions based on the research objectives, context, and the nature of technology (Castiblanco Jimenez et al, 2021).

In this context, an expanded Technology Acceptance Model was developed and validated to predict the extent of utilization of ICT tools in agricultural extension in the Province of Isabela.

The expanded TAM considered the Institutional Support by the Department of Agriculture and Local Government Unit, the ICT tools' Content Quality, and User Characteristics as predictor of PU and PEOU. Jimenez et al. (2020) identified content quality as one of the common external variables for TAM under Technology acceptance when the technology is a platform or system. Based on the literature search of Castiblanco Jimenez et al (2020), Content Quality (CQ) was defined as the extent to which the information fits user needs in terms of information organization, relevance and actuality, availability of support materials, and accuracy of the terminology. This definition was adopted in this study.

## II. METHODOLOGY

Descriptive causal research design was employed in this study. Quantitative data collection techniques, specifically survey, was used to elicit information for this study. The respondents of the study were Agricultural

Extension Workers (AEW) in Isabela. Both the regular and non-permanent AEWs working for at least one year at the Municipal/City Agriculture Office were included in the study. In selecting the respondents, only the AEWs residing in accessible municipalities of Districts 1 and 3 were considered. These are districts that are adjacent to the Training Centers of the Agricultural Training Institute. Based on accessibility, therefore, the municipalities of Cabagan, Delfin Albano and Tumauni, in District 1 and municipalities of Cabatuan, San Mateo and Ramon in District 3 of Isabela, Philippines were purposely chosen as sites for the study.

A survey questionnaire was used to collect the needed data for this study. It consists of two parts, the first part is designed to collect the AEWs characteristics while the second part explored the other intrinsic ICT traits, extrinsic factors, and extent of utilization of ICT tools among the respondents. The instrument partly adopted the TAM questionnaire by Davis and format as studied by Lewis (2019). The TAM has 12 items, six assessing perceived usefulness (PU) and six assessing perceived ease of use (PEOU). Meanwhile, three items assessing the content quality were derived from the study of Castiblanco Jimenez et al. (2021). And the questions for accessibility were derived from the study of Barroga (2019). On the other hand, questions referring to user interface were derived from the research of Choi et al (2017). Moreover, the study used the perceived constraints in utilization of ICT for agricultural extension by Kale et al. (2017). Self-administered survey questionnaires were sent in person or through email to all the respondents. Their consent to participate were solicited through an Informed Consent Form indicating their voluntary participation.

Data were analyzed through descriptive and inferential statistics. Encoding, cleaning, and sorting of data were done through MS Excel. These were processed in SPSS statistical software. Pearson correlation, p-test, and t-test were used to examine the predictive value of each independent variable on the dependent variable.

## III. RESULTS AND DISCUSSIONS

### Socio-demographic characteristics of AEWs

A new generation of Agricultural Extension workers are now in the frontline service. Table 1 shows that majority of AEWs are young, with nearly 60% aged 30 or younger. This indicates a youthful workforce, which could imply a high level of energy and potential for growth, and are

more receptive to innovations and technological advancements.

In terms of sex, there is a higher proportion of female AEWs compared to male, making up almost 61% of the workforce. The dominance of female AEW, in terms of number, is more evident in District 3 with 66% while in District 1 is almost equal at 53%.

Majority of the AEWs are young and new in the service. A significant majority of AEWs have relatively short tenure (1-5 years), which correlates with the younger age distribution. The average years in service is 5.15 years while 23% of them are in the service for only 1 year.

Nonetheless, majority or 52.2% are on permanent or regular job tenure status, 8.7% are contractual or casual and the rest 39.1% are job orders or under contract of service which has not employee-employer relationship. According to Briones et al. (2023), the type of appointment of the AEWs have an effect on the quality of the extension services provided to farmers. For their highest educational attainment, only one from the respondents has a Doctoral Degree and only two have masters' degree.

