USAGE OF ICT FOR EMPOWERMENT OF FARMERS

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Degree of Master of Business Administration in Information Technology

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the supervisor: Dr. Shantha Fernando

Signature of the supervisor: Date: 4/22/2017

ABSTRACT

Integrating Information Communication Technology (ICT) with Agriculture is identified as one of the most important tasks in order to achieve sustainable development in the agriculture sector in Sri Lanka. Main objective of this research is to suggest more suitable and proper approach to empower the Sri Lankan farmers through ICT. As entry criteria for the main objective there will be a fact finding session, which measures the current level of ICT knowledge of Sri Lankan farmers, identify the information needs, pattern of use of ICT and factors that hinder the use of ICT by the farmers.

The research started with a literature survey to identify the factors that affect the use of ICT in agriculture sector. A structured questionnaire was used as the research instrument to collect data from farmers in Southern province. Galle, Matara and Hambantota districts were selected to collect data and farmers from diversified agriculture segments were interviewed.

According to the result shown in the survey the farmers are ready to receive information. They are using ICT equipment mainly for entertainment purposes and they are not educated about the importance and how they can use ICT for their agricultural business related activities. The results of the study shows that Television, Radio, Mobile phone and Land phone are the most popular ICT tools that farmers are using and willing to use for the personal and business activities. The most highlighted barrier that discourages farmers using ICT is the fear to embrace new technology due to lack of knowledge. High cost of the equipment, technology and language limitation are the other main issues to be addressed in order to introduce ICT to the rural agriculture community. Results have shown that younger generation is willing to adopt and interested in the new technology while farmers above 45 years are still prefer the old system. It is found that information sharing on peer was wide accepted and popular among the farmers.

It could also be proven that usage of social networking applications specific for the farmers was highly satisfactory and widely accepted by the farming communities.

The research end-up by recommending the actions to be taken such as conducting ICT awareness sessions, introducing social media that enables the farmers to communicate each other, introducing easy payment systems for the farmers to buy ICT tools and introducing reward system to early adoption of ICT for agriculture related activities

Key words: ICT, Agriculture, Farmers, Knowledge, Information, Empowerment

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List of Abbreviations

AMIS	Agricultural Market Information System
DSS	Decision Support System
FSC	Forward Sales Contracts
GGS	Govi Gnana Service
GNP	Gross National Production
HARTI	Hector Kobbekaduwa Agrarian Research and Training Institute
ICT	Information Communication Technology
IoT	Internet of Things
IVRS	Interactive Voice Response System
PPA	Personal Portable Assistant
SMS	Short Message Service
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

1. INTRODUCTION

1.1Chapter overview

We start our discussion with an introduction to the background and motivation for the research. Then research problem and research question is discussed. Finally the research objectives are presented at the end of this chapter.

1.2 Background

Sri Lanka being a tropical island and being a country with sound agricultural background for many centuries, agriculture is a key component of the economy of this tropical island nation.

Sri Lanka is still largely depending on the agriculture for the economic development. Agriculture is one of the most important industries that contribute for the higher Gross National Production (GNP). Due to the constant growth in the population (at rate of 1.4% per year) it is necessary to increase the agricultural production to cope-up with increasing demand. But this has been a dilemma for many centuries and achieving a sustainable growth is still not achieved.

It is well known fact that ICT is not widely used in the agriculture sector of the island. Only few people or organizations are using ICT for their agriculture related activities. Several organizations such as large scale milk producers, flower exporters; large scale poultry farms are using the ICT in the process of production. For instance ICT equipment are used to prepare the feeds for animals and high-tech equipment are used to measure the PH-value of the soil. But using portals dedicated to farmers, DSS/expert system, using mobile apps for monitoring, using apps for data collection and other ecommerce applications are not available to farmers in Sri Lanka that are widely used mostly in developed countries.

There had been several instances in the past in which some parties were attempted to integrate ICT to Agriculture sector. But still there is no satisfying outcome of those

efforts and integrating ICT to agriculture sector remains a matter that should be address with urgency to reach a satisfying development in agriculture sector in the island. Development on using ICT in agriculture sector is more lethargic and scarcer compared to most other industries in Sri Lanka. But most other developed countries have garnered rapid development in the agriculture sector by using more and more ICT related equipment and services. Therefore it is necessary to study the facts that hinder the usage of ICT in agriculture sector while making a suitable strategy to promote ICT in the agriculture sector to reach a rapid and sustainable growth. Reducing the production cost, increase the productivity, improve the quality of the produce and reduce the wastage are some of the key areas that come to fore due to the implementation ICT in the agriculture sector.

1.3 Motivation of the research

Out of the total labour force in Sri Lanka, a significant percentage, around 31.7% are employed in the Agriculture sector. But still Agriculture productivity and value is very low and this leads to lot of difficulties to retrain agriculture labor force and improve the life style. ICT can be used as a tool to improve agricultural practices as well as farmer's life styles. Therefore there is emerging need of integrating Information Communication Technology (ICT) with Agriculture sector in Sri Lanka to achieve sustainable development.

Information and communication technologies (ICT) can be used as a tool to improve agricultural practices as well as farmer's life styles. Information may functions as a tool for obtaining knowledge for making decisions and for communication. Even though agricultural research has progressively improved production systems, useful findings from the research have not always been delivered to the farmers who could benefit from these findings.

It is authors' observation that due to the lack of new information in the sector, farmers have been left with traditional agricultural approaches and oral recommendations from other farmers. Practice of a combination of traditional practices, personal experience

and trial-and-error approaches for a long period of time leads to poor and low productivity in Agriculture. Knowledge management can play a key role in enhancing agricultural productivity and addressing the problem of food insecurity. Timely delivery of knowledge and information definitely minimizes the risk and uncertainty faced by the farmers from production to marketing of their produce. Information and communication technology (ICT) can play an important role in facilitating rapid, efficient, and cost effective knowledge management. ICT usage has increased especially in terms of use of mobile phones for communication by farmers.

ICT tools can provide a communication medium between agricultural experts and farmers. For example, communication via mobile phones can reach farmers in distant areas where land line phones are limited. Video conference or voice over IP (VoIP), for instance, could also be used to transfer information between an expert and groups of farmers in several areas. Such an approach, which is new to the extension services, could reduce the need for travelling to remote areas, the costs of travelling and the time spent to meet those farmers. Agricultural extension workers may thereby assist more farmers in the same period of time.

1.4 Research problem

In Sri Lanka there is no established way or procedure to work with ICT in agricultural context. There is an urgency to integrate ICT into applications with the activity of Agriculture sector in Sri Lanka. This need arises due to the problem of farmers not having adequate information for their decision making. Thereby the farmers been not empowered adequate to make right decisions regarding their products and sales. This also leads to the poor life style of the farmers.

Therefore the research question is formulated as,

How can the farmers be empowered through ICT to improve the productivity of the agriculture and to improve the life style of the farmers?

1.5 Research Objectives

In order to find and answer to the research question we would explore the mechanisms for farmer empowerment using ICT and explore the current level of ICT knowledge of farmers through a series of surveys. Our final objective is to recommend possible approaches to empower farmers through ICT considering the status of the farmers in the selected areas. Explore and identify the current level of ICT knowledge of farmers as part of the entry in to research.

1.6 Structure of the Thesis

This thesis contains six chapters and a brief description of each chapter is as follows.

The Chapter 1 provides the motivation and background to the research, research problem and research objectives.

In Chapter 2, will provide an insight to the diverse literature associated with ICT enabled farming communities, case studies from different countries as well as Sri Lanka.

The Chapter 3 explains the research methodology adopted for the present study, including detail descriptions on the theoretical framework, research variable definitions, variable relationships, questionnaire instrument development, survey approach, development of hypotheses etc.

In 4th Chapter will provide the observations and results associated with the collected data presented statistically. Also, a detailed analysis and discussion on the observations and the results obtained would be provided.

Based on the analysis and the interpretation of the data, Chapter 5 draws conclusions on the total research outcome, including the recommendations. Also, the limitations of the present study along with the directions for future research would be discussed.

2. LITERATURE REVIEW

2.1 Overview

This section will provide the review of the literature relevant to the research questions. Firstly, there will be a section on Empowerment theory then will be discuss on ICT tools used in agriculture. Next focus on types of agricultural information delivered. Then there will be a discussion on use of ICT in agriculture specially focuses on the case examples .Then will move into the benefits of using ICT for Agriculture. Then will be discuss on limitations face the use of ICT in agriculture.

