International Journal of Computing Sciences Research (ISSN print: 2546-0552; ISSN online: 2546-115X)
Vol. 2, No. 4, pp. 131-150
doi: 10.25147/ijcsr.2017.001.1.29
https://stepacademic.net

Short Paper

Development of an Online Laguna Agricultural Trading Center

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Date received: November 8, 2018
Date received in revised form: January 8, 2019
Date accepted: January 22, 2019

Recommended citation:

Jain, A. M. & Carandang, C. B. (2018). Development of an online Laguna agricultural trading center. *International Journal of Computing Sciences Research*, *2*(4), 131-150. doi: 10.25147/ijcsr.2017.001.1.29

Abstract

Purpose – The purpose of the study is to develop a system that can be used as an alternative channel to improve the marketability of farm products of framers in Laguna.

Method – The proponent used two research methodologies. First is the software development which utilized the Agile Software Development. Second is the descriptive research which involved the determination of the acceptability of the software's usability both by the farmers and the consumers. In this phase a combination of qualitative and quantitative methods was used.

Results – The proponent developed the Online Laguna Agricultural Trading Center. The system is an e-commerce website that will serve as an alternative channel of marketing the farmers' products. It will also provide the farmer an easy and economical way of managing some of its business process. Through its Short Message Service capability, the farmer can handle customer inquiries and update inventory of products and prices economically and easily. Based on evaluation, the farmers agreed, "it is easy to find information I needed", while the buyer agreed that "the system is simple to use".

Conclusion – Based on the findings, the proponent concluded that the developed system can be used as a channel to improve the marketability of farm products of farmers of Laguna.

Recommendation – Future researchers may look into the development of its own short messaging services that will not rely on third-party gateways. This will make its implementation less costly on the part of the Administrator. Adding of optional online payment transaction is also encouraged so that big farms who can afford to tie-up with payment centers may be able to do so.

Implications – E-commerce is not a new technology. However, there are no systems that directly resolved the problems of farmers. This paper reveals the real problems of farmers in the Philippines including their willingness to embrace technology that will improve their ability to gain income from their produce.

Keywords – e-commerce, agriculture, SMS, smartphone

INTRODUCTION

Adequate nutritional food is one of the basic needs of human. It enhances the physical health and human autonomy (Coote, 2014). According to the Food and Agriculture Organization (FAO), to improve nutrition, we need to improve agriculture. Philippines is a predominantly agricultural country, but improvement in the agriculture sector is rather slow (Rodriguez, 2014). Food producers in the Philippines still belong to below poverty line. According to Philippine Statistics Office, fishermen and farmers are the poorest among the different sectors in the Philippines. The poverty incidence for fishermen was 39.2% while that of the farmers was at 38.3% ("Who are the Philippines' Poor?", 2014). Although the Philippines through the Department of Agriculture and Department of Science and Technology provide technology-based farm inputs to increase their productivity, Filipino farmers still remain poor. National Economic Development Authority (NEDA) Chief Arsenio Balisacan mentioned that connectivity of farmer to market is still a constraint due to poor infrastructures in rural areas (Cayabyab, 2013). Another observation is that middlemen are getting richer since they can buy farm produce at a very low price and sell it at a higher price to the consumers. Direct selling in the urban area is difficult for farmers and fisher folks who do not have enough financial resources (Liao, 2013). Because of this, farmers cannot do anything about it since they have no other means of selling their products.

To increase the farmer's production, several interventions have been introduced. Among these are production-related training and quality grading (Aguinaldo et al., 2016). In addition, the improvement of market facility may also favor meager farmers (Shilpi & Umali-Deininger, 2008). Technology innovation which is also becoming important is also

being used to improve income and increase productivity (Luo & Hu, 2015). All of the mentioned interventions could solve the conflicting objectives of providing low agricultural prices to consumers and raising farmer's income in the long run.

Thus, the proponent proposed a study to develop an Online Laguna Agricultural Trading Center. The proposal sought to develop an e-commerce website that is accessible using personal computer, mobile and basic cell phone. It should able to serve as an alternative way of marketing the farmers' products, link the farmers directly to their buyers, and provide the farmers an easy and economical way of managing the system of handling customer inquiries, updating inventory of products, and updating of product's prices.

