

Beyond Agricultural tackle: An Analysis of e-Agriculture with paddy Sector in Sri Lanka

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Abstract: *Agriculture can be identified as the blood circulatory system of ancient Sri Lanka and after the world economy arrived to the information age, the association between Agriculture and Information and Communication Technologies (ICT) commenced. This research focused to analyze the familiarity level of the term e-agriculture, identify potential ICT facilities that they used for e-agriculture activities, the potential benefits of e-Agriculture, potential barriers for e-Agriculture implementation, and factors influencing their familiarity level of term e-Agriculture in paddy sector. A mixed- mode based survey was carried out to collect data from 50 paddy sector farmers in 5 different divisional secretaries' office such as Ipalogama, Nochchiyagama, Thalawa, Rajanganaya, and Thabuththegama. A questionnaire was used to collect quantitative data and the semi-structured interview was used to collect qualitative data from paddy sector farmers. The descriptive and content analysis used accordingly quantitative and qualitative data analysis. The study revealed that familiarity was 51% and the mix of technologies, mobile phone (26.4%), television (24.5%), radio (24.5%) and telephone (11.9%) were used for their agricultural activities. The major barrier to implementing e-Agriculture was lack of knowledge (21.1%) of Information and Communication Technology and it was highlighted that lack of training (19.6%), language problem, (18.6%) and lack of ICT benefits awareness (13.6%) obstructs the road of e- agriculture implementation. Respondents are mostly approved that they can get weather forecasting details using Information and communication technology (66.7%), 50% of respondents mostly agreed that they can get better market exposure, prices of the rice, reduce transport cost and save their time, and 33.3% farmers stated that they can increase their income level and increase productivity through e-Agriculture activities. It was recommended that the government can carry on e-Agriculture awareness programmes and workshops to increase the awareness of the e-Agriculture concepts and progammes. Further, the Information Communication and Technology Agency can be introduced a new mobile application which can be help farmers to get access e-Agriculture programmes, details of product price, details of market price changes in chemicals and Weather forecasting details.*

Keywords: *E-Agriculture, ICT, Paddy Sector*

Date of Submission: 02-07-2018

Date of acceptance: 20-07-2018

I. Introduction

Nowadays, Information and communication technology play a vital role in all the sectors in the world. Information and Communication Technology (ICT) is a technology that provides access to information through telecommunications. It consists of internet, wireless networks, mobile phones and communications medium (Production, 2010). In recent times the use of Information and Communication Technology (ICT) such as electronic mail (email), mobile communication, Social media, fax, E-commerce website, Management information system and the World Wide Web (WWW) has become extensive. Information and communication technology is the technology which consists of the gathering, organizing, storing, and spreading information such as sound, image, text or numbers computers and telecommunication devices (Mansoori, 1991 (as cited in (Yegane Madadi, 2011))). Furthermore, Wen M (1999) defined ICT also refers to computer and internet-based technology for the purpose of informational and communicational services to a large spectrum of users (as cited in (Yegane Madadi, 2011)). After the revolution of the information age, there has been significant progress in the use of Information and communication Technology (ICT) applications over the world. Today, ICT is embedded in the agriculture, and it improves the quality and quantity of agricultural production and the availability of market information in the agriculture sector. (Anon, 2005 (as cited in (Farwin, Jayathilake, & Weerakody, 2010))).

E- agriculture is a relatively recent term in the field of agriculture and rural development practices (Shayamasunder, 2017). In another hand, E-Agriculture is evolving in scope as new Information and Communication Technologies (ICTs) applications continue to be harnessed in the agriculture sector (Ministry of

Agriculture, 2016). Furthermore, Anon (2005) defined E-Agriculture as an emerging field in the intersection of agricultural informatics, agricultural development, and entrepreneurship, referring to agricultural services, technology dissemination and information delivered or enhanced through the internet and related technologies. More specifically it involves the conceptualization, design, development, evaluation, and application of new ways to use existing or emerging ICTs (as cited in (Yegane Madadi, 2011)). In the context of e-Agriculture, ICT is used as an umbrella term encompassing all information and communication technologies including devices, networks, services, and applications. These range from innovative Internet-era technologies and sensors to other technologies that have existed for much longer such as telephones, mobiles, television, radio, and satellites (Ministry of Agriculture, 2016).