2.2 Empowerment Theory

Empowerment is a concept linked to power. Empowerment has many definitions. Mechanic (1991) has defined it as "an intentional, ongoing process centered in the local community, involving mutual respect, critical reflection, caring and group participation, through which people lacking in equal share of valued resources gain greater access to and control over those resources". Group (1989) has defined empowerment as "a process where individuals learn to see a closer correspondence between their goals and sense of how to achieve them, and a relationship between their efforts and life outcomes". Both of the above definitions define empowerment as a process which has outcomes. Empowerment theory provides a framework that helps to organize the knowledge needed to create strategies to support the development of empowerment. The theory suggests that actions, activities or structures may be empowering, and the outcome of each process results in a level of being empowered (Zimmerman 1988). A thorough development of empowerment theory requires

exploration and description at multiple levels of analysis such as individual, organizational and community. Applying this general framework to community level analysis, empowerment may refer to collective action to improve the quality of life in a community and to the connections among community organizations and agencies. This can provide the basis to investigate how users can form into communities similar to the "group" concept in current Social Networks. In empowerment theory, empowering processes and their outcomes are clearly defined. Empowering processes for individuals might include learning decision-making skills, managing resources and working with others. Empowering processes for communities might include being able to access government agencies, media and other community resources. Possible outcomes of individuals feeling "empowered" would be situation specific perceived control, critical awareness, skills and proactive behaviors. For communities, empowerment outcomes might include the evidence of diversity, the existence of organizational coalition and accessible community resources.

2.3 ICT tools used in agriculture

This section will examine the Telephone, Internet, TV/Radio, DVD/CD and other related ICT tools which are used in Agriculture sector.

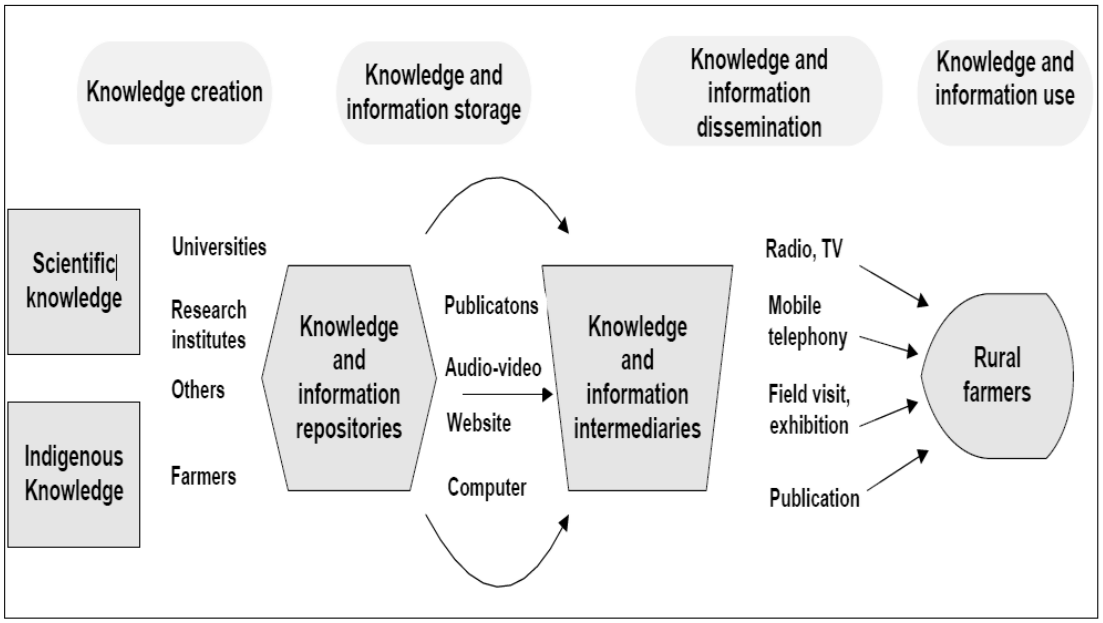


Figure 2.1 Tools of knowledge and information management in agriculture

Source: e-Sri Lanka: What Is in it for Agriculture. Joint National Conference on Information Technology in Agriculture

Effective knowledge management is achieved when the right knowledge and information is delivered to the right person at the right time in a user friendly and accessible manner that helps the recipients to perform their jobs efficiently (Islam 2010). The outcome of effective knowledge management includes improved productivity and performance of the agricultural sector.

2.3.1 Use of Telephone as an ICT tool;

The most widely used and available tools of farmers' advisory services are- telephone based Tele Advisory Services, the mobile based Agri Advisory services, television and radio based mass media programmers, web based online Agri Advisory services, video-conferencing, Online Agri video Channel, besides traditional media like, printed literature, newspapers, and farmer's exhibition/fair etc.

Most of the agricultural institutes and organizations have their own telephone based advisory services for farmers which provide telephone based Agri advisory services through a dedicated telephone number to provide real-time information and advisory. Beyond these hours the calls are attended in the Interactive Voice Response System (IVRS) mode. The mobile based Agri Advisory services offers text, voice and video content based Agri information services through mobile phones.

Mobile telephones have been used by farmers for a variety of purposes. For example,Jensen and Thysen (2003) reported that short message service (SMS) was used to acquire required information, such as weather information and suitable time to spray pesticides. Besides information delivery, the mobile phones can be applied to specific other purposes such as transferring money from one bank account to another for labour payments and input purchases in Kenya. Moreover, market information in voice mail formats is delivered to Kenyan farmers (Munyua, Adera& Jensen, 2008).

Research studies have reported that farmers and agricultural experts are sending information as images via mobile phones with a built-in digital camera (Parikh, 2009). This approach saved time and money in addition to providing more support by a limited number of agricultural experts to a greater number of farmers over a larger area.

As an affordable and accessible means of communication, most of the rural communities are now realizing the potential of mobile telephony to create economic opportunities and strengthen social networks. Mobile telephony effectively reduces the "distance" between individuals and institutions, making the sharing of information

and knowledge easier and more effective. The mobile telephone is no longer just an audio communication tool but capable of providing additional integrated functions.

Sri Lanka by end 2014, the fixed telephone penetration (connections per 100 persons) and the mobile telephone penetration stood at 13.0 and 107.0, respectively.(Central bank -2014)

IBM's EZ-Farm project - currently being trialed in Kenya , is exploring how sophisticated data analytics can help farmers keep in touch with what is really happening on their out-of-town small holdings. Sensors strategically placed around the farm monitor water tank levels, the amount of moisture in the soil, as well as the performance of irrigation equipment. And infrared cameras measure rates of photosynthesis, which can indicate whether crops are being watered too much or too little.

All this data is streamed wirelessly to the IBM Cloud and accessed by the farmer via a smartphone app.

"These 'telephone farmers' can often only travel to visit their farms at weekends," says IBM lead water and agriculture researcher, Dr Kala Fleming. "They are looking for smart solutions to better manage the water resources needed to irrigate and grow their crops.

2.3.2 Accelerate empowerment through Internet;

According to the Central bank of Sri Lanka “Total internet connections grew by 68.4 per cent during 2014 raising internet penetration (connections per 100 persons) to 16.4

by 2014.Adding to that “This was largely supported by the accelerated growth of 85.8 per cent in mobile internet connections.”(Central bank -2014)

The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to contend with the enormous challenges they face. The industry must overcome increasing water shortages, limited availability of lands, difficult to manage costs, while meeting the increasing consumption needs of a global population that is expected to grow by 70% by 2050. (Reference: Food and Agriculture Organization of the United Nations)

New innovative IoT (Internet of Things) applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. Today’s large and local farms can, for example, leverage IoT to remotely monitor sensors that can detect soil moisture, crop growth and livestock feed levels, remotely manage and control their smart connected harvesters and irrigation equipment, and utilize artificial intelligence based analytics to quickly analyze operational data combined with 3rd party information, such as weather services, to provide new insights and improve decision making.

In Africa, countries like Senegal, Uganda, Cameroon, Kenya, Tanzania, Zambia, Botswana, Gabon and Zimbabwe, have most of their populations use the Internet and eLearning for agricultural extension (Leary & Berge, 2005:57). In Kenya, extension officers even use Personal Portable Assistant (PPA) and wireless video conferencing to link farmers with distant experts, ministers and members of parliament to discuss agriculture and community-based development (ICT Update, 2004b:4).

2.3.3 Mass Media involvement for Empowerment -TV/radio;

Mass media methods in agricultural information dissemination generally, are useful in reaching a wide audience at a very fast rate. They are useful as sources of agricultural information to farmers and as well constitute methods of notifying farmers of new developments and emergencies. They could equally be important in stimulating farmers' interest in new ideas and practices (Ani et al. 1997). Radio and television are the most effective tools in communication for the support of development (Hussain, 1997). TV can provide an illiterate person valuable instruction and education in agriculture, health population control, sanitation and other aspect of his daily life (Rahman, 1999).

While many rural farmers have limited access to communications technologies, radio reaches at least 70 percent of rural households. Because small-scale farmers are often located in widespread, hard-to-reach rural areas, believe that radio is a key tool to reach them most cost-effectively.