Each AEW has multiple commodity assignments. Majority or 58.7% of the respondents are assigned on rice, reflecting its importance as staple crop. Livestock (32.6%) and corn (28.3%) are also significant areas of focus. The diversity in commodity assignments shows a broad range of expertise among AEWs, but the concentration on rice suggests it is a key priority of the government and it shows in the production performance of the Isabela province being one of the top rice producing provinces in the country.

Table 1. Socio-demographic Characteristics of AEWs

Variable		Frequency	Percentage (%)
Age	Young (≤30)	27	58.70
	Average (31-59)	19	41.30
	Old (≥60)	0	0
Sex	Male	18	39
	Female	28	61
Highest Education	Vocational/Diploma	1	2.2

Course	College Graduate	42	91.3	
	Masteral Graduate	2	4.3	
	Doctoral Graduate	1	2.2	
	Agribusiness	2	4.35	
	Agricultural engineering	3	6.52	
	Agricultural technology	8	17.39	
	Agriculture	23	50	
	Animal Husbandry	1	2.17	
	Business administration	2	4.35	
	Forestry	1	2.17	
Job Tenure	Information technology	3	6.52	
	Nursing	1	2.17	
	Veterinary medicine	1	2.17	
	Fisheries	1	2.17	
	Job Order/ Contract of Service	18	39.1	
	Contractual/ Casual	4	8.7	
	Regular/ Permanent	24	52.2	
	Years in Service	1-5	32	73
		6-10	8	18
		11-15	2	5
16-20		2	5	
Commodity Assignment*	Rice	27	58.7	
	Corn	13	28.3	
	Livestock	15	32.6	
	High Value Crops	10	21.7	

Rural Based Organizations	7	15.2
Crop Insurance	1	2.2
Fisheries	6	13.1
Agricultural Engineering/ Machines	2	4.4

\*Multiple responses

### Information needs of farmers

On the other hand, one of the main tasks of agricultural extension workers is to provide technical assistance or farm business advisory services. They provide information need by the farmers to improve their management practices, processing techniques, marketing, or even their resources. Table 3 shows the information AEWs provide to farmers. Moreover, the Municipal Agriculture Office is among the source of information of farmers specifically on agriculture, livestock, and fishery. As mentioned in a Baseline Study conducted by the Department of Agriculture, the top source of information of farmers is training/ coaching/ and mentoring (Briones, Galang, & Latigar, 2023).

The most frequently asked information by farmers is on variety and seed selection with 63% followed by planting with 45.7%, pest management with 43.5% and nutrient management as shown in Table 2. On the other hand, it can be observed in Table 3 that information on variety and seed selection is also the primary topic being provided by the AEWs to the farmers. It is worth to point out that, the information need by the farmers are being provided by the AEWs. This suggests that AEWs must have up-to-date knowledge on these topics or have an access to sources of information such as ICT tools.

Table 2. Information usually asked by farmers from AEWs

Variable	Frequency	Percentage (%)
Credit	18	39.1
Crop Insurance	10	87
Variety and Seed Selection	29	63
Land Preparation	18	39.1
Planting	21	45.7
Seedlings Management	18	39.1
Nutrient Management	19	41.3
Water Management	17	37
Pest Management	20	43.5
Harvest Management	13	28.3
Postharvest Management	12	26.1
Processing and Value adding	10	21.7
Marketing	13	28.3
Training	17	37.0

### ICT tools that the AEWs have access for agricultural extension

The almost all or 93.5% of the AEW respondents have access to ICT tools developed by the Department of Agriculture, which is crucial for disseminating updated agricultural information.

Most of the AEWs own smartphones (89.1%), which supports the use of mobile apps and internet resources in their work. However, fewer AEWs own laptops (41.3%) or desktops (37.0%), which might limit their ability. Nevertheless, the Local Government Units (LGUs) provide significant ICT resources, especially laptops (73.9%) and desktops (82.6%). This support enhances AEWs' capacity to access and disseminate information effectively.

A mix of internet connection types is used in offices, with fiber broadband (41.3%) being the most common, indicating good infrastructure for reliable internet access. Most AEWs have internet access in the field, primarily through prepaid mobile data (82.6%), which supports on-the-go information access and communication.