In today all over the world, there are several activities that are related to e- agriculture applications. They are mainly focused on the delivery of agricultural information and knowledge services (i.e. market prices, extension services, etc.) using the Internet and related technologies Anon, 2005 (as cited in (Farwin, Jayathilake, & Weerakody, 2010)). In Kenya Agricultural Commodity Exchange (KACE) has developed a short messaging service- *SMS SOKONI* in partnership with Safaricom mobile phone provider. Any farmer anywhere in the country can access updated and reliable market information on prices and commodity offers at an affordable rate using their mobile phones. So far, the service is easy to use, reliable, convenient and affordable (Anthony Gikandi Muriithi, 2009). As well as the Indian government has initiated to e-Agriculture activities by using agriculture based ICT programs such as e-Mithra, Drishtee, E-Sagu, N-Logue, Tel-Nek, Akshaya, etc. (M. Varun Kumar, 2016). Furthermore, Government of Philippines managed portals, e-Commerce applications and innovative technologies used to provide relevant agricultural information in country specifying the rural areas. Especially, e-AGRIKultura, e-Consortia & K-AgriNet place a major role among them. In Thailand a multi-lingual Internet portal, Agricultural Information Network (AIN) enabling Thai farmers, field officers, policy-makers, and government to communicate and access significant and useful agricultural information. Anon, 2006 (as cited in (Farwin, Jayathilake, & Weerakody, 2010))

In recent year, global attention came back to agriculture due to the price hike, resulting partly from long-standing carelessness on the diffusion of appropriate technology that stagnated production in the face of a rising population. In the present agriculture increasing production is a major challenge. Smallholder farmers, which dominate the landscape of developing world, need to improve farming through acquiring adequate knowledge and information. Agricultural extension services provide critical access to the knowledge, information and technology that farmers require to improve the productivity and thus improve the quality of their lives and livelihoods. It is hence crucial to provide farmers with the knowledge and information in a quality and timely way. Although some ground-breaking tools like the telecenters can serve as major catalysts for information, knowledge and development opportunities, the access for farmers in remote villages is restricted due to the lack of infrastructure (Nations, 2005).

Agriculture is the backbone of the Sri Lankan economy, and it constantly experiences with advances in technology (Farwin, Jayathilake, & Weerakody, 2010). It has contributed nearly 12.8% to the country's Gross Domestic Product (GDP) in the year 2008 (Central Bank of Sri Lanka, 2009). From the past, paddy sector plays a major role within the national agriculture sector in Sri Lanka. In 2015, total annual paddy production was 4,819,000 MT and net harvested extent estimated as 1,088,000 ha. Although the country is self-sufficient in paddy, almost 286,000 MT of rice was imported in the year 2015. Cost of cultivation of paddy including imputed cost was estimated as Rs6. 30.48 per kg of paddy (Ministry of Agriculture, 2016). Accordingly, Sri Lanka now has around 900,000 hectares of paddy land, a majority of which is located in the dry zone. Farmers in the paddy sector faced major challenges of enhancing productivity such as natural disasters, insufficient rain water, insufficient Mahaweli water, and rapid decrease of fertile agricultural lands due to urbanization. As well as they face to problems when they are buying agricultural equipment and paddy seeds, selecting the fertilizers and chemicals for their products and selling their product into the market because of lack of knowledge and information about the markets prices, government policies and new innovations in the agricultural sector. So to overcome these challenges new approaches and technical innovations are required in this sector. Accordingly, Information and Communication Technology plays an important role in addressing these challenges and uplifting the agri-business sector (Farwin, Jayathilake, & Weerakody, 2010).