Community radio is a type of radio service that caters to the interests of a certain area, broadcasting content that is popular to a local audience but which may often be overlooked by commercial or mass-media broadcasters. (UNESCO 2002). Community radio is a vibrant community broadcasting system to enhance pluralism and diversity. It is a truly people's radio that perceives listeners not only as receivers and consumers, but also as active citizens and creative producers of media content.

Rupasena et al (2007) conducted a case study on Agricultural marketing information systems in Matale District in Sri Lanka. They identified price information ,pre and post-harvest activity information ,input information and information on buyers as most

needed information respectively by the selected farmers and most of these farmers viewed price information telecasted on television. Their study suggests that support of government agencies is required to establish a system that is essential for vegetable farmers.

2.3.4 Knowledge transfer through VCD/DVD;

Agricultural knowledge also can be transferred through learning modules in offline video compact disc /format which was not only used in Sujhietal."s project (2009) but also has proved viable in several other studies (Pye et al., 2003 citedin Munyua, Adera& Jensen, 2008; Parikh, 2009; Sheriff, 2009). This format of knowledge transfer has been recommended for use by illiterate farmers without the need for assistance from others (Sujhi et al., 2009). This stimulates self-learning activities and also reduces dependency on technical staff for learning new agricultural knowledge and technologies.

Moreover, not only text information can be included in CD-ROM but also other types of data like pictures, audio and video clips (Sujhi et al., 2009). This advantage helps to overcome the illiteracy problems hindering further learning by poor farmers in rural areas. In addition, it is a solution to the problem of agricultural knowledge dissemination in areas where there is no Internet connectivity or the connection is unreliable (Rao, 2007).

2.4 Types of agricultural information delivered

Starting from cultivation plan till the marketing, farmers need to be aware on wide range of information. Basically can be categorized as government regulations, marketing information, weather and climate information and pesticide-weedicide information.

In Bangladesh the use of Grameen phone wasalso increased the income of farmers further it was showed that communication media used by farmers were receiving technological information and marketing information from concerning authorities. In India today farmers were closely attached with media and they get market information from different sources such as mobile phones, radio and by television. Farmers now work with various information sources to tap markets and provide consumers with good-quality commodities (Kashem2009, Adhiguru et al., 2009).

Farmers use mobile phones in rural areas to access market information. in the context of the Ghana Trade net, based trading platform was established which allowed farmers to sign up for short message service (SMS) for commodities and markets information where farmers can sell their product of their own choice. Furthermore farmers could request and receive actual and real prices about different commodities from different markets across West Africa. The Ghana Agricultural Producers and Traders Organization is a major beneficiary in 2006 this organization purchased products from farmers by use email or mobile phone contact to farmer.

In Bangladesh the Agricultural Market Information System (AMIS) project was established to provide information about local agricultural markets and, in particular, supporting small farmers.

The aim of this project was to make market information to farmers that improve their position in the value chain by increasing their knowledge and able to make decisions about increase their bargaining for sell their produce in market with good margin (Islam &Grönlund, 2007).The use of ICT could provide latest information about market rates of their product to farmers, buyers and producers this technology has increased the power of bargaining among farmers. The project was launched in 70 village of Maharashtra India to allow theses villagers and farmers to get information about agriculture, medical by use of internet this project given a good benefit to farmers and villager for increase their income and knowledge. The buyers and farmers access to price information ICT could reduce the prices that suppliers could charge for their goods. Similarly ICT could decrease the competitive advantage of location and allowing a foreign investor to under-price a local competitor (Bhatnagar, 2000).

There were number of satellite system have been have been deployed worldwide to connect farmers and provided latest and timely information and relevant knowledge. However, most of these have focused on the provision of specific knowledge resources, such as weather and seed information to famers. Furthermore, in India broadcast different related announcements of general interest such as, regarding animal husbandry relevant programmers and weather information to farmers for save their farms from disaster (Patel, et al., 2010).The solar-powered wireless sensor network provided weather information in remote areas. Such application server relayed data from sensor network to local users via Wireless Local Area Network (WLAN) and to remote users through cellular network and the Internet where farmers could obtain information about weather Tsunami and other disaster by use this technology (Crossbow Technology, 2004).

Weather information is very essential for adapting to climate change and providing timely information weather. The program initiated in Mali in 1982 helped farmers to get information and better control climate risk which was given a positive result (World Bank, 2007). The introduction of ICT was closely related to the issue of learning and could facilitate and enhance the distribution of important information about weather, pesticides, seed and different diseases to farmers (Byerlee et al., 2010)

2.5 Use of ICT in agriculture sector – Case studies

Most developing countries' economy based on agriculture base activities. As ICT has spread throughout the world, ICT tools and techniques have been employed in agricultural sectors with the hope that they will eventually improve agricultural productivity, quality and values. This section will discuss the some of the case studies on developing countries which are related to ICT use in agriculture.

2.5.1 Case studies from India

In India, around 60% of farmers in the country still remain un-reached, not served by any extension agency or functionary. Of the 40%, who have some access to Agricultural Information, the major sources of this information are Radio and Television. The telephone has just started to make its presence felt on this scenario. Internet supporting Information-Kiosks are also serving the farming community, in many parts of the country.

In India ICT applications such as Warana, Dristee, E-Chaupal, E-Seva, Lokmitra, E-Post, Gramdoot, Dyandoot, Tarahaat, Dhan, Akshaya, Honeybee, Praja are quite successful in achieving their objectives. Some of these have been detail below:

ICTs and Farmers' Advisory Service: Kisan Call Centres.

Kisan call centers have been established across the India with a view to leverage the extensive telecom infrastructure in the country to deliver extension services to the farming community. The sole objective is to make agriculture knowledge available at free of cost to the farmers as and when desired. Queries related to agri. And allied sectors are being addressed through the kisan call centers, instantly, in the local language by the experts of State departments, SAUs, ICAR institutions etc. There are call centers for every state which are expected to handle traffic from any part of the country. SMS using telephone and computer interact with farmers to understand the problem and answer the queries at a call center. The process of Kisan Call Center is explained in Figure 2.2.

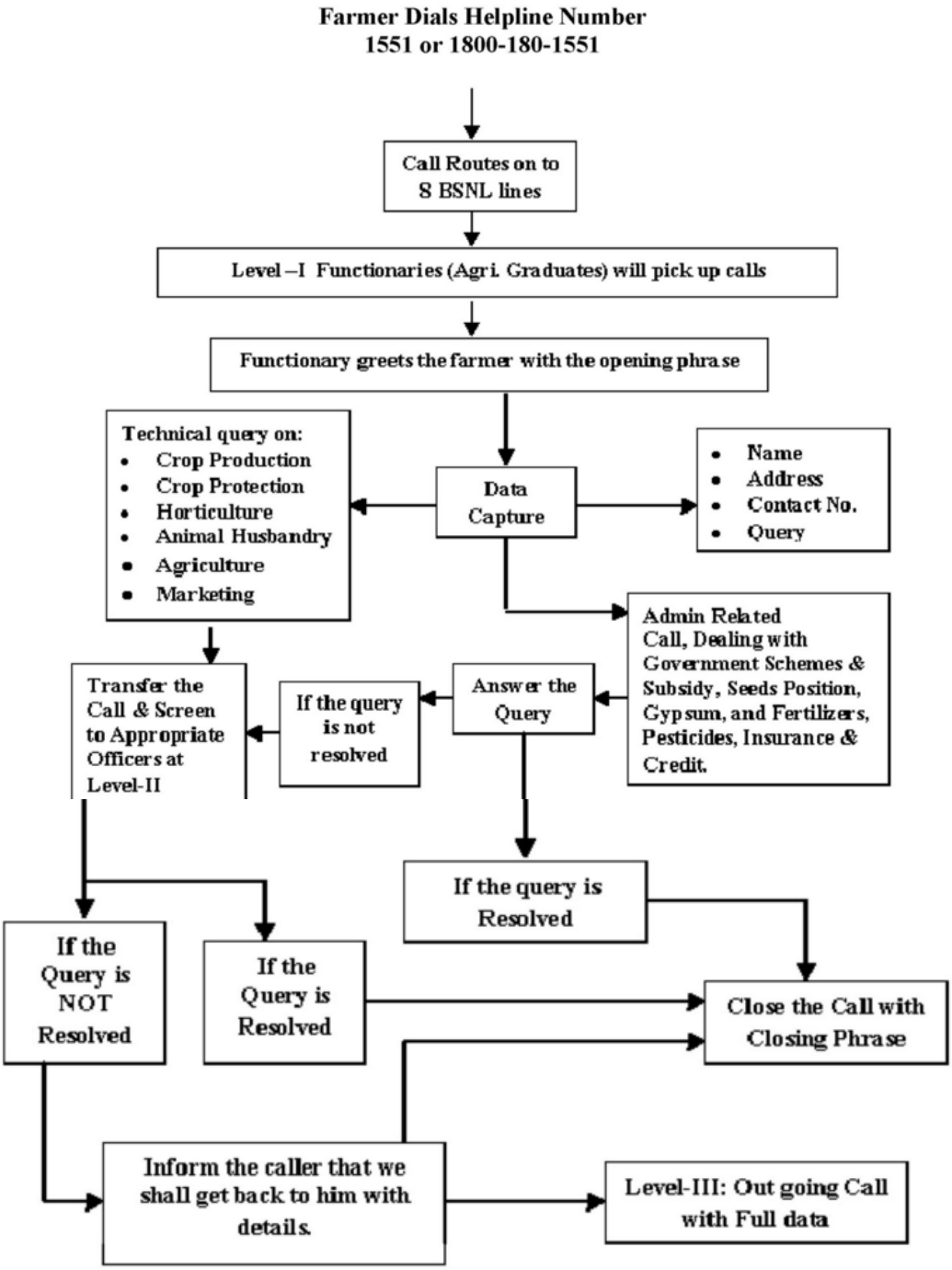


Figure 2.2 ICTs and Farmers' Advisory Service: Kisan Call Centers

Source: e- Saravanan Raj(2008)Arik: ICTs for Agricultural Extension Services to the Tribal Farmers

e-Extension (e- Soil Health card Programme).