The high percentage of smartphone ownership (89.1%), internet connectivity in the field (89.1%), and access to DA-developed ICT tools (93.5%) could equip the AEWs to provide timely and relevant information to farmers. This infrastructure supports the effective dissemination of agricultural information, aligning well with the high demand for specific types of information from farmers.

Table 4. ICT Ownership and Access

Variable		Frequency	Percentage (%)
Accessing DA-Developed ICT tools for Information Sharing	Yes	43	93.5
	No	3	6.5
ICTs Personally Owned by AEW	Keypad/ Feature Phone	4	8.7
	Smartphone	41	89.1
	Tablet	3	6.5
	Laptop	19	41.3
	Desktop	17	37.0
ICTs owned by LGU for Agricultural Extension	Keypad/ Feature Phone	2	4.3
	Smartphone	23	50
	Tablet	2	4.3
	Laptop	34	73.9
	Desktop	38	82.6
Internet Connection at their Office	Radio	1	2.2
	Television	3	6.5
	Prepaid Mobile Data	14	30.4
	- Personal Expense	9	19.6
	- LGU Provided		
	Postpaid Mobile Data	2	4.3
	Wireless Broadband	11	23.9
Fiber Broadband	19	41.3	

Internet Connection in the Field	Yes	41	89.1
	- Prepaid	38	82.6
	- Postpaid	3	6.5
	None	5	10.9

Table 3. Information provided by AEWs to farmers

Variable	Frequency	Percentage (%)
Credit	17	37
Crop Insurance	10	87
Variety and Seed Selection	33	71.7
Land Preparation	20	43.5
Planting	22	47.8
Seedlings Management	21	45.7
Nutrient Management	23	50
Water Management	22	47.8
Pest Management	22	47.8
Harvest Management	19	41.3
Postharvest Management	17	37
Processing and Value adding	12	26
Marketing	13	30.4
Training	13	30.4

In terms of awareness of the AEWs on the ICT tools developed and being promoted by the Department of Agriculture, a large majority or 91.3 percent are aware of these technologies. The Rice Crop Manager is the most popular app with 76.1% of the respondents followed by Binhing Palay App with 71.7%. Since its launching in 2018, there is a massive campaign on the utilization of Rice Crop Manager Advisory Services which started as Nutrient Manager for Rice. Several Trainings on the Use and Operation of the RCMAS were conducted by the Agricultural Training Institute, Department of Agriculture, Philippine Rice Research Institute and the International Rice Research Institute.

Table 5. AEW Awareness on the ICT Tools Developed and being Promoted by DA for Agricultural Extension

Variable	Frequency	Percentage (%)
Awareness on existing ICT tools developed by DA		
Yes	42	91.3
Binhing Palay App	33	71.7
Rice Crop Manager	35	76.1
Leaf Color Computing App	20	43.5
MOET App	19	41.3
e-Damuhan	15	32.6
Rice Doctor	10	21.7
AgriDoc App	8	17.4
Rice Knowledge Bank	7	15.2
Pinoy Rice Knowledge Bank	10	21.7
e-Extension/eLearning for AgriFishery	13	28.3
PhilRice Text Center	12	26.1
Farmers' Contact Center	8	17.4
No	4	8.7

**ICT tools developed by DA that are being used by the AEWs**

The top three ICT tools or applications that are being utilized by the AEWs are Rice Crop Manager (76.1%), Binhing Palay App (56.5%), and MOET App (34.8%). Respondents have noted that both the RCM and Binhing Palay app are being utilized during the seed distribution every cropping season. "Farmers are usually asking the maturity of the variety, how much it can yield, and other information about the seeds (Respondent A, 40 years old)." Hence, they are using the Binhing Palay App to look for the information about rice varieties. On the other hand, the provision of nutrient and crop management recommendation

through the Rice Crop Manager has been a practice of most local government units. "We use them seasonally, but during seed distribution we use it every day (Respondent A, 40 years old)." According to the AEWs, rice seed distribution occurs on May to June for the Wet Cropping season and November to December for the Dry Cropping season.