The Sri Lanka is developing country as a result of that it is not able to access all the new ICTs due to some barriers (Farwin, Jayathilake, & Weerakody, 2010). Accordingly, Kurtenbach and Thompson (2000) the most important limiting factors in developing countries are infrastructure and cost of technology (as cited in (Farwin, Jayathilake, & Weerakody, 2010)). According to the (H.A.C.K Jayathilake, 2008) It's clearly demonstrated that the cost of technology, lack of training, inability of farmers to use ICT, trust level in the ICT system, lack of technological infrastructure and lack of ICT proficiency are the factors which affect the ICT adoption in agriculture sector in Sri Lanka. Accordingly, above facts it will lead to low acceptability of the use of e-Agriculture in Sri Lanka.

In the Sri Lankan context, there will be few kind of literatures on e-Agriculture implications (Farwin, Jayathilake, & Weerakody, 2010). Department of Agriculture (DOA) under the Ministry of Agriculture plays the major role in technology generation in Sri Lanka. Department of Agriculture (DOA) has already initiated several e-Agriculture programs. In 2005 it opened the official website of the department of agriculture (www.doa.gov.lk) which provides access to the farming community to view agricultural technical information, to view agricultural publications, videos, and radio programs. As well as, it has developed *wikigoviya* website (www.Goviya.lk) to facilitate all stakeholders in agriculture to have progressive dialogues on agriculture issues (Agriforum) and establish public knowledge repository in this area (Agripedia). Furthermore, Sri Lankan government initiated e-Agriculture programs such as “Krushilanka” agriculture portal (www.krushilanka.gov.lk), “AgMIS” (Agriculture Management Information System), Rice Knowledge Bank website, Call Center (1920) for Agriculture Advisory Service, e-SMS Service (1920), “Krushu FM” web radio (www.krushifm.lk), Rice-Pest Spread Analysis System (www.ricepestpps.com), Market price Information Systems, “GoviMithuru” project, Social media pages and Agriculture videos on the Internet like “GoviBimataArunalu”, “MihikathaDinuwo”, “KethaBathaKamatha” to overcome challenges in agriculture sector (Ministry of Agriculture, 2016). The Ministry of Rural Economy and Information and Communication Technology Agency of Sri Lanka (ICTA) has opened a knowledge services for farmers called “GoviGananaSeva” (GGS), where walking investigators collect price of products and disseminates them via price board at the market, where price is updated on a website and made available via radio and mobiles. Information and Communication Technology Agency of Sri Lanka (ICTA) has implemented “Nenasala project” in 2005 to meet the infrastructure requirements of the people in the rural area in order to address the information and communication needs. ((Anon, 2007) as cited in (Farwin, Jayathilake, & Weerakody, 2010)).

Accordingly, the study mainly focuses on analyze the familiarity level with the term of e-Agriculture and identify the e-Agriculture facilities that paddy farmers are used. As well as it is intended to identify potential benefits of e-Agriculture, barriers to e-Agriculture implementation and factors influence towards increase their e-Agriculture familiarity level.

II. Methodology

As a study which is based on multi-mode research methodology, the study employed both quantitative and qualitative methods. The data for the quantitative analysis collected by using structured questionnaire tagged “Survey of E-Agriculture” from the paddy sector farmers in Anuradhapura district. The questionnaire was comprised of two sections, and the first section was designed to collect demographic information of the respondents, while the second section comprised of open and closed-ended questions; on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) which is directed to collect data on e-Agriculture awareness, barriers for e-Agriculture implementation, potential benefits of e-Agriculture and e-Agriculture facilities that paddy farmers are used.

Furthermore, the semi-structured interview was carried out to gather the opinions of the farmers regarding factors influence their familiarity level towards e-Agriculture in Paddy sector.

The sample comprised of male and female respondents with different levels of agricultural experiences, as well as different ages and educational backgrounds. The questionnaire was distributed across the 50 farmers from 5 divisional secretary units such as Ipalogma, Nochchiyagama, Nachchaduwa, Thalawa, and Thabuthtegama which were drawn from a convenience sampling method.

The Quantitative data collected for this study were analyzed using frequency distribution, simple percentages and mean and standard deviation value using SPSS (Ver. 17).

Content analysis method was used to identify themes of qualitative data spreading which is gathered from the paddy sector farmers in Anuradhapura district.