The Dept. Of Agriculture, Gujarat State is one of the ambitious programmes which aims to analyses the soil of all the villages of the state & proposes to provide online guidance to farmers on their soil health condition, fertilizer usage and alternative cropping pattern. The website is www.agri.gujarat.gov.in/ www.shc.gujarat.gov.in/ .

AGRISNET

Uses state-of-the-art broadband satellite technology to establish the network within the country. The website is http://www.apgrinet.gov.in.

AGMARKNET

It is a comprehensive database which links together all the important agricultural produce markets in the country (http://www.stockholmchallenge.se/data/agmarknet/).

Agri Business Centers:

It provides a web based solution to the small and medium farmers as well as owners of large landholdings. It brings on a single platform all the stakeholders in agribusiness like farmers and farmer groups, institutions and autonomous bodies, agro machinery and farm equipment makers, cold chain tech., commodity brokers, cooperatives, food processors, pre and post-harvest management experts, packaging technology providers, insurance companies, warehousing and logistics agencies, surveyors and certification agencies.

e-KRISHI VIPANAN:

It professionalizes and reorganizes the agriculture trading business of Mandi Board by installing cost effective digital infrastructure using latest advancement in ICT by collecting and delivering real time information, online. It makes the operations more effective, totally transparent, benefiting all stake holders (farmers, traders & the government), empowering them through accurate and timely information for effective decision making. Figure 2.3 explain the graphical representation of the e-KRISHI VIPANAN.

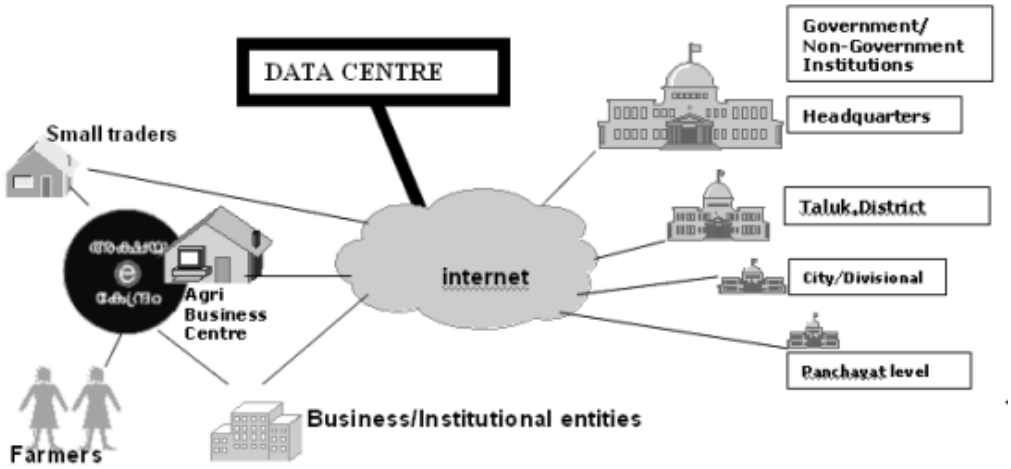


Figure 2.3 Graphical representation of e-KRISHI VIPANAN:
Source: e- Saravanan Raj(2008)Arik: ICTs for Agricultural Extension Services to the Tribal Farmers.

Query Redress Services:

Empowering the farmer community through effective, need-based interventions. It enhances livelihood promotion of farmer community through information dissemination and extension services, using ICT as tool. The project helps the farming

community by making available a 10000 plus network of experts to them. Any queries from farmers are forwarded to the ISAP central office from where it is routed to the relevant experts. The service caters to information and knowledge needs of the farmers, professional members of ISAP, individuals and other stakeholders involved in the wider agricultural and allied sectors.

Tata Kisan Kendra:

The concept of precision farming being implemented by the Tata Kisan Kendra (TKK) has the potential to catapult rural India from the bullock-cart age into the new era of satellites and IT. TCL's extension services, brought to farmers through the TKKs, use remote-sensing technology to analyze soil, inform about crop health, pest attacks and coverage of various crops predicting the final output. This helps farmers adapt quickly to changing conditions. The result: healthier crops, higher yields and enhanced incomes for farmers. Figure 2.4 explain the graphical representation of the Tata Kisan Kendra.

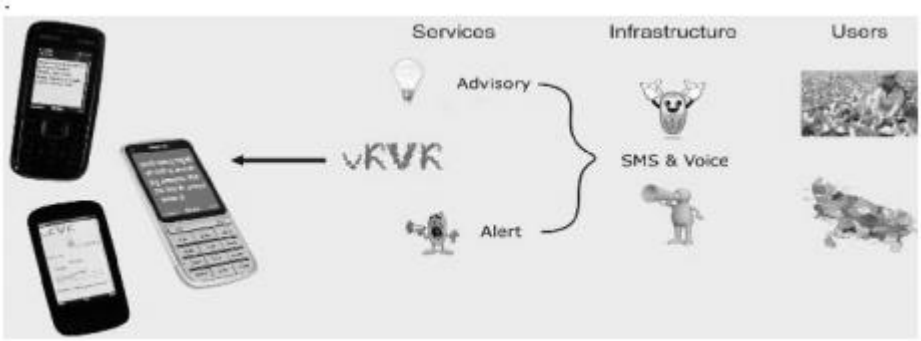


Figure 2.4 Graphical representation of Tata Kisan Kendra
Source: Dr.Singh,A K,Mobile Technologies for Enriching Knowledge and Empowering Farmers.

eChoupal:

ITC's Agri Business Division launched **"e-Choupal**" in June 2000 in which village internet kiosks managed by farmers - called *sanchalaks*- themselves, enable the agricultural community access ready information in their local language on the weather & market prices, disseminate knowledge on scientific farm practices & risk management, facilitate the sale of farm inputs (now with embedded knowledge) and purchase farm produce from the farmers' doorsteps (decision making is now information-based). Figure 2.5 explain the graphical representation of eChoupal.

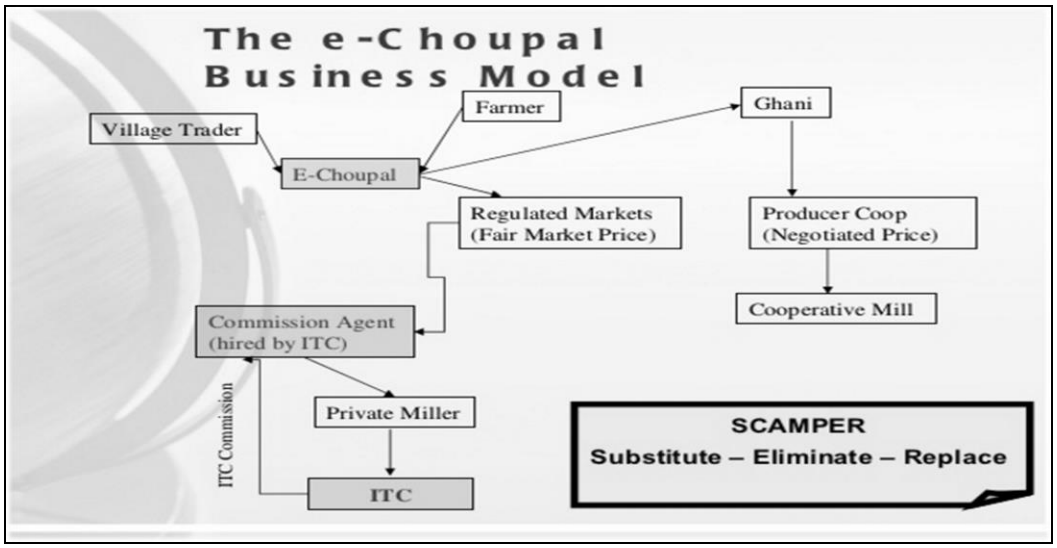


Figure 2.5 Graphical representation of eChoupal

Source: e- Saravanan Raj(2008)Arik: ICTs for Agricultural Extension Services to the Tribal Farmers

e-Sagu:

***e*-Sagu** an ICT based personalized agro-advisory system is being developed since 2004.The The word 'Sagu' means 'cultivation' in Telugu language. It aims to improve farm productivity by delivering high quality personalized (farm-specific) agro-expert advice in a timely manner to each farm at the farmer.sdoor-steps without farmer asking

a question. The advice is provided on a regular basis (typically once a week) from sowing to harvesting which reduces the cost of cultivation and increases the farm productivity as well as quality of agri-commodities. Figure 2.6 explain the eSagu extension process.