LITERATURE REVIEW

Adequate nutritional food is one of the basic needs of humans. It improves the physical health and human autonomy (Coote, 2014). Today, however, high food prices have distressing effects on developing countries (Swinnen, 2011). Despite the fact that farmers are the one producers of food, they are among the most vulnerable groups. Most of the people below poverty line are small farmers living in small farms (Hazell, 2011).

Current Situation of Philippine Farmers

In the Philippines, food producers still belong to below poverty threshold. According to Philippine Statistics Office, fishermen and farmers are the poorest among the different sectors in the Philippines. Agrarian reform and modernizing agriculture had minimal impact on farmers due to increasing gap between farm gate and retail prices (Martinez et al., 2016). The poverty incidence for fishermen was 39.2% while that of farmers was at 38.3% ("Who are the Philippines' Poor?", 2014). This is comparable to Africa. Among the 850 million people living in continual hunger, half of them are small shareholder farmers (Munyua & Adera, 2009). The study of Acero and Baquiran (2016) found that in selected towns of Laguna 81.7% had an income of Php 5,000 (approximately US$95.96) and below during harvesting period.

Reasons Why Farmers Have Low Profitability

The high poverty incidence of farmers can be attributed to farmers' low profitability that could be attributed to several factors. These may include lower prices of products (Reyes, 2010;Tabora, 2009), no regular buyers of commodities or seasonality of high demand (Monteiro, 2015; Baral, 2015), low agricultural productivity that resulted to aging in the agricultural field (Kashima et al., 2016), wastage and post-harvest losses (Minten et al., 2016) and price dispersals in the market (Aker, Ghosh, & Burrell, 2016).

Dispersal of prices in developing countries is common (Aker et al., 2016); that is why there is always a high ambiguity in prices of agricultural products in the market. It could be due to distance and poor communication in the marketplace (Courtois & Subervie, 2014), unavailability of market information (Tang, Wang & Zhao, 2015), and middlemen that are commanding the prices and gaining more profits (Tumibay et al., 2016). According to De Silva and Ratnadiwakara (2008), in Sri-Lanka, farmers do not have correct and timely information so they have to go to the market to get a good price for their produce.

Hayami, Kikuchi, and Marciano (1999) revealed in their study that there are countless numbers of middlemen that are competing in buying paddy from farmers in Laguna. This could be an advantage to rice farmers since the price can be more competitive and monopoly can be eliminated. However, farmers may not still get the fair price for the products (Oguoma, Nikwocha, & Ibeawuchi, 2010) while the middlemen get to sell the products at a higher price to consumers even when the producer prices are low (Sandika, 2012). Thus, this system can be a threat to food security (Oguoma et al., 2010).

Interventions to Improve Farmer's Production

To increase the farmer's production, several interventions have been introduced. Among these are production-related training and quality grading (Aguinaldo et al., 2016). The improvement of market facility may also favor meager farmers (Shilpi & Umali-Deininger, 2008). Technology innovation is also being used to improve income and increase productivity which is becoming an important aspect (Luo & Hu, 2015).

One of these technology innovations is the Information and Communication Technology (ICT), which may include the Internet, mobile phones, Market Information System (MIS) and e-commerce. Benefits of farmers from these are higher prices of their produce (Aker et al., 2016), greater rural productivity impact (Mittal & Mehar, 2012), reduced search cost (Brown & Goolsbee, 2002), improved market performance and increase welfare (Jensen, 2007), broken barrier between farmers and consumers (Tumibay et al., 2016), elimination of intermediaries, awareness of farmers in market prices and increasing competition (Ebrahim, 2013).

Most farmers are not aware of the technologies in the development of agriculture (Chhachhar, Chen, & Jin, 2016). Although there are many benefits of adopting these technologies, further studies relating to technology acceptance must be considered. One of these is the farmer readiness to adopt new trade system using Internet and mobile technologies (Shaukat, 2013). To ensure its success, Information Communication Technology Platforms that consider the gender digital divide (Aker et al., 2016), issues of illiteracy (Ninsiima, 2015), and employment of the mass communication technology such as mobile systems (Jain, Kumar, & Singla, 2015) must be built.

Mobile technology has many benefits for the farmers, among which is information dissemination (Jain et al., 2015) that includes information of grazing, weather and market conditions (Debsu et al., 2016).