III. Results and Discussions

Quantitative Analysis

Based on the results obtained from the sample group of 50 paddy farmers under study, there were 84% male farmers and 16% female farmers. 4% were below 25 years of age, 16% of them were between 25 and 35 years of age, 28% individuals were 35 to 44 years of age, 34% paddy farmers were between 45 to 54 years of age, and 18% were owned to the 55 or above. 12% of the overall majorities have never participated in the school. 20%, 56% and 12% of paddy farmers completed their education up to grade 8, GCE(O/L) and GCE(A/L) accordingly. The survey responses show that 4% of paddy farmers have the less than 5 year experience in agriculture sector, 10% of farmers have 5 to 10 years agricultural experience, 14% were had between 10 and 15 years of paddy sector experience, 20% were have 15 to 20 years working experience in paddy sectors, 20 to 25 paddy sector experience was had 10% of the respondents and 42% paddy farmers majority of the samples have more than 25 years working experience in paddy sector.

The survey resultsshowed that an overall majority (52%) was unaware of the term e- agriculture and 32 percent haven't any idea of their awareness of e-Agriculture term (See

Table 1: Familiarity towards e-Agriculture term). S.R Farwin, H.A.C.K Jayathilake and W.J.S.K Weerakkody highlighted in their study in 2010 there was 51% unaware of thee-Agriculture term in the plantation sector. Moreover result of their study showed even though the 42% manager did not have paper-based ICT qualification, 20% of them were familiarized with the term of e-Agriculture.(Farwin, Jayathilake, & Weerakody, 2010)

Table 1: Familiarity towards e-Agriculture term

Familiarity with the e-Agriculture term		Frequency
Valid	Yes	8
	No	26
	I think So	16
	Total	50

The survey indicated that although 100% of whole paddy farmers did not have paper-based ICT qualification there were 16% of farmers who are familiar with the terme-Agriculture. They have enhanced their knowledge of e-Agriculture from their agriculture officers and after participation in e-agricultural induction programme which is conduct by Sri Lankan government.As a result of their e-Agriculture awareness, they have updated their knowledge of market agricultural equipment and chemicals.

Farmers who are connected with paddy sector agricultural activities use following ICT facilities for their day today agricultural activities. The present status of identified key ICT facilities of paddy sector is depicted in

