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Utilization of Information and Communication Technology (ICT) Tools Among Masbate Rice Seed Growers

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Abstract: This study aimed to determine the awareness, adoption, and utilization of the active rice seed growers of the different ICT-based resources on rice production, their competence and technological capacities to access the different resources, and the recommended practices available for adoption, particularly along: improved agricultural management practices; early warning system and weather updates; and agricultural mechanization. A total of 36 active rice seed growers participated in a series of focus group discussions. Findings revealed that seed growers have a very low level of awareness, competence, and technological capacity in the presence of various ICT-based resources. Some seed growers do not have internet connections due to high connection costs with lower internet speeds. Accordingly, a huge number of rice seed growers were non-adopters, there were very few who adopted the ICT-based resources, particularly in terms of agricultural management practices and experienced the benefits of accessing the resources such as getting prompt answers to pest and disease problems, fertilizer recommendation, characteristics of rice seed varieties and rice seeds that are adaptable in their areas, new technologies in rice farming. They suggested producing IEC materials for seed growers on ICT-based resources on rice and promote technology adoption to farmers to address the lack of awareness; enhancement of internet signal speed by regulating the internet service providers to address the problem; inclusion topic on ICT usage during training/retooling of rice seed growers to address the problem on lack of technical know-how on ICT; provision of tablet to rice seed growers and provision of free internet Wi-Fi for all farmers as solutions to the problems on lack of computer and internet connection at home.

Keywords: ICT-based; seed growers; utilization; competence; rice

1. Introduction

Rice is the calorie source for half of the global population and the staple food for the world's poorest and undernourished people in Asia and Africa. Yield and total production have plateaued for many years in some major rice-producing countries, while the demand is ever-increasing. [1]. In the Philippines, rice remains the primary choice for staple food, locally known as "Palay" (un-milled rice), "Bigas" (milled rice), and "Kanin" (cooked rice). The country's production performance recorded 4.81 million hectares of area harvested for rice and a total production of 19.96 million metric tons, with a value of Php 403.89 billion. However, even with this level of rice production in the Philippines, rice is still the country's 3rd most imported agricultural item [2]. Rice production is constrained by low yield and quality, high postharvest losses, and high water requirements in an increasingly resource-scarce country due to the growing population and water demand, and increasing threat of climate change [3]. Global agricultural production encountered various challenges in

attaining the demand for basic needs of the increasing human population [4]. It is expected to address global challenges by increasing the farmers' competitiveness in enhancing crop yield and reducing crop losses through smart decision-making. [5]. Digital farming technologies range from 'low-tech' tools such as mobile phones and computers to more 'high-tech' solutions such as blockchain, the Internet of Things (IoT), and artificial intelligence that can help smallholder farmers increase their yields and incomes if they are effectively targeted to facilitate agriculture as a 'pathway out of poverty [6].

Information and Communication Technology has advanced more rapidly than any innovation throughout history [7]. In agriculture, the development of digital farming technologies has significantly improved the potential to transform agricultural production and reduce the environmental impact of the green revolution [8]. Digital agricultural technologies are revolutionizing modern farming by leveraging cutting-edge digital tools like data analytics and wireless connectivity, which are being used in agriculture more and more in a variety of ways to improve farm decision-making and practice [9]. The "MASAGANA Rice Industry Development Program 2023-2028" recognizes digital transformation as a key strategy to achieve a stable rice supply, high farm productivity, and increased income for rice farmers by embracing precision farming enabled by drones, remote sensing and IoT devices, and data-driven decision-making through farm management systems, weather forecasts, and access to market information, farming communities can enhance productivity, resource management, and sustainability [10].

At present, the Philippine government, through the initiative of DA-PhilRice, started accelerating its investment in ICT in the early 2000s with the nationwide implementation of the Open Academy for Philippine Agriculture that complemented and supplemented face-to-face rice extension services to reach farmers in "unreachable" areas with more timely information [11]. Agricultural digitalization is an information-driven farming approach that taps digital technology to improve farm productivity while lowering the costs of farming inputs [12]. Similarly, the International Rice Research Institute has created and distributed desktop and mobile programs like Rice Crop Manager, which advises farmers on how to manage crop fertilizer applications in order to boost rice yield [13]. However, according to the Philippine Rice Research Institute [14], the Rice-Based Farm Households Survey notes that while farmers' access to ICT tools is 93%, the percentage of those who use digital tools in their rice cultivation is only 31%.