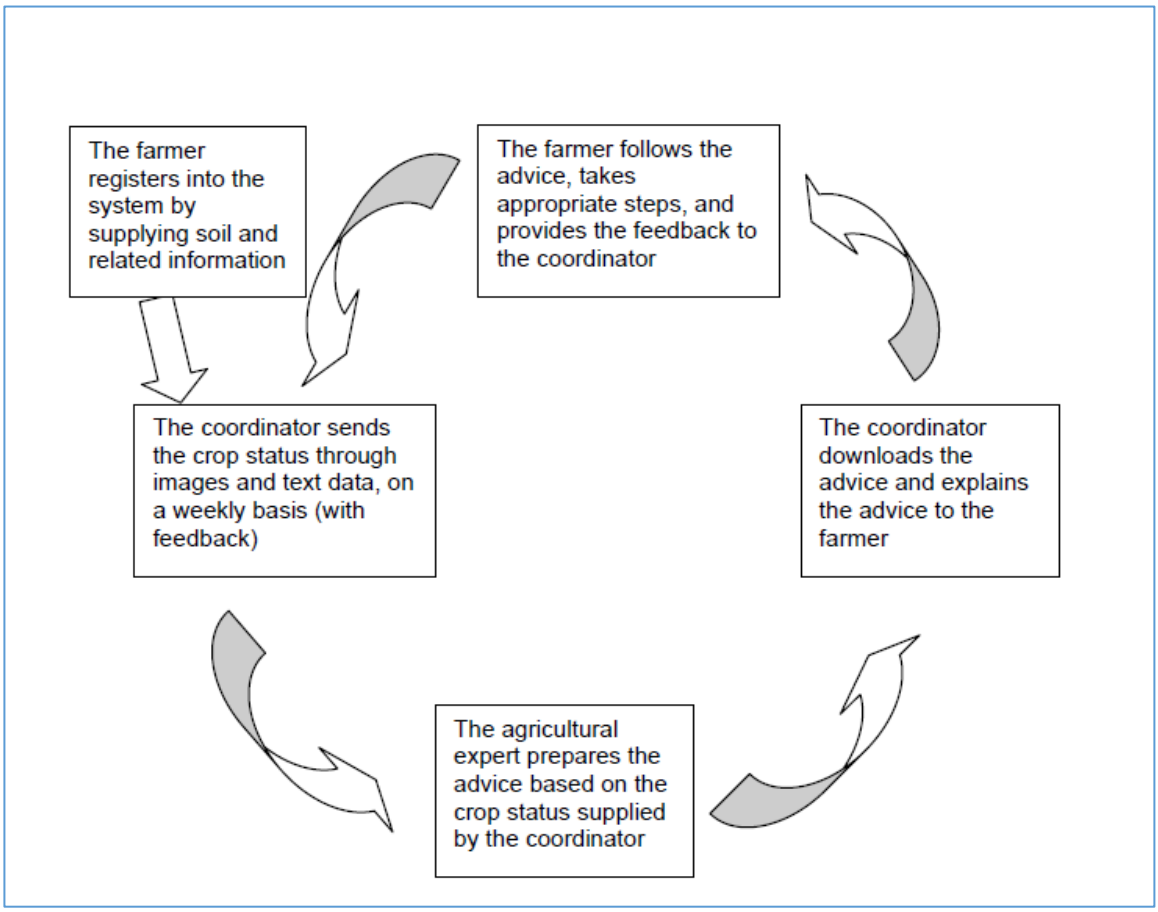


Figure 2.6 eSagu IT based personalized agriculture extension process
Source : e- Saravanan Raj(2008)Arik: ICTs for Agricultural Extension Services to the Tribal Farmers

2.5.2 Case studies from Sri Lanka.

The Govi Gnana (Farmer Knowledge) Service

GGS is an ICT intervention to increase Sri Lankan farmer income by improving crop planning, and increasing marketing efficiency also helping credit facilitation through forward sales contracts [FSC]. The Govi Gnana Service [GGS] is available in Sinhala and Tamil languages. Project refers to an independent price collection and dissemination service to deliver price information to farmers using price displays, radio broadcast, and newspapers (de Silva, 2011). This project was funded by the eSri Lanka lunched by the Government of Sri Lanka to take the 'dividends of ICT to the Sri Lankan community'. Later the same GGS was extended in collaboration with Dialog telekom, a private cellular service provider, to deliver price information via mobile phones to a group of pre-registered farmers. This service was based on a TradeNet platform which collected price information from three Dedicated Economic Centers; namely Dambulla (Central Province), Meegoda and Narahenpita (Western Province). Interested farmers could register with the network and obtain the prices of interested crops via SMS facility (Dialog telekom, 2011). Figure 2.7 graphically express the GGS info-structure.

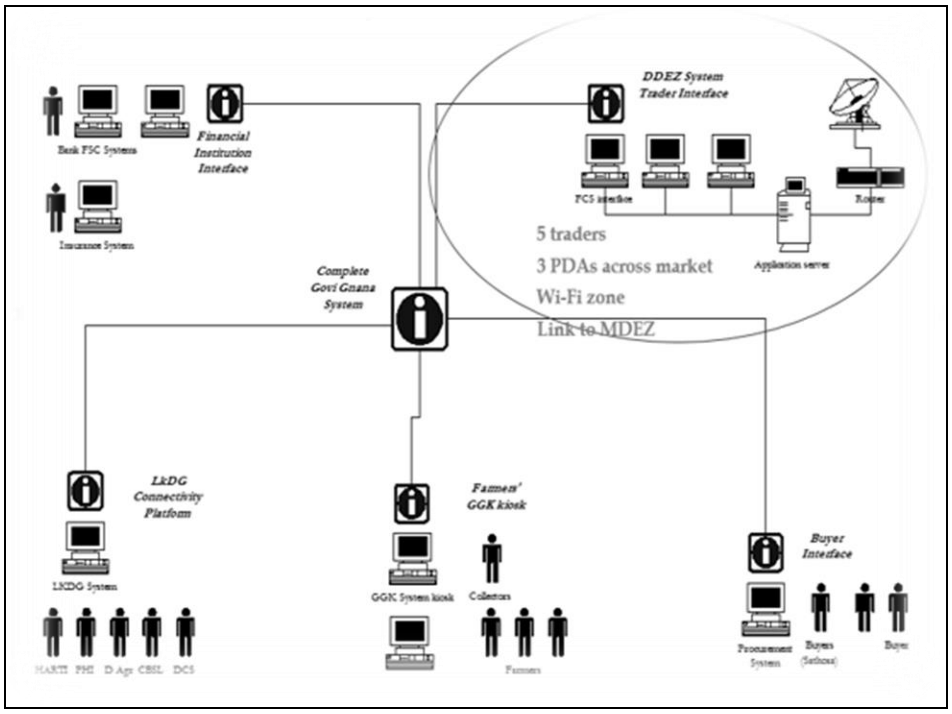


Figure 2.7 the GGS info-structure: DDEZ framework

Source: Department of Agriculture (2006) GGS

Govi Sahana Sarana

Govi Sahana Sarana is an Agriculture Advisory Service. As per the suggestion made by the former Minister of Agricultural Development, Hon. Mr. Chamal Rajapaksha, this service was established at the Audio Visual Centre of the Department of Agriculture, Peradeniya on 23rd February, 2006.

The service can be contacted by farmers for their queries over any land or mobile phone in office hours by dialing 1920. The main objectives are :to give quick advice to farmers over the phone on their queries, to refer experts or relevant literature and give advice within 72 hours, when the problem is complicated and to maintain a digital database on the queries for further action and report generation. The expected outputs are: Demand driven agriculture extension, quick mechanism of disseminating Agriculture information, strengthening of research-extension-training-farmer linkage and maintain of records on farmers queries as a digital database for further action.

The Kothmale Community Radio Internet project.

The Kothmale Community Radio Internet Project is an attempt to extend the benefits of information and communication technology (ICT) to some of the remote areas of Sri Lanka through the innovative convergence of two media; the radio and the Internet. Most of the radio broadcasts use information collected by browsing the Internet; this information is then discussed with listeners on the air. The Internet access points established in the community enable direct computer access and respond to the information needs of various groups in the community (60 villages and 3 rural towns).