METHODOLOGY

Research Design

The proponent followed two phases in its design. The first phase involves software development. In this phase, agile software development methodologies have been followed. As Figure 1 shows, it follows the iterative development or repeated cycle of small portions of the software development. In every iteration, called a sprint, the cycles are repeated. The cycles involve requirement gathering, analysis and design, testing and deployment. In requirement gathering, review of several related literatures and studies have been conducted. Coordination was also done with the Office of Provincial Agriculturist of Laguna. Each of the information gathered were used to create the design of every modules of the system where three sprints were carried out in the development of the system.

Figure 2 summarizes the architectural design of the system which has three different major users. The first users are the Administrators which are composed of two levels. The first level is the Provincial administrator who should create the Municipal administrator and the name of the products including its code. Second is the Municipal administrator who is responsible for adding the farmers to their own municipality. Both the provincial and municipal administrators can print the list of farmers with their products or commodities. The second users are the farmers who can add their products, and update the quantity, price and availability using conventional cellphones. The farmers can also be notified by the system through SMS if there are interested buyers. The third users are the buyers who can access the system using any internet-capable devices such as personal computer, tablet and smartphone. The buyers can search a product and notify the farmers interested in the product.

To use the system, the following are the requirements:

1. Hardware and Software Requirements
    - Administrators and Buyers: Personal computer or smart phones that are capable of connecting to the Internet.
    - Farmers: Personal computer or smart phones that are capable of connecting to the Internet for setting-up the account. Basic cellphone for updating the inventory and prices of the commodities.
2. Internet browser
   The system can run on any internet browser, but can run best in Google Chrome both for Personal computer and smart phone.
3. Website domain and hosting accessible in 24/7

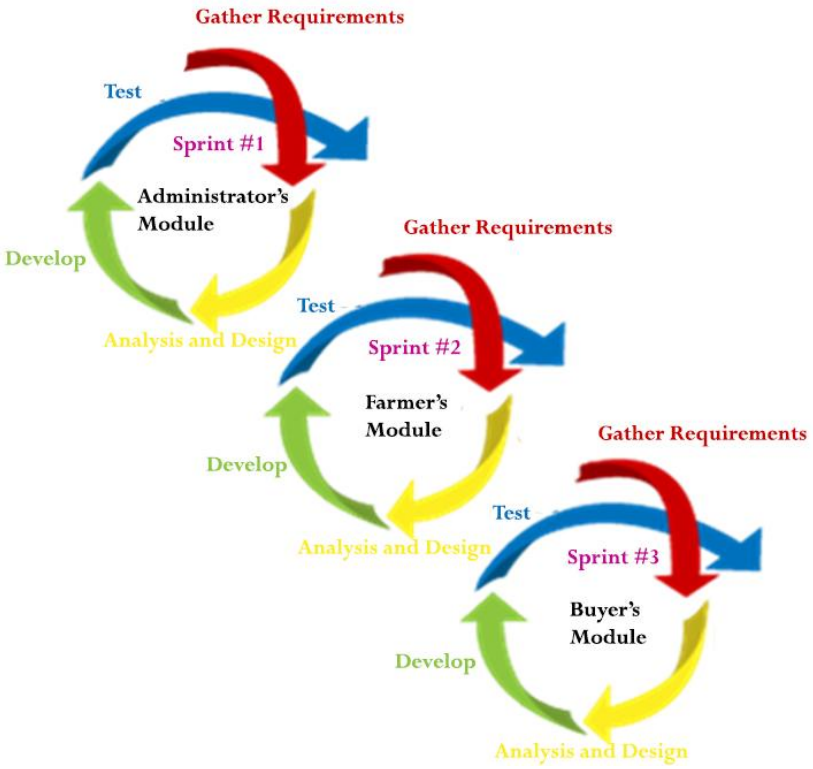

Figure 1. The agile software development methodology

The software was tested and evaluated by experts in the field of Information Technology following the ISO 9126 standard. The second phase involves the determination of the acceptability of the software's usability both by the farmers and the consumers. In this phase a combination of qualitative and quantitative methods was used. According to Wabwoba and Ikoha (2011), in most cases the approaches taken by an IT researcher will normally include a combination of these two categories. This is sometimes called triangulation. Mixed method allows the ability to cross-check the data gathered. Likewise, gathered information from one method may also be used to assist the design of the other method.