One of the major goals of the Department of Agriculture is to have a continuous and reliable supply of high-quality inbred rice seeds for positive long-term impacts on seed security and farm productivity, and these directly contribute to attaining rice sufficiency in the country. Seed growers play a vital role in achieving this goal of distributing and producing high-quality inbred rice seeds [15] to meet the seed requirements of the rice farmers. The inbred rice seed growers undergo special training in rice seed production from seed selection, land preparation, and other farm production technologies to ensure quality seeds for the farmers. Likewise, seed growers need greater access to virtually unlimited information offered by agricultural institutions to acquire up-to-date information and new technologies in farming to become more competitive [16]. Despite technological advancement in rice production using digital tools, farmers' adoption and utilization levels remain low, especially in developing countries like the Philippines [17]. This study determined the rice seed growers' awareness of the presence of digital technology-based resources on rice, how they assessed their competence and technological capacity on the use of ICT, and what recommended practices available in ICT they had adopted. The problems that hindered adoption and the possible solutions, as suggested by the seed growers, were also taken into account.

2. Methodology

Research Design

The study used the descriptive-evaluative type of research. This discusses the adoption of ICT-based resources on rice by the seed growers, employing simple statistical computations like percentages, averaging, and ranking to analyze data gathered from a series of focus group discussions (FGD) and key informant interviews. Secondary data were also gathered from published and unpublished documents related to the use of digital tools.

Respondents of the Study

The study's respondents were selected using purposive sampling from the total population of 36 accredited and active rice seed growers in the three congressional districts of the province of Masbate. A total of 36 accredited and active rice seed growers from the three congressional districts of the province of Masbate were selected to participate in the series of focus group discussions. Rice seed growers were chosen as the respondents in this study because they produce quality palay seeds that pass seed certification to maintain the genetic identity and purity of superior rice crop varieties, which are critical in rice sufficiency.

Table 1. Distribution of population and respondents of the study.

District	Active Seed Growers (N=36)	Seed Grower-Respondent (N=36)
First District	5	5
Second District	22	22
Third District	9	9
Total	**36**	**36**

** Source: Masbate Provincial Agriculture Office, Masbate City.*

Data Collection

This study employed a series of Focused Group Discussions (FGD) as the method to extract data and information. FGD is a form of qualitative research in which a group of people is asked about their perceptions, opinions, beliefs, and attitudes toward a concept. Questions are asked in an interactive group setting where participants can talk with other group members. It provides an opportunity for all respondents to participate and to give their opinion/s.

Before the FGD was conducted, the researcher administered a pre-test to 10 rice seed growers to validate the effectiveness and clarity of the guide questions that would be posed to the respondents. The researcher facilitated the conduct of the FGDs and, at the same time, took notes during the discussion. The FGD checklists consisted of:

1. Rice seed growers' awareness of Digital tools for rice production
2. Technological capacity of rice seed growers to access Digital tools
3. Recommended practices available in the Digital tools adopted by the rice seed growers in terms of:
   a. Improved agricultural management practices
      - Pests and diseases
      - Fertilizer recommendation
      - Rice varieties are adaptable to their area
   b. Market and credit access
   c. Early warning system and weather update
   d. Agricultural mechanization, and
   e. And other agricultural services
4. Problems encountered with the use of Digital tools and possible solutions.

During the FGDs, the researcher briefly discussed the features of the Digital tools on rice. The researcher also distributed flyers on digital tools containing instructions on how to access most of the 14 websites. All the FGDs were recorded for reference purposes, and significant answers were quoted from the seed growers.

The researcher also conducted an in-depth interview with the rice seed growers who could not join the FGDs using the Nominal Group Technique (NGT), a variation in FGD introduced by Stewart and Shamdasani (1990). The same questions that were asked during the FGDs were also asked during the NGT. The researcher also related to the interviewees some answers that the other rice seed growers mentioned during the FGDs, so that the interviewees had the chance to react to them.