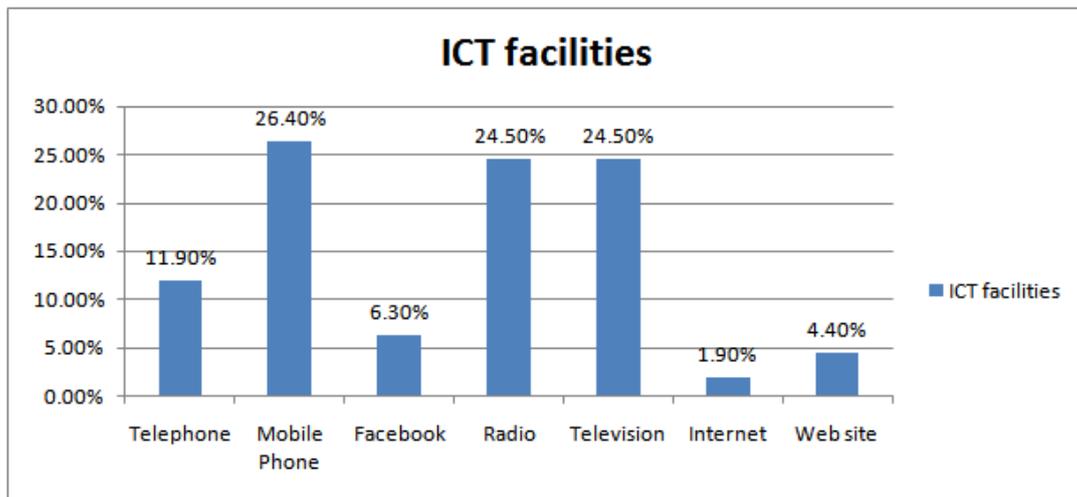


Figure 1: ICT facilities

When compared to ICT facilities usage 26.40% use mobile phones for their agricultural activities. 24.50% farmers used the radio and television to take a market exposure, listen and watch agriculture-related program and update their knowledge regarding weather forecasting details. As well as 11.9% used the land phones for the updated knowledge of market prices. Modern technologies such as Facebook, internet, and websites are used a very limited number of farmers for their agricultural activities. Accordingly (Farwin, Jayathilake, & Weerakody, 2010), 97% of their sample has used a telephone for their agricultural and business activities. Further, it was demonstrated by Weerasinghe and JasingheMudalige in their study, 100% respondent were used the telephone, 92.1% were used personal computer and 88.2% have used information systems for their agricultural activities.(Weerasinghe & Mudalige, 2008)

The

Table 2: Barriers to e-Agricultureindicates that the major barrier to implementing e-Agriculture was lack of knowledge (21.1%) of Information Communication Technology. It was highlighted that lack of training

(19.6%), language problem (18.6%) and lack of ICT benefits awareness (13.6%) obstruct the road of e-agriculture implementation.

Table 2: Barriers to e-Agriculture

	Respondent Percentage	
Barriers ^a	Cost of technology	5.7%
	Lack of technology infrastructure	9.3%
	Lack of knowledge on ICT	21.1%
	Lack of ICT benefits awareness	13.9%
	Not enough time to spend on technology	5.7%
	Lack of training	19.6%
	Lack of trust of the information	6.2%
	language problem	18.6%
Total	100.0%	

Accordingly, 5.7% of respondents didn't use ICT facilities for their agriculture activities because of the cost of the technology and time limitation. 9.3% agreed that they haven't technology infrastructure for use ICT in their agricultural activities. 6.2% have the problem with reliability and correctness of information that gets via technology equipment.

The survey conducted by (Farwin, Jayathilake, & Weerakody, 2010) highlighted that cost of technology and timing is not a major barrier to integration ICT with agriculture. Further study has emphasized that lack of benefit awareness and knowledge of ICT are the foremost reasons which are affected by e-Agriculture implementation.