An online database of information requests is maintained, and a web page in local languages enables active community participation in the operation of the radio.

Kothmale Radio Internet Project has provided easy access to information for its community members. Information from the two media, the radio and the Internet, has been used constructively for a variety of purposes. Increased participation and a sense of ownership among the audience have made the radio station an important part of the community, and have facilitated the organization of events, exhibitions, and discussions about local needs. Information access and increased community participation can be regarded as major forces behind the success of the project.

Agri Price Information Index Project

Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) provides daily whole sale price information collected from Pettah, Kandy, Dhabulla, Meegoda, Norochcholai, Thabuthegama, Nuwaraeliya and Kappetipola markets. Information is fully verified and validated by HARTI and entered to the system according to the market and product availability.

Customer needs to dial 6666 to connect in to the IVR which is available in Sinhala and Tamil Languages.

Information can be browsed product wise or market wise. If product wise selected, required product code needs to be entered. In the case of a wrong code is entered, the list of products will be readout to the customer. If customer wish to select by the

market, they can get all the products of Pettah, Kandy, Dambulla, Meegoda, Norochcholai, Thabuthegama, NuwaraEliya and Kappetipola.

2.6 Benefits of use of ICT for Agriculture

Undoubtedly, ICTs greatly improved economic growth in developing countries. The role of ICTs is focused on reducing poverty and providing livelihood and empowerment (Development Co-operation Directorate & Development Assistance Committee, 2004). According to the studies, ICTs had larger impacts on labour productivity than other types of capital; and combined capital and labour to develop multi-factor productivity and networking. ICT-based networking can also reduce transaction costs and accelerate innovation between rural-urban firms. ICTs investment can improve national economic performance and farmers' technological awareness. More over below benefits also can enjoy by using ICT for Agriculture.

- Increasing efficiency, productivity and sustainability of small scale farms.
- Information about pest and disease control, especially early warning systems, new varieties, new ways to optimize production and regulations for quality control.
- Better of markets resulting from informed decisions about future crops and commodities and best time and place to sell and buy goods.
- Up-to-date market information on prices for commodities, inputs and consumer trends.
- Strengthen capacities and better representation of their constituencies when negotiating input and output prices, land claims, resource rights and infrastructure projects.

- Reduce social isolation, widen the perspective of local communities in terms of national or global developments, open up new business opportunities and allow easier contact with friends and relatives.

2.7 Barriers to the use of ICT in agriculture:

Studies and projects around the world related to agricultural information dissemination have encountered different obstacles depending on several issues (Kari, 2007; Margono & Sugimoto, 2011; Ratnam, Krishna Reddy & Reddy, 2005). These problems include poverty, illiteracy, insufficient support, lack of timely information, user-friendly interface, two-way communication, insufficient network infrastructure and a lack of awareness of ICT benefits and cultures (Kari, 2007; Margono& Sugimoto, 2011; Ratnam, KrishnaReddy & Reddy, 2005).

2.7.1 Sri Lanka common problems associated with ICT adoption.

It is universally accepted that strong links between agribusiness smallholders can reduce rural poverty. However, lack of rural finance, infrastructure, and business and public services is particularly creating disadvantaged situation for rural farmers as pilot survey revealed. It further reveals that as in many developing countries, Sri Lankan government run market information services may not be the main source of information for farmers. As a result of that small farmers often rely on word of mouth information from other farmers and from traders. Some farmers and extension officers highlighted some issues with the existing systems as follows. (Towards an ICT Enabled Farming Community; DevakaJ.Punchihewa and Prasad Wimalaratne)

• Very poor at making collected information available to farmers.

• Pay inadequate attention to the quality of data collected

• Publish information in a form which is unsuitable for some farmers.

• No updated information on manual systems, sometimes with incomplete information

• Report information on prices in urban markets, but farmers have no way of understanding what these prices mean to them.

• They provide farmers with market prices but give no analysis of trends.

• Rarely provide information about quantities supplied or other important commercial information.

3. METHODOLOGY

3.1 Overview of Chapter

This chapter highlights the details of the research method adopted for the study. All the details will be discussed on how and where the research was carried out. More information about the location of study, conceptual research framework, define variables, developed hypotheses, sampling techniques and the data collection methods will be discussed in this chapter.

3.2 The research methodology

Conceptual research framework define as "explains either graphically, or in narrative form, the main things to be studied –key factors, concepts or variables –& the presumed relationship among them". (Miles and Huberman, 1994, P18).

The research methodology proposed for the study is available in Figure 3.1.According to the below chart the research procedure began with the reviewing literature. The relevant literature in the area of ICT empowerment for agriculture was reviewed. Once a fair idea on the empowerment through ICT, then the research concept was defined. It had to be refined several times to finalize the research topic and concept on "Empowerment of farmers through ICT"

The research approach was decided and accordingly the research participants were identified in Southern province. Then a questionnaire was prepared and finalized after several revision cycles and after pilot survey. This questionnaire was used for data collection, through interviews. Collected data were analyzed in order to achieve the intended objectives. Subsequently, the conclusions were drawn and based on which, certain recommendations were made.

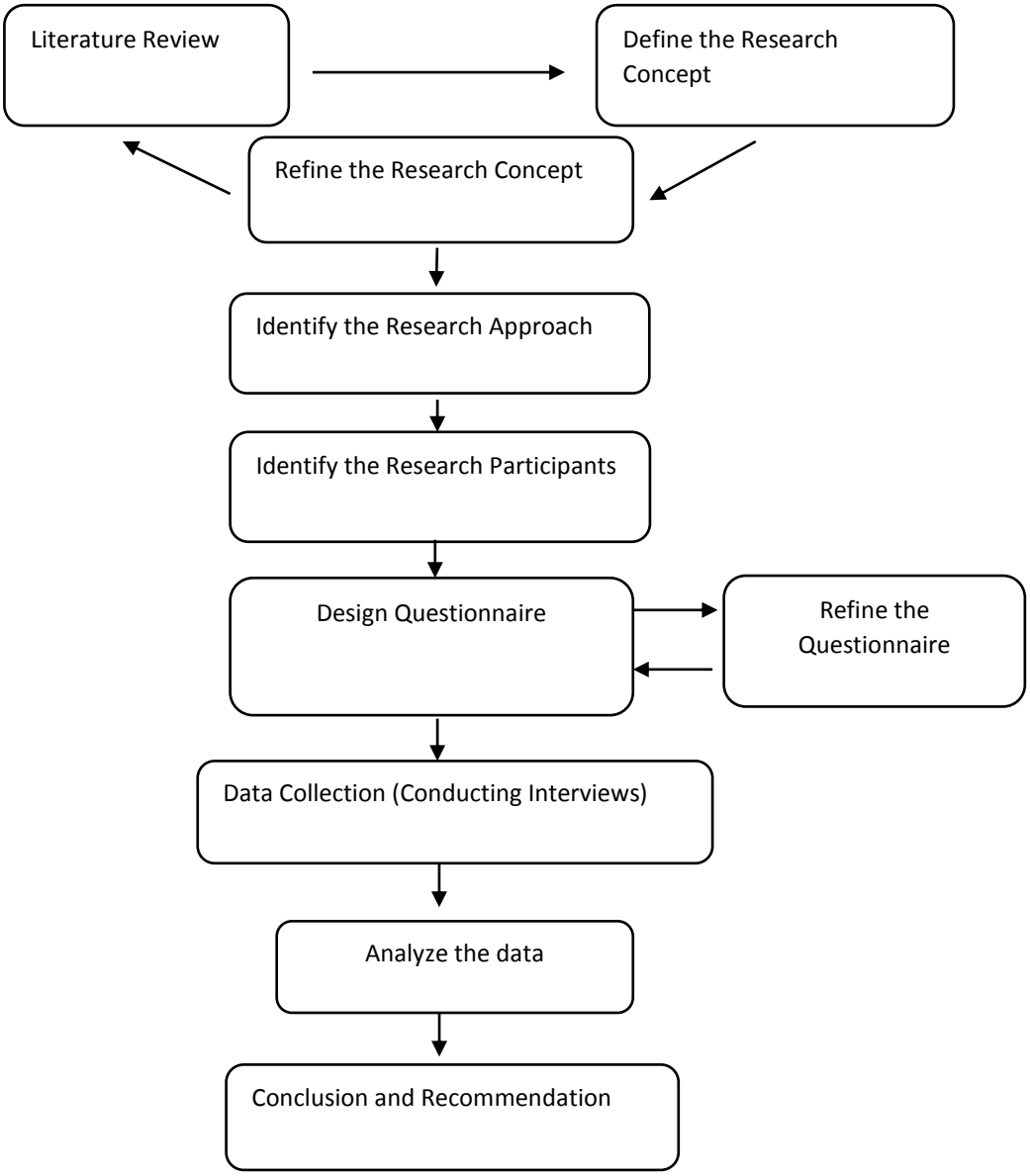


Figure 3.1 Research methodology

Table 0.1 Identified Variables | Literature Survey Summary

Concept derived from literature	Variables	Literature aspect
Current Status and Future Projection	Age Income	Tekin, A. B. (2013) Saravanan Raj(2008) Dr. C. Krishnan(2013-2014)
Factors impinging farmers use of agriculture technology	Level of education Level of Experience	Abdullah, F. A., &Samah, B. A. (2013) Dr. A.K. Singh(2008)
Access and use of agricultural information and knowledge	Crop diversification Farmer attitude towards ICT	TandiLwoga, E., Stilwell, C., &Ngulube, P. (2011).
Agriclture Empowering Farmers	Income	NeGP Agriclture Empowering Farmers(2012),Department of Agriculture & Cooperation,Ministry of Agriculture,Government of India
Mobile Technologies for Enriching Knowledge and Empowering Farmers	Computer literacy	Dr.Singh,A K,(2010) W.A.D.P. Wanigasundera and Uvasara Dissanayeke(2014)