It is also important to note the findings of Briones et al. in 2023 that the RCM received a large funding from the National Rice Program which provides incentives to AEWs who generated the number of target RCM recommendations.

Table 6. ICT Tools that are being used by AEWs in agricultural extension

Variable	Frequency	Percentage (%)
Binhing Palay App	26	56.5
Rice Crop Manager	35	76.1
Leaf Color Computing App	14	30.4
MOET App	16	34.8
e-Damuhan	15	32.6
Rice Doctor	10	21.7
AgriDoc App	3	6.5
Rice Knowledge Bank	5	10.9
Pinoy Rice Knowledge Bank	7	15.2
e-Extension/eLearning for AgriFishery	9	19.6
PhilRice Text Center	10	21.7
Farmers' Contact Center	7	15.2

With the access to ICT tools, the agricultural extension workers usually search information on crop production from the different apps and websites. The top information they are searching is on Variety and Seed Selection (73.9%), Pest Management (63.0%), Water Management (56.5%), and Seedlings Management (54.3%). Meanwhile, they are also looking for topics such as Crop Insurance (43.5%), Land Preparation (45.7%), Planting (50.0%), and Nutrient Management (52.2%). It



can be observed that the topics searched by the AEWs are closely related to the functionalities and information being offered by the ICT tools.

Table 7. Information Usually Search by AEWs in the ICT Tools

Variable	Frequency	Percentage (%)
Credit	12	26.1
Crop Insurance	20	43.5
Variety and Seed Selection	34	73.9
Land Preparation	21	45.7
Planting	23	50
Seedlings Management	25	54.3
Nutrient Management	24	52.2
Water Management	26	56.5
Pest Management	29	63
Harvest Management	17	37
Postharvest Management	18	39.1
Processing and Value adding	12	26.1
Marketing	15	32.6
Training	14	30.4
Livestock	14	30.4

Table 7. Information Usually Search by AEWs in the ICT Tools

Variable	Frequency	Percentage (%)
Organic Agriculture	12	26.1
Price Information	6	13
Weather Forecast	12	26.1

**Extent of utilization of ICT tools among AEWs in the delivery of agricultural extension services**

There is a variability in usage patterns of the different ICT tools, with some being used more consistently than the others. The Binhing Palay App and Rice Crop Manager, are used more frequently, with a higher proportion of AEWs using them on a daily or weekly basis. On the other hand, ICT tools such as Rice Doctor and AgriDoc App, are used less frequently, with usage typically occurring once in 2 months or even less frequently. Some of the respondents who answered “others” specified that the utilization of the RCM and Binhing Palay App is seasonal. As mentioned earlier, during seed distribution prior to the planting season, these two apps are used almost every day. Meanwhile, the Rice Doctor which provides information on Pest Management is used only during insect pests’ infestations.

Table 8. Utilization of ICT Tools Developed by DA for Agricultural Extension for the past 6 months

ICT Tools	Everyday		1x a week		1-2 times a month		Once in 2 months		Once in 6 months		Others	
	f	%	f	%	f	%	f	%	f	%	f	%
Binhing Palay App	1	2.2	2	4.3	5	10.9	6	13.0	8	17.4	5	10.9
Rice Crop Manager	1	2.2	1	2.2	11	23.9	7	15.2	12	26.1	3	6.5
Leaf Color Computing App	-	-	-	-	3	6.5	4	8.7	7	15.2	5	10.9
MOET App	-	-	3	6.5	5	10.9	7	15.2	4	8.7	-	-
e-Damuhan	1	2.2	2	4.3	2	4.3	3	6.5	4	8.7	4	8.7
Rice Doctor	1	2.2	1	2.2	1	2.2	1	2.2	-	-	5	10.9
AgriDoc App	-	-	-	-	1	2.2	-	-	-	-	5	10.9
Rice Knowledge Bank	-	-	-	-	2	4.3	-	-	1	2.2	5	10.9
Pinoy Rice Knowledge Bank	-	-	-	-	2	4.3	-	-	1	2.2	5	10.9

e-Extension/ eLearning for AgriFishery	-	-	-	-	3	6.5	-	-	1	2.2	5	10.9
PhilRice Text Center	-	-	-	-	2	4.3	1	2.2	3	6.5	5	10.9
Farmers' Contact Center	-	-	-	-	1	2.2	1	2.2	2	4.3	4	8.7