In this study, the proponent first demonstrated the developed software. Since the study involves large number of respondents, a self-made questionnaire was used both for the farmers and consumers. This allowed the respondents to easily evaluate the system based on its usability. To permit the researcher to go beyond statistical results, qualitative method was also used. An open-ended question was incorporated in the questionnaires. This allowed the proponent to gather information concerning the actual insights of the farmers and buyers about the system.

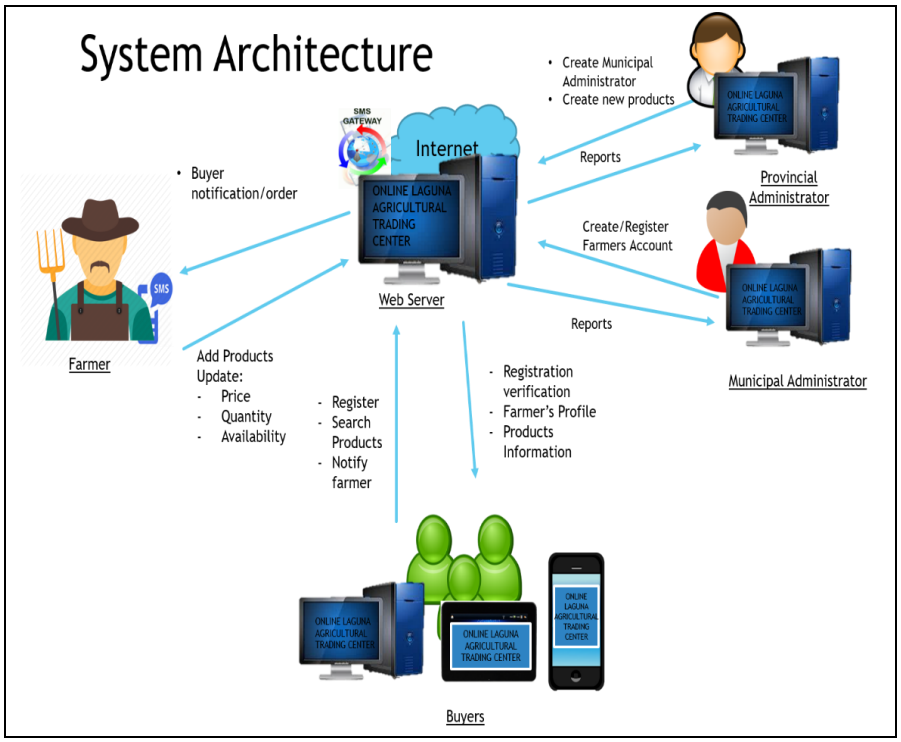

Figure 2. The Architecture of Online Laguna Agricultural Trading Center

Research Instruments

To assess the developed system, a survey questionnaire made by the proponent and was validated by the proponent's capstone project adviser and chairman of the advisory committee in the Cavite State University was utilized. Three sets of questionnaire were developed. They are described below.

1. ICT Expert Respondents

The survey questionnaire for the ICT Expert respondents contains the demographic profile of the respondents such as the job description, age, sex, civil status and years in service. The criteria for software evaluation includes functionality, reliability, efficiency, maintainability and portability which can be rated using the following Likert scale: (5) strongly agree, (4) agree, (3) undecided, (2) disagree and (1) strongly disagree.

2. Farmers

The questionnaire for the farmers includes demographic profile such as place of residence, age, sex, civil status, years in farming, commodities, methods of selling, gadget owned and interest in selling online. The second part is the System's Usability Acceptance. It includes 10 criteria which can also be rated using the following Likert scale: (5) strongly agree, (4) agree, (3) undecided, (2) disagree and (1) strongly disagree. The questionnaire also contains question on whether the farmers will recommend or not the

system to other farmers and their observations on the positive and negative aspects of the system.

3. Buyers

The questionnaire for the buyers include their demographic profile such as place of residence, age, sex, civil status, methods of buying commodities, gadget owned and interest in buying online. The second part is the System's Usability Acceptance. It includes 10 criteria which can also be rated using the following Likert scale: (5) strongly agree, (4) agree, (3) undecided, (2) disagree and (1) strongly disagree. The questionnaire also contains a question on whether the buyer will recommend or not the system to other buyers and their observations on the positive and negative aspects of the system.