Table 3.2 Variable classification

Independent variable	Dependent variable
Age	ICT empowerment
Income	
Level of education	
Level of Experience	
Availability of ICT infrastructure	

3.3 Hypothesis Development

This study based on certain hypothesis. They were formulated based on the variables identified and constructed based on the opinions given by the literature review. Mainly the hypothesis were formulated considering the relationship between the independent and dependent variables. Thus the following hypothesis were formulated.

HA: Alternate Hypothesis

H0: Null Hypothesis

Hypothesis 1

H1A: Empowerment of Farmers through ICT is influenced by Age.
H1O: Age has no impact on empowerment of farmers through ICT.

Hypothesis 2

H2A: Empowerment of Farmers through ICT is influenced by income per month.

H2O: Income per month has no impact on empowerment of farmers through ICT.

Hypothesis 3

H3A: Empowerment of Farmers through ICT is influenced by level of education.

H3O: Level of education has no impact on empowerment of farmers through ICT.

Hypothesis 4

H40: Empowerment of Farmers through ICT is influenced by type of information need.

H4A: Type of information need has no impact on empowerment of farmers through ICT.

The aim of the analysis is to accept and prove the alternative hypothesis and reject the null hypothesis through the data analysis.

3.4 Location of the study

Southern province in Sri Lanka was the focus location for the study. Southern province was selected for the study because of tits diversified agriculture commercial activities such as paddy, vegetable cultivation, fruit cultivation, animal husbandry, tea, and coconut cultivation. Specifically in the Southern province main six sub divisions were selected for the study by using random sampling technique.

3.4.1 Suitability of study location:

Southern Province was chosen for a number of reasons. Since the province is rapidly developed through new airport, harbor other development projects there is underground stable infrastructure development associate herewith. This province is popular due to tourism too. There is a possibility of growth and trend to use of ICT for the day to day business activities and possibility of interest on ICT for their development.

The other reason was Agriculture Faculty of Ruhuna University also located in the Southern Province that will have impact on farmer knowledge on new technology.

Another most important reason is the location is geographically close and easily accessible. The measure of convenience afforded by this is considerable, given the ever-present issues of tight constraints in time, money and other resources. Figure 3.2 shows the map of the Southern Province.

Figure 3.2 The map of Southern Province

Figure 3.3 Map of Galle district; highlighted the selected areas for data gathering

Figure 3.4 Map of Matara district; highlighted the selected areas for data gathering

Figure 3.5 Map of Hambantota district; highlighted the selected areas for data gathering

3.5 Research methods

This study is employed with quantitative approach, since it is descriptive nature. Quantitative approach can engage with where to establish, confirm and validate relationships. As the data collection method, the survey method was used in this study. Survey method is the widely used method for primary data collection. The survey technique was helpful in establishing the existing relationships among the variables and explaining the possible reasons behind the relationships. The survey was standardized to ensure reliability, generalizability, and the validity every respondent were presented with the same questions and in the same order as other respondents.

Survey research is defined as acquiring information about the characteristics, opinions, behavior, attitudes, experiences and beliefs of one or more groups of people through questionnaires administered by mail, handouts, personal and telephone interviews and the Internet, and tabulating their answers (Leedy&Ormrod, 2005:183).

As the key primary data collection technique, well known survey method – interview based questionnaire was administrated to collect data from farmers in all three districts.

The pilot survey has done with twenty farmers to determine the validity of the questionnaire and check how flexible to understand. After the pilot survey finalize questionnaire was formulated. All the farmers interviewed face to face and collected data according to the questionnaire. Randomly selected farmers used to gather data. The data analysis and conclusions of this study will be solely based on the primary data.

In addition to the primary data, to get more information and deeper understanding for further observations was made and collected from secondary sources as well. Secondary data collections were conducted by collecting information from a diverse source of electronically stored information.

For further clarification of the problem and to collect more information, researcher individually met relevant individuals in Agriculture Sector like professor from Agriculture economics department, University of Ruhuna, dairy milk collecting center people, Farm gate buyers/sellers and famer's family members.

3.6 The population

The aim of this research is to check how farmers can empower with ICT literacy. As per Census of Population and Housing (2001), there are 5941574 farmers in Sri Lanka and from that 725778 farmers are in Southern Province. Breakdown is Galle 318,680, Matara 242,175 and Hambantota 164,923.These Southern Province farmers are the target group for this study.

3.7 Sample size

Convenient sampling was used to select a total number of 384 farmers who were interviewed for the purpose of the study. The sample consists of paddy farmers,

vegetable farmers, fruit farmers, tea, sand coconut farmers. Sample consists of 136 farmers from Galle district, 138 farmers from Matara district and 106 farmers from Hambantota district. The Southern province map is available in figure 3.2 and Galle, Matara and Hambantota districts map and data collection areas are highlighted in 3.3,3.4 and 3.5 figures correspondingly.

3.8 Data collection

As stated in above paragraphs both primary and secondary data were collected for the study. Interview based questionnaire was used as a survey instrument. The questionnaires were equipped with both open and close-ended questions to gather data. After the prior appointments the farmers were met at their residence or in a field visit.

Two and half months of field survey is participated by me, several regional managers of Peoples bank of Sri Lanka, several branch managers and several field officers of Peoples bank in the respective districts. Face to face interviews were conducted for each respondent. Each interview took approximately 40-45 minutes.

At the first stage of data collection, the regional mangers of people's bank in the respective districts were educated on the importance of the research and sought their assistance for the survey. Later the field officers were educated on the questionnaire and its content with the permission of the regional managers. Field officers being the staff of the bank that directly deals with the farmers they were very useful to collect data. Moreover acquaintance of field officers and farmers helped these officers to collect data without any hardships. Visiting farmers is a regular part of the job of field officers and therefore allocating extra time was not necessary regarding the data collection, neither had it incurred any extra expenses. Several other branch managers of people's bank also helped in the process of collecting data. Since the banking staff has close relationship with large number of farmers and I had the opportunity to use the assistance of bank staff in the respective districts, I had chosen the previously mentioned method to collect data from the farmers.

The data collection was to identify the current level of ICT knowledge of farmers. As secondary data research had followed several articles, journals, these sources have been consulted in the reviewing of literature for the study.

3.9 Questionnaire Structure

Questionnaire designed under two main categories. They are Demographic Data and Data related to the use of information and communication (ICT) tools in agricultural Sector.

Almost all the questions in Part B have arranged in a five point Likert scale manner by letting the respondent to select one among five different alternatives, which is summarized below in table 3.3.

Table 0.3 Likert Scale for Questionnaire

Scale	Very frequently	Frequently	Occasionally	Rarely	Very rarely
Scale	strongly agree	agree	Neutral	disagree	strongly disagree
Scale	strongly believe	believe	neutral	disbelieve	strongly disbelieve
Scale	strongly like	Like	Neutral	Unlike	Strongly unlike
Scale	Highly satisfied with no congestion	Satisfied with rare congestion	Accepted level of speed	Not satisfied with frequent congestion	Highly not satisfied with more frequent congestion
Scale	Highly satisfied with no congestion	Satisfied with rare congestion	Accepted level of speed	Not satisfied with frequent congestion	Highly not satisfied with more frequent congestion
Point	5	4	3	2	1

3.10 Methods of data analysis

All the collected data for the study analyzed through SPSS 22.0, considering a two tailed test under significance level at 0.01. The analysis and data presentation has categorized into several sections, where demographic data analyzed through 'Descriptive statistics 'and ascertained data analyzed through 'Correlation "

3.10.1 Descriptive statistics

Descriptive statistics were used to make frequency tables, pie charts, histograms, bar graphs and to calculate averages, ranges, percentages, means and correlations among key ICT use variables. To facilitate the analysis, some items on the questionnaire were measured using a Likhert scale of 1 to 5 scores.