Research Instrument

The research instrument used in this study was primarily the FGD. It was complemented by the Nominal Group Technique, a variation of the FGD, which was used to conduct the one-on-one interview with the rice seed growers who could not attend the FGD. This technique also used the same guide questions that were used in the FGD.

Data Analysis

The data gathered from the series of FGD were analyzed and synthesized to determine rice seed growers' adoption of ICT-based farming tools, specifically their awareness of the presence of Digital tools, their competence and technological capacity, problems encountered, and recommended solutions. Simple statistical computations were applied using percentages, averaging, frequency count, and ranking.

3. Results and Discussion

Rice Seed Growers Awareness of ICT-based Resources on Rice Production

Table 2 presents the different responses to the awareness of the rice seed growers of the various digital tools in rice production. The results showed that 38% of Masbate rice seed growers were aware of the availability of ICT-based resources for rice production. Among these resources, the most familiar was the Binhing Palay App developed by the Philippine Rice Research Institute (38%), followed by the Leaf Color Computing App (36%), ATI Farmers' Contact Center (33%), Farm Machineries (30%), and E-Extension by ATI (30%).

The Binhing Palay App and the Leaf Color Computing App were the most popular resources being used among the rice seed growers since most of them had joined an expository tour to PhilRice, where they were briefed on the ICT-based resources of the institution. Similarly, most of the seed growers of Masbate have heard about the farming resources during their training and accreditation with the BPI-NSQCS and their annual retooling training conducted by the NSQCS. Other ICT-based resources were also introduced by their respective extension workers in their respective areas, and a few discovered the website by themselves by searching a keyword on rice on the internet. Likewise, the ICT-based resources like the Weather-rice-nutrient integrated decision support system (WeRise) of IRRI, the Philippine Rice Information System (PRiSM) of IRRI, FertRight, and the EDamuhan App obtained a lower awareness rank among the enumerated resources. According to seed growers, their lower awareness of some ICT-based resources in rice production was due to their limited time to access the Internet, not being introduced during the training, and focusing only on the technology introduced by the extension works. These findings call for a more intensive campaign to promote the adoption and awareness of ICT-based resources. The lower percentage of awareness on the use of ICT-based resources by rice seed growers requires a more aggressive and comprehensive campaign on the utilization of ICT-based resources in rice production as Thi Hoa Sen, et al [18] argued that intensification of extension methods on the utilization of digital tools in agricultural production must be increased to boost the rate of adoption practices among local farmers. In addition, the early warning information by seed growers, especially on weather disturbances, was from the PAGASA website and was adopted by 27 % of the seed growers. All of them said radio and television were the primary sources of early warning for them, particularly on occurrences of typhoons and other natural calamities. The findings supported by the study of Pham et al [19] that Early warning systems are essential in mitigating losses, and community-based early warning systems aim to empower at-risk communities for better preparedness and responses. In this study, Masbate rice seed growers will likely adopt the different practices presented in the ICT-based technology if they think that these new tools or practices are far better than their current practices, or they are more compatible with their present norms, and the directions are easily understood, or they are easy to use so that they could try them in their respective farms.

Technological Capacity and Competence of the Rice Seed Growers to Access the Digital Tools in Rice Production

Competence means the ability of rice seed growers to apply the basic knowledge in computer operations and in navigating the internet, while technological capacity means the rice seed growers' capacity to afford or acquire ICT-based resources such as computers, tablets, and mobile phones, and their ability to access internet connectivity.

The results of the study showed that 55.55% of the rice seed growers of Masbate were competent, and 63.88% were technologically capacitated, which only means they have personal computers and access to internet connectivity. Table 3 presents the competence and technological capacity of rice seed growers of Masbate. Accordingly, only 38.88% have adopted some of the recommended practices in crop production. This is shown in Table 4. The low percentage of adoption is attributed to the lack of awareness of ICT-based resources among rice seed growers. Another major problem was the weak signal strength and slow internet service in their respective location that hindered their capacity to visit and gain more information about rice crop production [20].