Identification of Participants in the Study

A combination of purposive sampling and convenience sampling methods were used in the selection of respondents. Purposive sampling is a non-probability sampling that chooses samples based on the characteristics of the population that is needed in the study (Crossman, 2017). For the study, 10 farmers for each of the 16 municipalities within the third and fourth district of Laguna were utilized to answer the questionnaires. This is due to the fact that the towns near Metro Manila have been industrialized while those that belong to the inner towns are still into agricultural production as well as agriculture-based industries (Tan, n.d.).

Convenience sampling on the other hand was used so that the respondents are easily accessible and in proximity to the researcher. It is fast and easy because the subjects are readily available. The proponent targeted 150 buyers to equate with the number of farmers. But only 130 were accomplished due to time constraints. To test the software quality using ISO 9126, the proponent selected 10 experts in the field. The experts were composed of a college dean, computer instructors, systems programmer, and web developer.

Interview of the Participants of the Study

To facilitate the survey and interview, the system has to be demonstrated first. During the demonstration, laptop and cellphones were used. After the demonstration, participants were asked to answer the survey forms. Those who needed assistance in answering the questionnaire were assisted. The survey was conducted at the residency of the respondents last during the period of March, 2017. 153 farmers, 130 buyers, and 10 ICT experts were surveyed. Responses were gathered through questionnaires.

Statistical Analysis and Interpretation of Data

The results of the survey were tabulated using computer software. The following statistical tools were used in the analysis of data:

1. Percentage. To illustrate the profiles of the respondents, percentage was computed. The highest percentage was used to determine the state of the respondents.
2. Rank. Qualitative response by the participants were grouped and ranked in decreasing order. Response with the highest number of occurrence was given the highest rank.
3. Weighted Mean. To get the participant's degree of approval on the criteria of software quality, weighted mean which is a measure of central tendency was used. Weighted mean was applied on the following software quality criteria: functionality, reliability, efficiency, maintainability, and portability. It was also used on the farmer and buyer's acceptability on its usability.

RESULTS

This section includes the presentation, analysis, interpretation, and discussion of the results of the study.

The Developed System

1. An alternative way of marketing the farmer's product

The proponent developed an e-commerce website that can display the farmer's product so that more buyers or customers can see it. Figure 3 shows that the farmer can add pictures and prices of the produced commodities. This method of marketing the product is not new but a system that focuses only on agricultural products can be a great help for the farmers.

2. A system that will link the farmers directly to the buyers

The system was developed using an internet platform. It can be viewed using a personal computer or android-based form as long as it is connected to the internet. The buyer can browse the products posted by the farmers. Once the buyer was through in selecting the product, he or she can "add it to cart" and notify the farmer directly using the system. Figure 4 shows its interface using a personal computer and Figure 5 shows its equivalent in smartphone.