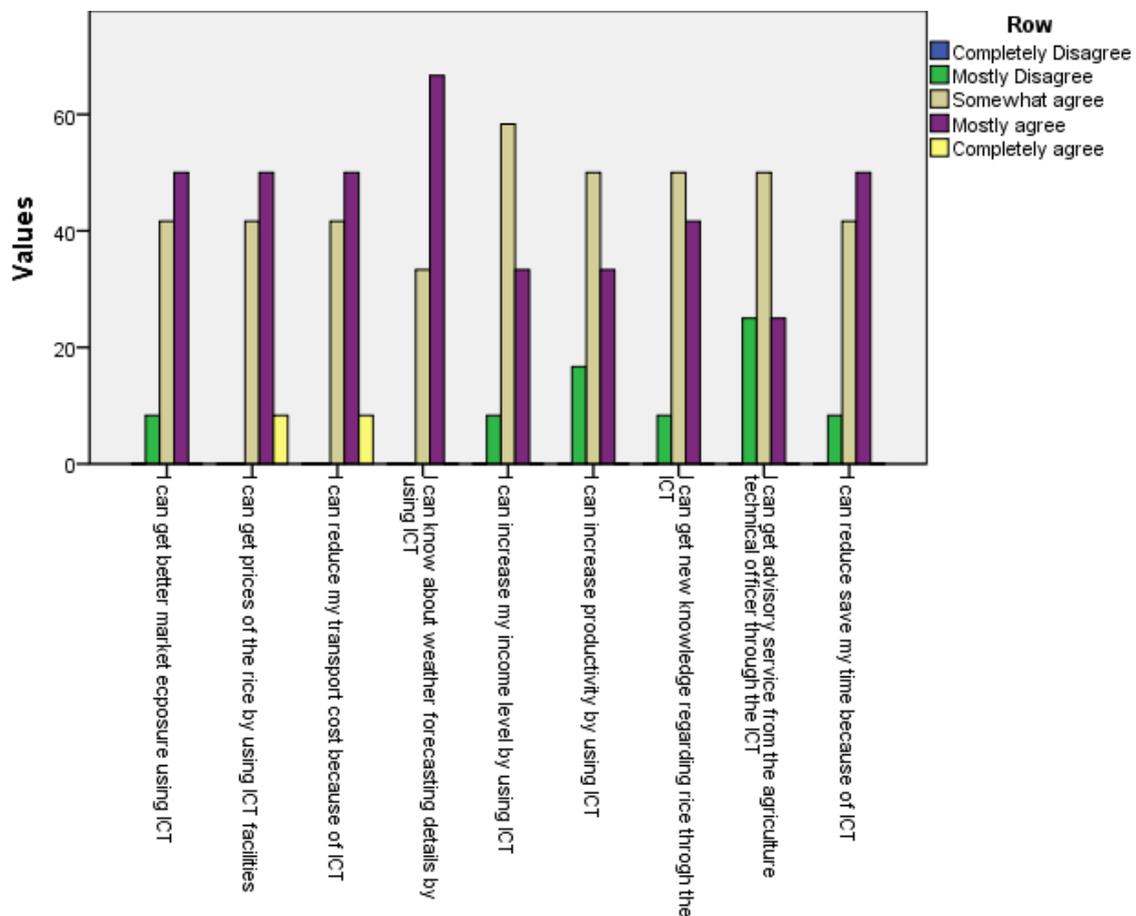


Figure 2: Pros of e-Agriculture

The survey result has highlighted the awareness of advantages that they have taken along with e-Agriculture implementation. Accordingly, the result was indicated that majority of farmers agree they can get advantages from the usage of Information and communication technology (mean=3.3511). As well as there is no

much deviation among the farmers awareness of e-Agriculture advantages (standard deviation=.40862).Accordingly **Figure 2: Pros of e-Agriculture** is indicated that most of the respondents are mostly agreed with that they can get weather forecasting details using Information and communication technology (66.7%). 50% from the respondents mostly agree that they can get better market exposure, they can get prices of the rice, they can reduce transport cost and they can save their time by using information and communication technology for their agricultural activities. Among the respondent, 33.3% farmers stated that they could increase their income level and they can increase productivity by using ICT in the agricultural activities.

In the research conducted by (Farwin, Jayathilake, & Weerakody, 2010) identified that six benefits of e-Agriculture in plantation sector in Sri Lanka such as better marketing exposure and pricing (mean=2.05), Reduce the cost of transporting products to the markets(mean=2.69), Reduction of agricultural risks and enhanced incomes (mean=2.82), Better awareness and information about products (mean=2.52), Increasing Productivity (mean=3.1) and access market information (2.54).

Qualitative Analysis

The results of quantitative analysis highlighted that 52% of farmers are unaware of the term “e-Agriculture”. For that reason to answer the question “what are the factors influence onfarmers’ familiarity level ofterm of e-Agriculture?” the qualitative analysis was conducted. Accordingly content analysis result followings are identified as factors impact of the e-Agriculture awareness of farmers in Paddy Sector.

Low Educational attainment

In the opinion of the majority of the respondents, agreed that information and communication technology plays a major role in the society. But an average of farmers said that they never heard the e-Agriculture term. They have mentioned the reason for the unfamiliarity of the term e-Agriculture is their education level. For instance, most of the farmers mentioned that;

“Madam, I think I don’t know about e-Agriculture because I have never participated in school”

“I think the most important thing to work with information technology equipment is education. We only participated in school at the rainy times, so how we used the internet, Facebook or any other for our agricultural activities”

“Ma’am, we have not learned enough to use smart phone, computers, internet and Facebook so how we use them in our daily agricultural activities.”

Accordingly, their description it has highlighted that education level plays a vital role to increase the awareness of e-Agriculture among farmers. So, lack of education direct to make farmers who are unfamiliar with the term e-Agriculture.