Table 2. Responses on the awareness of digital tools on rice among rice seed growers of Masbate Province (%).

Digital Technologies on Rice	Number of Seed Growers Who Are Aware of The Digital Technologies	
	Total (n=36)	%
Binhing Palay App of PhilRice	14	38
PhilRice Text Center (call or text 09209111398)	12	33
Leaf Color Computing App of PhilRice	13	36
Minus One Element Technique Kit (MOET) of Philrice	9	25
Weed Identification Tool (E-damuhan) Philrice	5	13
Rice Doctor (http://ricedoctor.irri.org)	6	16
Rice Crop Manager (http://webapps.irri.org/ph/rcm)	4	11
Weather-rice-nutrient integrated decision support system (WeRise) of IRRI	2	5
Philippine Rice Information System (PRiSM) of IRRI	5	13
Rice Knowledge Bank (http://www.knowledgebank. irri.org)	5	13
Smarter Pest Identification Technology (SPidTEch) of DOST Project SARAi	5	13
Farm Machineries (www.philmech.gov.ph)	11	30
E-Extension (http://e-extension.gov.ph)	11	30
ATI Farmers' Contact Center	2	5
PAGASA website	10	27
FertRight (www.bswm.da.gov.ph)	3	8
eDamuhan App (www.philrice.gov.ph)	4	11

Table 3. The number of rice seed growers who have competence and technological capacity in the use of digital tools in rice seed production

District	Number of Seed Growers (n = 36)			
	Number of Rice Seed Growers	Perceived Technological Capacity		Number of Seed Growers with the Competence to Access
		With Computer/Android/Mac Cellular Phones	With Internet Connectivity	
First District	5	2	3	2
Second District	22	12	11	12
Third District	9	4	5	6
Total	**36**	**18**	**19**	**20**
Percent		**50%**	**52%**	**55%**

The third major problem was the lack of competence of 44% of the rice seed growers. Some who have computers and internet connections at home said their computer was used mainly by their children in the preparation of homework and projects in school because they don't know how to use it. This finding implies that competence in the use of computers is crucial in the access and subsequent adoption of ICT-based

resources. ICT-based materials and the subsequent implementation of recommended practices are not always guaranteed by the possession of ICT devices and an internet connection. Rice seed growers are encouraged to undergo capability training on digital literacy, affirming the World Bank [21] assertion that the use of ICT-based tools in the farming areas can be encouraged by providing a more reliable ICT infrastructure and training to the farmers. Investing in ICT-based resources in agricultural production and giving training to help farmers gain access to ICT resources in agriculture were likewise recommended by Montesclaros and Teng [22]. According to them, digital farming tools are important in adapting the agriculture sector to climate change and rising demand for it to serve as a key sector for food security, income, trade, and employment. This study also found that learning the use of a computer and the internet can be more effective for rice seed growers if it is done as a group activity, thus validating the old Social Learning Theory of Bandura [23], stating that learning is a cognitive process that takes place in a social context.

Recommended Practices Available in the Digital Tools that the Rice Seed Growers Adopted

The rice seed producers were questioned regarding the many methods they have implemented on their individual rice farms as a result of using the various ICT-based tools for rice production. Among the practices were as follows: extension services; use of improved agricultural practices, which include pest and disease management; fertilizer management recommendations and rice varieties adoptable in their area; use of market and credit access; use of early warning devices; and agricultural mechanization. Extension service was also excluded in the discussion and analysis, as the seed growers said they have not availed of any extension service from the ICT-based resources. Some seed growers said they don't need the help of ICT in extension as the agricultural technicians in their area always visit their farms. On the other hand, other seed growers said they felt they were excluded from the programs of the Department of Agriculture as they were considered private entrepreneurs, not farmers. Improved agricultural management practices**.** Only 38.88% of the respondents adopted the improved agricultural practices recommended on the website. Agricultural management practices were defined in this study as management principles that are used from crop production up to the marketing of agricultural products or farm practices employed from land preparation to postharvest handling activities and marketing of agricultural produce. Table 4 shows the number of rice growers who have adopted the recommended practices.