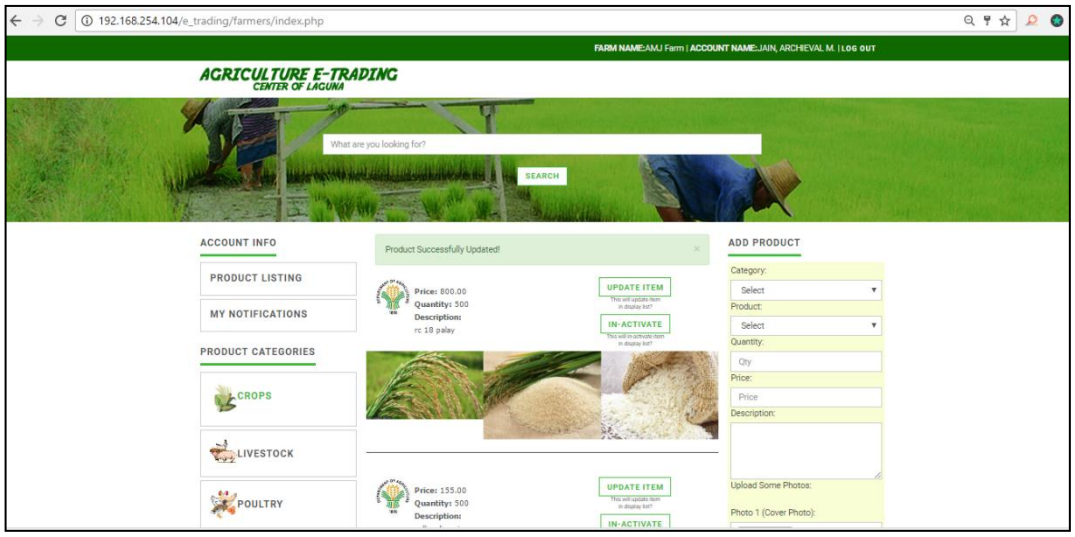

Figure 3. The website can display the products of the farmers who are registered in the system.

3. An easy and economical way of managing the system

In terms of handling customer inquiries, updating inventory of products, and updating of product's prices, farmers can use a conventional cellphone with short messaging services feature. Handling of customer's inquiry is done through the use of a conventional cellphone. Once the customer has notified the farmer, a text message will be received by the farmers as shown in Figure 6. It contains the inquiry and cellphone number of the buyer.

Monitoring and updating inventory of products and prices can be done using a text message. Figure 7 indicates that the farmer only needs to input the product code followed by the new quantity and the updated price of the product.

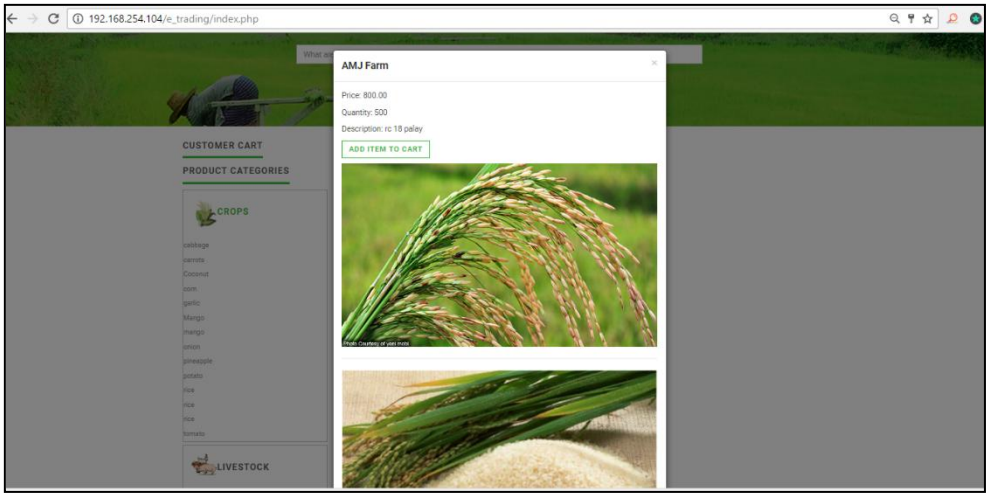

Figure 4. Adding products by the customers using the personal computer.

Figure 5. Adding products by the customer using smartphone

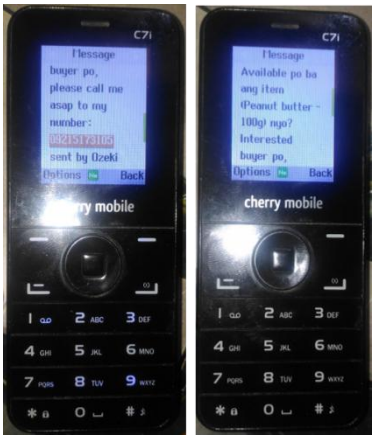

Figure 6. A text message received by the farmers on the customer's inquiry.

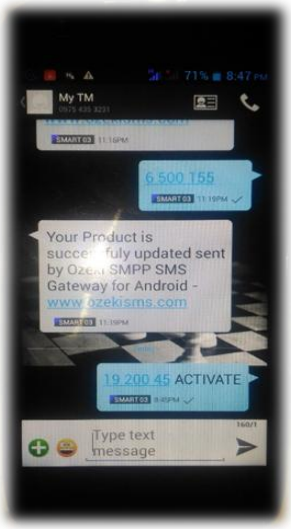

Figure 7. A text message can be sent to the system using codes to update the quantity and price of the product

Evaluation of the System

Farmers

Some of the farmer-respondents owned an ICT tool or gadget such as computer, Internet connection and a cellphone. Based on survey, most of the farmers (n = 110, 71%) own a cellphone. Of the said farmers who own a cellphone, 61 or 55% is a smartphone user, while 49 or 45% owns a conventional cellphone. This implies that a mobile technology system is more suitable for the farmers.