**Perception of AEWs on ICT traits**

According to Davis, the user's beliefs can influence the attitude of the users which will affect the intention to use or not the ICT tools (Castiblanco Jimenez, Cepeda Garcia, Violante, & Vrezzetti, 2020). Using a Likert Scale of 1-5 with where 1= Extremely Disagree, 2= Slightly Disagree, 3= Neither Agree nor Disagree, 4= Slightly Agree, 5- Extremely Agree, the respondents assessed their perception on different beliefs used in the TAM. Based on the result on Table 8, respondents generally agree on these beliefs. In terms of Perceived Usefulness, a mean of 4.50 was obtained wherein the highest score was recorded on the statement "Using ICT tools improves my job performance as an AEW". Meanwhile, on the Perceived Ease of Use there is an average of 4.25 which positively indicates that the ICT tools are user-friendly and easy to navigate. For the Content Quality, the respondents agreed that information presented in the ICT tools are relevant, accurate and in appropriate format with a score of 4.24. On the other hand, the Accessibility recorded the lowest mean with 3.89 of which some of the respondents have disagreement on their willingness to pay or buy ICT tools for the performance of their job. Nonetheless, on average a score of 3.59 which places between Neither Disagree nor Agree and Slightly Agree was obtained. Lastly, the respondents agreed that the user interface is also an important traits of ICT tools to be considered with a score of 4.09.

Table 9. Perception on ICT Traits towards utilization

Variables	Mean	Standard error
<b>Perceived Usefulness</b>	<b>4.50</b>	<b>0.10</b>
1. Using ICT Tools in my job enables me to accomplish tasks more quickly than other products in its class.	4.37	0.09

2. Using ICT tools improves my job performance as an AEW.	4.59	0.09
3. Using ICT tools in my job increases my productivity as an AEW.	4.48	0.10
4. Using this product enhances my effectiveness on the delivery of agricultural extension.	4.52	0.10
5. Using the ICT tools makes it easier to provide agricultural extension.	4.48	0.10
6. I have found the ICT tools useful in my job as an agricultural extension worker.	4.57	0.10
<b>Perceived Ease of Use</b>	<b>4.25</b>	<b>0.11</b>
7. Learning to operate the ICT tools was easy for me.	4.22	0.10
8. I found it easy to get the ICT tools to do what I want it to do.	4.09	0.11
9. My interaction with the ICT tools has been clear and understandable.	4.39	0.10
10. I found the ICT tools to be flexible	4.22	0.12

	to interact with.				easy to learn.		
11.	It was easy for me to become skillful at using the ICT tools.	4.33	0.10	20.	The interface is pleasant.	4.07	0.12
12.	I found the ICT tools easy to use.	4.26	0.12	21.	The interface is simple.	4.11	0.13
	<b>Content Quality</b>	<b>4.24</b>	<b>0.12</b>	22.	I can input data accurately using the interface.	4.07	0.12
13.	The ICT tools provide up-to-date information and content that is relevant to my needs and interests as AEW.	4.07	0.14	23.	I can input data quickly using the interface.	4.13	0.12
14.	I think that the information I will get from the ICT tools are valuable in the performance of my job as an AEW.	4.39	0.09				
15.	The ICT tools present the information in an appropriate format.	4.26	0.12				
	<b>Accessibility</b>	<b>3.89</b>	<b>0.12</b>				
16.	I am willing to pay/buy ICT tools for the delivery of agricultural extension.	3.59	0.14				
17.	I consider the internet connectivity requirement of an ICT tool before using it.	4.20	0.11				
	<b>User-interface</b>	<b>4.09</b>	<b>0.12</b>				
18.	The interface is fun to use.	4.02	0.11				
19.	The interface is	4.17	0.12				

Aside from the intrinsic and extrinsic factors that may affect the utilization of ICT tools, this study also explored the relationship of the socio-demographic characteristics of the respondents and their perception on the ICT Traits. Results showed that there are two socio-demographic variables that have significant relationship with the perception of AEWs on some ICT Traits.