Other rice seed growers who have been to PhilRice said that they were impressed by the technology that uses the Global Positioning System (GPS) in analyzing the soil properties. GPS output is location-specific, particularly nutrient management recommendations. Furthermore, they said that it is more sophisticated and that they wished to implement it on their farms since they are no longer required to submit soil samples; nevertheless, they claim that they lack the necessary technical know-how and internet access. In addition, twenty-two percent of the seed growers also tried submitting their problem, particularly on discoloration of leaves, to the Rice Doctor and said they received a reply immediately. Similarly, twenty-seven percent of rice seed growers said they opened the websites of the Philippine Rice Institute (PhilRice) and International Rice Research Institute (IRRI) to look for characteristics of rice seed varieties, seeds adaptable in their areas, new technologies in rice farming, and updates on the programs in agriculture, such as seed subsidies, freebies, and grants. Likewise, sixteen percent of the rice seed growers who have accessed the Rice Crop Manager said it is an excellent tool for farmers. They only input all the needed data regarding their rice farm, and a fertilizer recommendation was immediately sent to their email addresses.

Table 4. Number of rice seed growers- adopters of the recommended practices on the use of digital tools in rice seed production

Recommended Practices	Number of Adopters (n= 36)	Percent
Utilization of improved agricultural practices (Land preparation to Postharvest)	14	38.88
- pest and disease management	8	22.22
- fertilizer recommendation	6	16.66
- varietal suitability in the area	10	27.77
Use of market/credit access	3	8.33
Use of agricultural Mechanization	7	19.44
Early Warning	12	33.33

Similarly, 4% of the rice seed growers who responded to market and credit access recalled that they had merely uploaded their firm name and the number of rice types they had in stock to promote their goods and draw in customers, but that no one had replied. This could be attributed to the lack of awareness of the ICT-based resources among their fellow seed growers. Rice seed growers revealed that Early warning systems and weather updates, especially on impending weather disturbances from the PAGASA website, were adopted by 33% of the seed growers. All of them said the primary source of early warning for them, particularly on occurrences of typhoons and other natural calamities, was radio and television. In this area, the results showed that TV and broadcast media are still the most effective and most powerful mediums in information dissemination. Accordingly, nineteen percent of rice seed growers adopted the recommended machinery and equipment posted on the PhilMech website to improve their production practices. The findings of the study were supported by the study of Hidayat and Mahardiko [24] that the use of ICT tools in farming helps rice farmers identify different insect pests and diseases and provides better control practices than their old pest control methods. In general, the rice seed growers' adoption of agricultural practices in the ICT-based resources was very low due to some constraints, such as lack of knowledge on ICT usage and lack of knowledge on ICT-based resources, lack of computers, absence of internet connectivity because they perceived it as very costly or have very weak signal strength, particularly in the rural areas in the three districts of Masbate Province. At the same time, a huge problem faced by the rice seed growers in all three districts was the very weak internet signal, coupled with the exorbitant rates of internet subscriptions.

Possible Solutions to the Problems that Hinder the Adoption of ICT-based Resources

Eighty-three percent of the Masbate rice seed growers identified poor internet connectivity as their foremost problem in accessing ICT-based resources for their rice seed production activity. In addition, the rice seed growers also complained that the internet services in their areas, regardless of the service provider, were very weak and yet very expensive. According to them, regulating the internet providers will also enhance the internet speed, strength, and area covered by their network, thereby increasing its utilization. Another problem pinpointed by seventy-seven percent of the seed growers was the lack of awareness of the ICT-based resources in rice. The lack of awareness of some seed growers was attributed to insufficient information dissemination on ICT-based resources. The seed growers also complained that they are not included in the program briefing for farmers as "*DA only caters to marginal and subsistent farmers and regards the seed growers as entrepreneurs*." Among the solutions suggested by the rice seed growers was to increase their awareness on ICT-based resources through the production and distribution of IEC materials on ICT-based resources on rice particularly emphasizing the practices available on the websites, how to access the sites and the benefits of adopting the practices such as prevention of pests and diseases, reduction in postharvest losses, reduction in input cost and increase in yield. These IEC materials may be distributed to farmers during special events such as Farmers' Fora, Climate Farmers Field School training and graduations, and other events. Other strategies suggested to increase awareness were video showing and promotion of ICT-based resources through the use of quad media, which will inform a great number of farmers on "what" is available on the government websites. Another problem that hindered adoption was the lack of time and interest in ICT-based resources,