Most of the farmers (n = 86, 56.2%) are not willing to sell their products online. This can be attributed to the reason that they are still dependent on their regular buyers. Another reason is that they do not know how to use computer. However, not all farmers object to selling their product online so that the buyer can see their product; their products sell fast; and more consumers will buy. These imply that by using an online system, more buyers will see their product which could be sold faster.

Buyers

Among the ICT tools, the cellphone is the most owned. 120 respondents or 92.3% have this gadget. Among the 120 respondents with cellphones, 73.3% or 88 own a smartphone. The survey also shows that 39.2% or 51 respondents have an Internet connection. These are good signs since smartphones are capable of browsing the Internet.

A big number of respondents (n = 85, 65.4%) are not currently buying from an online site. According to them this is due to the fact that they do not know how to use computers. Those who buy products online say that it is more convenient and transaction is fast.

Acceptance of farmer-respondents on the system's usability

The usability of the system was evaluated by 153 farmers. Based on the result in Table 1, all of the 10 criteria were evaluated with a mean score from 3.70 to 3.99 which can be interpreted verbally as *agree*. It means that the respondents agree that the system is usable and can perform the task where it is intended for. Among the 10 criteria, the 6th criteria ("It is easy to find information I needed") is the highest whereas the 4th criteria ("I believe I can be productive using this system") got the lowest score. This implies the importance of information to the farmers. According to Fedale (1987) as cited by Riesenberg and Gor (1989), in the agricultural industry, survival depends on having advantage on information related to market. Based also on the survey, 100 among the 153 respondents agree to recommend the system to other farmers. This can be attributed to the farmer's response that the system can help them and the products can be sold faster using the system. Based also on the same survey, as shown in Table 2, the farmers believe that the system can help them more particularly in selling their products.

Acceptance of buyer-respondents of the system's usability

The study utilized 130 buyer-respondents. Based on the survey, as shown in Table 3 all of the 10 criteria obtained the mean of 3.67 to 3.83 with a verbal interpretation of *agree*. It means that the buyer-respondents accepted that the system presented is usable for its intended purpose. Among the 10 criteria, criteria 1: "The system is simple to use" got the highest score with a mean of 3.83 while criteria 9: "The system has all the functions and capabilities I expect it to have" got the lowest with a mean of 3.67. This implies that this less complex system will attract more users. In addition, the buyer-respondents would likely recommend the system to other buyers. This can be attributed to the system's positive sides shown in Table 4. One of these is simplicity and convenient to use which matches the reaction of the respondents. The system also has three negative sides based on the respondents' perception that includes technical knowledge and internet connection problem in the area.

Table 1. Farmer-respondent's acceptance on the system's usability

	CRITERIA	MEAN SCORE	VERBAL INTERPRETATION
1.	The system is simple to use	3.95	Agree
2.	I feel comfortable in using the system	3.79	Agree
3.	The system is easy to learn	3.91	Agree
4.	I believe I can be productive using this system	3.70	Agree
5.	The information provided for the system is easy to understand	3.89	Agree
6.	It is easy to find the information I needed	3.99	Agree
7.	The interface of this system is pleasant	3.81	Agree
8.	I like using the interface of this system	3.71	Agree
9.	The system has all the functions and capabilities I expect it to have	3.72	Agree
10.	Overall, I am satisfied with the system	3.88	Agree

Table 2. Ranking of the negative and positive sides of the system based on the farmer-respondent's perception

RANK	NEGATIVE SIDE OF THE SYSTEM	RANK	POSITIVE SIDES OF THE SYSTEM
1	The system is good for big farms	1	The system can help them
2	don't know how to operate	2	To sell products faster
3.5	Additional job	3	To have more options to be fair (competition)
3.5	Not good for old farmers	4	For the product of the farmers to be known to customers from other towns
		5	The system is good and easy to use
		6.5	To improve the process
		6.5	It is needed because everything now is computerized
		8	The farmers can be upgraded in terms of technology (
		9	To increase income

ICT Experts

A total of 10 experts have evaluated the software quality based on ISO 9126 criteria. Majority of the ICT expert respondents are regular faculty instructors with a frequency of four or 40% of the total respondents. Their age range is between 25 to 34 years of age (n = 6, 60%); majority are male(n =8 , 80%), and mostly are single (n = 6, 60%). Most of them (n = 6, 60%) are still young in their profession with 1 to 5 years of job experience.