The education degree or course graduated by the AEWs has significant influence with the Perceived Usefulness of the ICTs with p-value of 0.0075. The AEWs working in different Local Government Units varies on the courses they finished which include Agriculture, BS in Agricultural Engineering, Fisheries, Forestry, Veterinary Medicine, Information Technology, and Business Administration. However, as Ani and Correa (2016) found “Extension workers have become “jack of all trades, master of none” since they have to address all agricultural related issues in their respective localities”. The nature of their work providing farm business advisory outside of their specialization could influence their perception on how useful the ICT tools in the performance of their job.

Meanwhile, the educational attainment of the AEWs significantly influences the Perceived Ease of Use with p-value of 0.0451. With their exposure on and use of ICT tools during their university years, it provides them prior knowledge on computer system which influences their perception on ease of use.

Table 10. Relationship of Socio-demographic characteristics and user’s beliefs towards ICT

ICT Traits	p-value					
	Age	Sex	Years in Services	Educational Attainment	Course	Job Tenure
Perceived Usefulness	0.3892	0.6729	0.8184	0.1141	<b>0.0075*</b>	0.1064
Perceived Ease of Use	0.4376	0.2718	0.786	<b>0.0451*</b>	0.1043	0.4154
Content Quality	0.5617	0.3216	0.4771	0.2869	0.1305	0.2352
Accessibility	0.705	0.8332	0.5359	0.1075	0.4498	0.1744
User Interface	0.8948	0.6952	0.6553	0.0548	0.7491	0.6527

\*significant at 0.05 level

### Institutional support

The Department of Agriculture and the Local Government Unit are providing support for the utilization of ICT tools in different municipalities. These include provision of financial resources, provision of ICT equipment and capability building activities. The Department of Agriculture through the Agricultural Training Institute (DA-ATI) conducted trainings on the

operation and maintenance on the Rice Crop Manager and included modules on ICT Tools for Agriculture in different Training Modules (ATI-RTC 02, 2023). In addition, the DA-ATI also provided ICT tools such as laptops, wifi modem, tablet, and GPS device to some Farmers Information and Technology Services (FITS) Centers maintained by the Office of the Municipal Agriculturist for different Local Government Units.

Table 11. Institutional Support of LGUs on ICT

Variable	Frequency (n=46)	Percentage (%)
Allocate funds for office internet connection	28	60.9
Provides/procure ICT gadget for extension service	9	19.6
Provides training program on ICT/ digital literacy	21	45.7
Allows staff to attend training program on ICT/ digital literacy	35	76.1
Provides communication allowance of staff	6	13.0
Maintains an ICT lounge	2	4.3
Maintains the LGU FITS Center	24	52.2
Documented support on ICT (Memorandum, resolution, development plan, etc)	5	10.9

Furthermore, the result of the study shows that 76.1% of the respondents said that the LGUs allow them to attend training programs. Moreover, 60.9 of the AEWs said that their LGUs allocate fund for office internet. The LGUs are also maintaining their FITS Centers said by the majority (52.2%) of the respondents.

### Influence of ICT Traits on the Extent of Utilization of ICT Tools

Based on the result on Table 8, the respondents agreed that their perceptions on the usefulness, ease of use, content quality, accessibility and user interface of the ICT tools greatly influence their attitude towards the tools which eventually affect their intention to use. However, the extent of the utilization could be different. Among the ICT traits, only the accessibility and user interface showed significant relationship with the utilization of ICT tools. The result on Table 11 shows the extent of utilization of the Binhing Palay App is significantly influenced by accessibility (0.38) and user interface (0.34) and while the Leaf Color Computing App has significant relationship with accessibility (0.34).