Persuasion on Blind beliefs

Most of the respondents are in their old age. They believe what their ancestors said. Most of the respondents based on blind beliefs, because they don’t believe the application of technology in the agricultural activities. For instance, a respondent mentioned;

“What a technology, we look at the sky and decide the weather and make our day today agriculture activity. It is good our old system rather than modern one”

Because of their beliefs they haven’t any idea of the e-Agriculture, and they haven’t any need of using technological equipment for their activities. They keep their trust in their experience, beliefs of their ancestors and myths.

Furthermore, most of the respondents among majority stated that the beliefs of the myths are better than beliefs on the technology. For example, a farmer said;

“I think, well known dude is better than ignorant, ma’am. That’s why the usual way is better than application technology in our field”

Accordingly, it has emphasized that persuasion on blind beliefs affect lower level familiarity towards e-Agriculture.

Helping hand from government

Among the majority of respondents,a small percentage stated that they are familiar with the term e-Agriculture because they have participated awareness programme that is conducted by the Sri Lankan government in 2005. For instance, farmers said;

“Ahhh.... E-Agriculture is a well-known concept. We use the technology for our day today paddy sector activities such as for update the market price details, update the knowledge regarding prices of agricultural equipment, to get new knowledge, to update about new innovation of agriculture sectors etc. we got the knowledge to work with information technology through the government awareness programme ”

“According to my view, it was the best awareness programme to enhance my knowledge regarding e-Agriculture which is conducted by Sri Lanka government”

Most of the respondents agreed with that they could enhance their knowledge through government awareness programme. This is indicated that implementation of e-Agriculture awareness programme is important to take a new path in the agriculture sector.

In brief, it has emphasized that low educational attainment, Persuasion on blind beliefs and government awareness programme highly impacts on increasing awareness of e-Agriculture term among farmers.

IV. Conclusion and Recommendations

This research investigated the familiarity level of an e-Agriculture term, ICT facilities used in the agriculture sector, prominent barriers which are faced in e-Agriculture implementation, benefits of e-Agriculture and factors affecting towards e-Agriculture familiarity level of paddy sector farmers. The research study was based on multi-mode research method and the study employed both quantitative and qualitative methods. Quantitative data were collected through questionnaires which were distributed across the 50 farmers from 5 divisional secretary units such as Ipalogma, Nochchiyagama, Nachchaduwa, Thalawa, and Thabuttegama. Further, qualitative data were collected from this 50 farmers using the semi-structured interview.

The following conclusions can be drawn from that the analysis of quantitative data using descriptive statistics, cross-tabulation, frequency distribution, mean, and standard deviation. Result publicized that 52% of the farmer unaware of the term e-Agriculture. Mainly mobile phone, television and radio are used as the key ICT facilities in the agriculture sector. Furthermore, it was indicated that Lack of knowledge on ICT, Lack of training and language problem are major barriers in implementing ICT in the agriculture sector. As well the result was indicated that majority of farmer agreed that they could get advantages from using of Information and communication technology with agriculture (mean=3.3511) and there is no much deviation among the farmer awareness of e-Agriculture advantages (standard deviation=.40862). Accordingly, it was highlighted that aware of the weather forecasting details, market prices and reduce the transport cost as major advantages which are taken from e-Agriculture activities.

Through the qualitative result, it has concluded low educational attainment, persuasion on blind beliefs and helping hand from the government are the factors influence to increase paddy sector farmers familiarity level towards e-Agriculture.

Although farmers can earn a lot of benefits from the e-Agriculture implementation, the majority of farmers didn't use Information technology in the paddy sector. Accordingly Sri Lankan government concept still so many e-Agriculture projects such as www.doa.gov.lk, wikigoviya website, Agriforum, Agripedia, Kushilana, etc are continuing. Based on the findings and conclusions of the study it is recommended to government carry on e-Agriculture awareness programme and workshop to increase the awareness of the e-Agriculture concepts and programmes. As well as ICTA can introduce new mobile application which can help farmers to get access e-Agriculture programmes, details of market price, details of market price changes in chemicals and Weather forecasting details.

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Rmmd Pamarathna "Beyond Agricultural Tackle: An Analysis of Agriculture with Paddy Sector in Sri Lanka." IOSR Journal of Business and Management (IOSR-JBM) 20.7 (2018): 46-52