Table 5 shows that all of the evaluation criteria has a verbal interpretation of *Agree*. Each of the evaluation criteria has the following average weighted mean: Efficiency and Portability got 4.5, Maintainability and Portability has 4.4 while Reliability is at 4.2. This implies that the ICT experts who evaluated the system agree that the system follows the ISO 9126 standard criteria for software quality.

Table 3. Buyer-respondent's acceptance of the system's usability

CRITERIA	MEAN	VERBAL INTERPRETATION
1. The system is simple to use	3.83	Agree
2. I feel comfortable in using the system	3.68	Agree
3. The system is easy to learn	3.75	Agree
4. I believe I can be productive using this system	3.72	Agree
5. The information provided for the system is easy to understand	3.71	Agree
6. It is easy to find the information I needed	3.71	Agree
7. The interface of this system is pleasant	3.80	Agree
8. I like using the interface of this system	3.69	Agree
9. The system has all the functions and capabilities I expect it to have	3.67	Agree
10. Overall, I am satisfied with the system	3.78	Agree

Table 4. List of the negative and positive sides of the system based on the buyer-respondent's perception

NEGATIVE SIDE OF THE SYSTEM	POSITIVE SIDE OF THE SYSTEM
The system cannot be used if the user do not know how	More people can buy and they can come from any places
Why would you buy far if it is available near	Buyers will have more contacts
The system will not be used if there is no internet connection	The system will make transactions faster
	Simple and convenient to use

Table 5. Result of evaluation of ICT experts using ISO 9126 standard criteria.

EVALUATION CRITERIA	MEAN	VERBAL INTERPRETATION
Functionality		
Suitability	4.4	Agree
Accuracy	4.7	Strongly agree
Interoperability	4.4	Agree
Security	4.3	Agree
Compliance	4.3	Agree
Average Weighted Mean (AWM)	**4.4**	**Agree**
Reliability		
Maturity	4.2	Agree
Fault-tolerance	4.3	Agree
Recoverability	4.2	Agree
AWM	**4.2**	**Agree**
Efficiency		
Time behavior	4.5	Agree
Resource utilization	4.5	Agree
AWM	**4.5**	**Agree**
Maintainability		
Changeability	4.5	Agree
Stability	4.3	Agree
Testability	4.5	Agree
AWM	**4.4**	**Agree**
Portability		
Adaptability	4.5	Agree
Installability	4.5	Agree
Co-existence	4.5	Agree
Replaceability	4.3	Agree
AWM	**4.5**	**Agree**

CONCLUSIONS AND RECOMMENDATIONS

Result of the study shows that the developed system has met the ISO 9126 standards on software quality. It includes criteria such as functionality, reliability, efficiency, maintainability and portability. Acceptability testing also showed a good result from both from the farmer and buyer-respondents. The outcomes also showed that majority of the farmers are willing to recommend the use of the system to other farmers because they perceived that the system can help them. Buyers also recommended the system to be used by other buyers so that more people that come from other places may also buy the products. Based on these results, the proponent concluded that the developed system can improve the marketability of farm products of farmers of Laguna.

As a recommendation, future researchers could look into the development of its own short messaging services that will not rely on third-party gateways. This will make its implementation less costly on the part of the Administrator. Adding an optional online payment transaction is also encouraged so that big farms who can afford to tie-up with payment centers may be able to do so.

IMPLICATIONS

E-commerce is not a new technology. However, there are no system that directly resolved the problems of farmers, especially in the Philippines. This paper shows the real problems of farmers in the Philippines including their willingness to embrace technology that will improve their ability to gain more income from their produce. This paper should serve as a reference to future researchers who desire to develop a similar system for farmers.

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