Furthermore, in terms of Institutional Support, the fund allocation for the office internet recorded a significant influence on the use of majority of the ICT tools as reported on Table 12. In addition, the maintenance of the FITS Center and

documented support such as memorandum of agreements, resolutions, and development plans have also a significant influence on the extent of utilization of the ICT tools (Table 13).

Table 12. Influence of ICT Traits on the Extent of Utilization of ICT

ICT Trait	Correlation (pearson r)											
	Binhin g Palay App	Rice Crop Manag er	Leaf Color Computi ng App	MOE T App	e- Damuh an App	Rice Doct or	AgriDo c App	Rice Knowled ge Bank	Pinoy Rice Knowled ge Bank	e- Extension / eLearning for Agri/Fishe ry	PhilRic e Text Center	Farmer s' Contac t Center
<b>usefulness</b>	0.28	-0.23	0.21	-0.09	0.06	0.04	-0.02	0.05	-0.05	0.10	0.05	-0.02
<b>ease of use</b>	0.27	-0.10	0.25	-0.07	0.26	0.12	0.08	0.14	0.06	0.23	0.04	0.11
<b>content quality</b>	0.24	-0.12	0.20	-0.05	0.24	0.17	0.10	0.18	0.10	0.24	0.09	0.13
<b>accessibility</b>	<b>0.38*</b>	-0.02	<b>0.34*</b>	0.04	0.11	0.12	0.05	0.13	0.06	0.24	0.05	0.12
<b>user interface</b>	<b>0.34*</b>	-0.02	0.29	0.03	0.23	0.07	0.01	0.09	0.02	0.16	-0.02	0.06

\*significant at 0.05 level

Table 13. Influence of Institutional Support on the Extent of Utilization of ICT Tools

Institutional Support	t-test											
	Binhi ng Pala y App	Rice Crop Mana ger	Leaf Color Compu ting App	MOE T App	e- Damu han App	Rice Doct or	AgriD oc App	Rice Knowle dge Bank	Pinoy Rice Knowle dge Bank	e- Extensi on/ eLearni ng for Agri/Fis hery	PhilR ice Text Cent er	Farm ers' Conta ct Cent er
Allocate funds for office internet	0.4762	0.6015	<b>0.0048*</b>	<b>0.0260*</b>	<b>0.0367*</b>	0.0516	<b>0.0404*</b>	<b>0.0155*</b>	<b>0.0155*</b>	<b>0.0350*</b>	0.1192	<b>0.0143*</b>
Provides ICT gadget	0.5013	0.3875	0.4077	0.9735	0.5205	0.4379	0.2874	0.2061	0.2061	0.5455	0.388	0.469
Provides training program on ICT	0.7054	0.301	0.334	0.261	0.3854	0.5806	0.6555	0.5394	0.5394	0.2025	0.9073	0.2894
Allows staff to	0.85	0.620	0.7307	0.38	0.2175	0.34	0.203	0.0833	0.3836	0.1116	0.777	0.477

attend training on ICT	5	3		87		68	3				9	6
Provides communication allowance	0.5648	0.454	0.8966	0.4142	0.154	0.8644	0.7031	0.4383	0.4383	0.9564	0.1253	0.8891
Maintains ICT lounge	0.7516	0.6809	0.5438	0.5174	0.3198	0.1196	0.085	0.1358	0.1358	0.1524	0.2458	0.1314
Maintains LGU FITS center	0.149	0.5754	0.1862	<b>0.0033*</b>	0.0825	0.2912	0.1335	0.2156	<b>0.0472*</b>	0.3169	0.3387	0.1211
Documented support on ICT	0.9381	0.4118	0.6729	<b>0.0218*</b>	0.3192	0.0655	<b>0.0361*</b>	0.079	0.079	0.1538	0.2038	0.125