which was reported by 72 % of the rice seed growers. They suggested the incorporation of one-day training on ICT–based resources on rice in the retooling program of the DA-NSQCS. Agricultural extension workers should also help the rice seed growers navigate among the available ICT-based resources on rice and interpret the various messages from the ICT. Accordingly, it has been observed during the conduct of FGD that the respondents were 50-86 years old, thus they were not more interested in ICT or had not learned the technology. Those above the age of 60 don't have computers at home, or if they have, they are for their children. Some sexagenarians who have computers and internet connections at home said they can't learn using them despite many tries. They said they hardly see the computer screen due to cataracts. They just leave the computers to their children or grandchildren. When asked if they were using the internet, some said, *"No, I do not use the internet because I am too old for that."* Or *"I don't have time to waste browsing the internet."*

Table 5. Solutions to problems in the adoption of the use of digital tools in rice seed production

Number of Seed Growers (n = 36)			
Problems Encountered	**Percent**	**Rank**	**Recommended Solutions**
Poor internet connections (Very slow yet very expensive)	83	1	Enhancement of signal strength and internet speed by regulating internet service providers
Lack of knowledge of ICT-based resources	77	2	Production and distribution of IEC materials on Digital tools on rice; promotion of ICT in farmers' training on Digital tools on rice
Lack of time and interest in ICT-based tools in rice farming	72	3	Increase awareness of the benefits of Digital tools to create and sustain interest in ICT.
Difficulty on how to operate the digital tools	66	4	Inclusion of the topic on ICT usage during training/retooling of seed growers
Lack of internet connection at home	55	5	Provision of free Wi-Fi internet access for all farmers under the DOST-ICTO project
Old age	52	6	Inclusion of their children in the training retooling of rice seed growers and in the orientation of DA programs
Lack of a Personal Computer	47	7	Provision of tablets to seed growers

4. Recommendations

The rice seed growers were convinced of the potential of ICT-based resources in improving their agricultural productivity, and they were also very willing to enhance their access to these various ICT-based resources; thus, they recommended the following solutions. To promote awareness of the ICT-based resources among rice seed growers, there should be a massive information campaign on the different ICT-based resources on rice using IEC materials, video presentations, radio and TV interviews, and guest appearances. The IEC materials to be produced should emphasize the new technologies available in the ICT-based resources on rice, how to access the sites, and the outcome if the technologies are adopted, such as prevention of pests and diseases, reduction in postharvest losses, reduction in input cost, and increase in yield. These IEC materials will be distributed to the Municipal Agriculture Offices in the region, and also to seed growers and rice farmers during trainings and special gatherings. To improve the competence of the rice seed growers in using ICT, there must be an inclusion of capacity building as one of the topics in the five-day training on accreditation and seed testing of newly accredited rice seed growers and the three-day retooling of accredited seed growers. A successor/child of the elderly seed growers should also be included in the training. This strategy would not only encourage more youth to engage in agriculture but would also encourage new breeds of rice seed growers. The Agricultural Extension Workers may be included in the ICT-based resources on rice

so that they can promote them during their interaction with the farmers. To enhance the rice seed growers' technological capacity, this study recommends the regulation of internet service providers to significantly enhance internet signal strength and speed. The government must encourage competition among internet service providers to lower internet costs and improve internet services to be on par with other countries' internet services. Another recommendation to enhance technological capacity was the provision of tablets to rice seed growers, and the implementation of the DOST-ICTO project aimed to provide free Wi-Fi internet to all farmers. The lack of awareness of the ICT-based resources among rice seed growers should be addressed first by massive information dissemination, followed by improving access by capacity building and ICT infrastructure development to bridge the gap hindering the adoption of ICT-based resources. To sustain the interest of the rice seed growers and encourage the adoption of the ICT-recommended practices, ICT should be promoted as a general solution for life on the farm rather than as just an exclusive solution for specific farm problems.

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