\*significant at 0.05 level

### Challenges and constraints on the use of ICT tools

The study also explored the possible conditions that may constrain the Agricultural Extension Workers on their utilization of the ICT Tools. The respondents provided their insights using a Likert Scale of 1-5 where 1= Extremely Disagree, 2= Slightly Disagree, 3= Neither Agree nor Disagree, 4= Slightly Agree, 5- Extremely Agree. Based on the result of their scores on Table 10, the respondents may agree and disagree that the conditions such as Time management problems in learning to use ICT (3.0), Lack of fund for ICT (3.35), Poor ICT based infrastructure facilities in our office (3.24), Lack of technical support from our organization (3.11), and Slow functioning of internet/ server break down may restrict their use of ICT tools (3.33). On the other hand, they disagree that the conditions such as lack of expertise to use ICT (2.87), lack of motivation towards ICT (2.85), use of ICT cause health problems like eye pain, body pain etc (2.65), lack of confidence to use ICT (2.54), lack of training facilities to learn ICT (2.89), and lack of useful software/ app (2.89) restrict them to use ICT tools.

Table 14. Challenges and constraints on the use of ICT tools among the AEWs in the delivery of extension services

Constraints	Mean
Lack of expertise to use ICT	2.87
Time management problems in learning to use ICT	3.00
Lack of learner motivation towards using ICT	2.85
Use of ICT cause health problems like eye pain, body pain etc.	2.65
Lack of confidence to use ICT	2.54
Lack of training facilities to learn ICT	2.89
Lack of fund for ICT	3.35
Poor ICT based infrastructure facilities in our office	3.24
Lack of technical support from agency	3.11
Slow functioning of internet/ server break down	3.33
Lack of useful software/	2.89

app	
Power supply interruption	2.43
No network coverage for mobile	3.17
High threat of virus	2.72

#### IV. CONCLUSION

With the advent of information and communications technology, the diffusion of modern farming technologies and information could be enhanced. At present, there are several ICT tools and resources that were developed and promoted to advance agricultural extension.

The Technology Acceptance Model (TAM) by developed by Davis in 1989 to explain and predict computer technology adoption. It is one of the widely used models to study utilization of information systems such as ICT tools and resources for agriculture.

Based on the results of the study, most of the agricultural extension workers have access to ICTs such as smartphones, desktop computers, and internet. The Local Government Units through the Municipal Agriculture Offices provide ICT tools such as laptops and desktops for the delivery of agriculture and fishery extension services. The AEWs are also using their personal smartphones and internet connectivity when accessing ICT apps in the field.

Among the many ICT tools, AEWs frequently use the Rice Crop Manager, Binhing Palay App, and MOET App. The respondents noted that the utilization of apps is seasonal or as the need arises. For example, the Binhing Palay App and the Rice Crop Manager are being used during the on-set of the cropping season since farmers will seek information on recommended variety and nutrient management.

The study explored different factors that could affect the extent of utilization of ICT tools on rice among the agricultural extension workers in Isabela. Among the areas considered include intrinsic factors such as usefulness, ease of use, content quality, accessibility, user-interface, and extrinsic factor specifically institutional support.

The results of the study showed that among the intrinsic factors, the accessibility and user interface have significant influence on the extent of ICT

utilization specifically on the Binhing Palay App and Leaf Color Computing App.

Meanwhile, on institutional support the allocation of funds for office internet, maintenance of LGU FITS Centers, and documented support on ICT have significant influence on the utilization of the ICT tools. Hence it is recommended for the Local Government Units to allot regular budget for ICT to improve internet connection and upgrade equipment for efficient extension delivery. Moreover, given that the AEWs have different specializations, the LGUs are encouraged continuously to invest on ICT resources since most of the AEWs share information from the ICT tools to the farmers

On the other hand, factors that could limit the use of ICT tools among AEWs include lack of fund for CIT, poor ICT infrastructure facilities, lack of technical support and slow function of internet or server breakdown.

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