3.10.2 Correlation Analysis.

Correlation analysis tests were conducted to identify and find the relationship between ICT use and some variables, and between the variables themselves.

4. DATA ANALYSIS

4.1 Introduction

This chapter presents the data analysis from the survey gathered data. The study aim was to two main objectives one is explore and identify the current level of ICT knowledge of farmers and the second one is suggest the possible approaches to empower farmers through ICT.

The scope of this study is limited to descriptive statistics and correlation analysis. The correlation analysis were used to find relationships between factors influencing the use of ICT Southern province agriculture sector. SPSS was used as statistical analysis software. From the study, the following information was found about the demographics of the farm employees, ICT access, ICT awareness and use patterns, perception and attitudes towards ICT.

Out of the selected 384 farmers, 144 are from Galle, 136 farmers from Matara and 104 farmers from Hambantota.A total quantity of 370 completed questionnaires were collected successfully from these three districts. Breakdown of the return rates shown in below table. An overall success returns rate around 96% and which was a very good rate of response for research survey. The details of the three districts available in Table 4.1.

Table 4.1 Questionnaire return rate

	Questionnaires sent	Questionnaires received	Return rate
Galle	144	138	96%
Matara	136	136	100%
Hambantota	104	96	92%
Total	384	370	96%

The data analysis was conducted in order to analysis each and every aspects of the questionnaire. In order to do so, various relationships were identified and analyzed further, from the background information obtained, relevant to ICT usage of the farmers.

4.2 Demographic Analysis

In this section collected answers have been described in terms of the farmer's characteristics and behaviors relevant to the study. Farmer's basic profile has been described at the beginning in order to understand the population. Later the answers for the questions have been taken into discussion.

Farmer – Age

Details of the farmer age is displayed in the following table 4.2.According to the table 4.2, in the express the figures that mention more famers were belong to 31 to 50 years ,which is 64% from overall sample.

Table 4.2: Farmer age

Age	Galle	Matara	Hambantota	Total	Percentage (%)
20-30 years	16	20	2	38	8.88
31-40 years	53	39	38	130	30.37
41-50 years	42	45	60	147	34.35
Above 50	29	46	38	113	26.40

Source –Survey Data

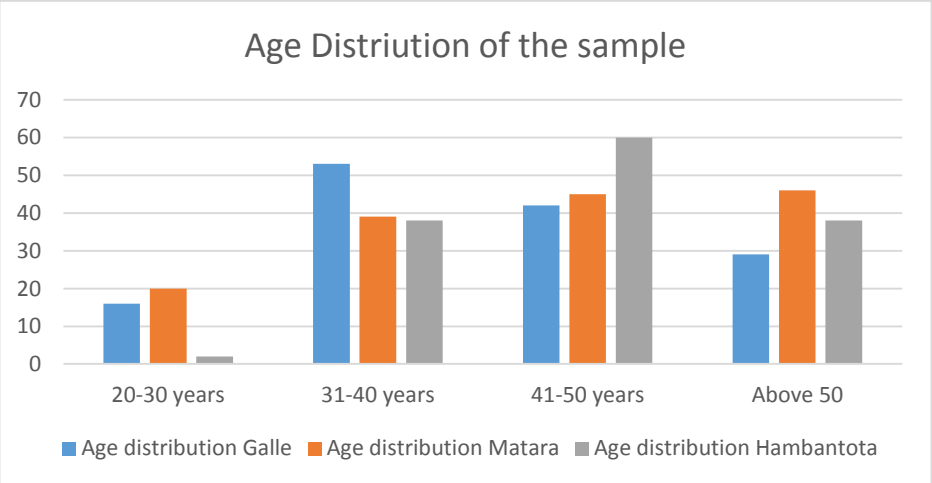


Figure 4.1 Farmer –Age

Farmer – Income

According to the Table 4.2 and Figure 4.2, majority is fall into monthly income 25000-50000SLR.only 3% of the farmers fall in to less than 10000 and more than 75000 income per month. 23% of the farmers were getting 10000-25000 income per month. The majority 44% were getting 25000-50000SLR income per month and 24% of the sample were getting 50000-75000SLR income.

Table 4.3 Farmer-Income level

	Galle	Matara	Hambantota	Total	Total in percentage
Less than 10,000	6	7	0	13	3.31
10000-25000	34	35	24	93	23.66
25000-50000	52	55	67	174	44.27
50000-75000	33	38	27	98	24.94
More than 75000	1	7	7	15	3.82

Source- Survey Data

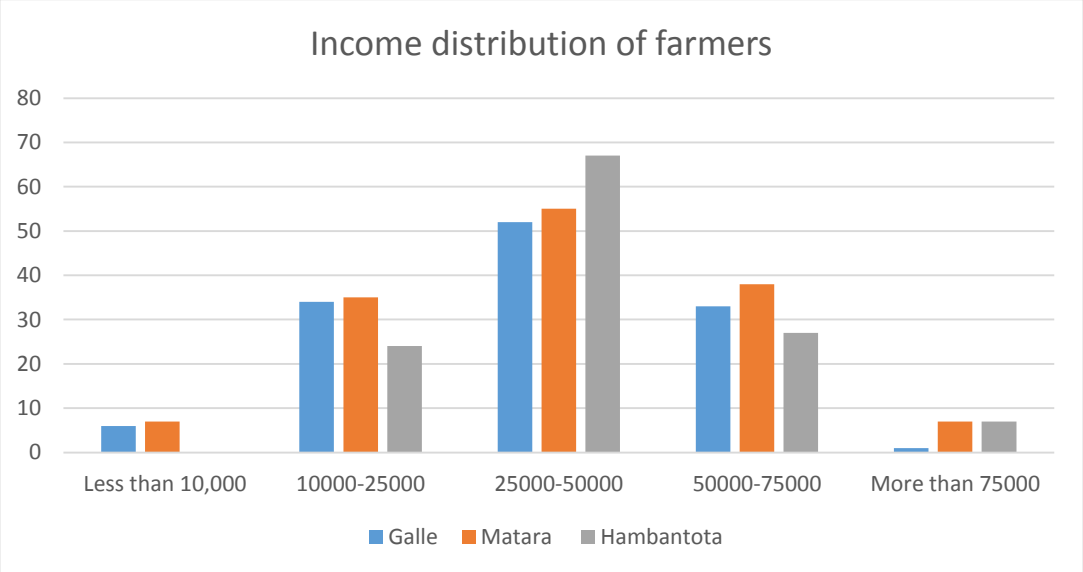


Figure 4.2 Farmer–Income level

Farmer - ICT literacy by Monthly income

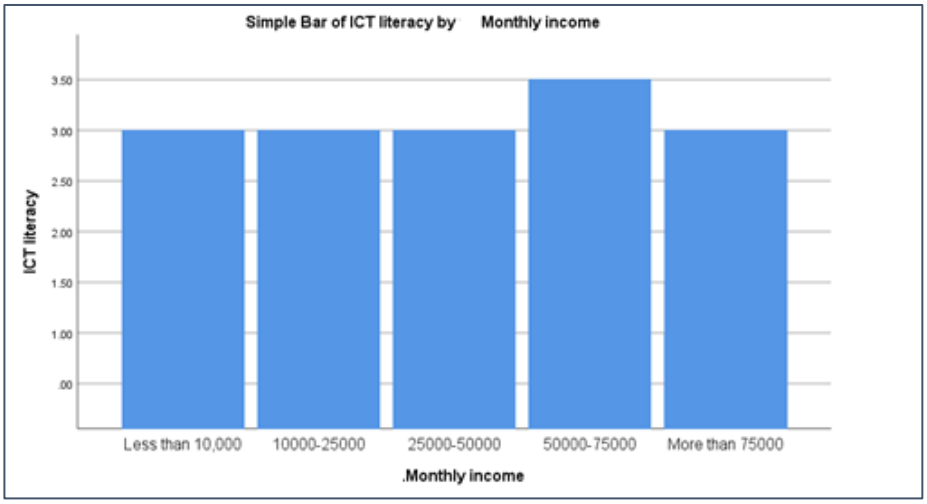


Figure 4.3 Farmer–ICT literacy by Monthly income

ICT is high when famer monthly income in between 50000-75000SLR.According to the figure 4.3, there is no significant different or relationship with monthly income with ICT literacy.

Farmer - Education level

Table 4.4 Farmer-Education level

	Galle	Matara	Hambantota	Total	Total in percentage
Not attend	2			2	0.47
Pass grade 5	4	11	6	21	4.91
Pass grade 8	10	14	8	32	7.48
Pass O/L	89	77	88	254	59.35
Pass A/L	31	52	27	110	25.70
Diploma	4	4	1	9	2.10
Degree	0	0	0	0	0.00

Source: Survey Data

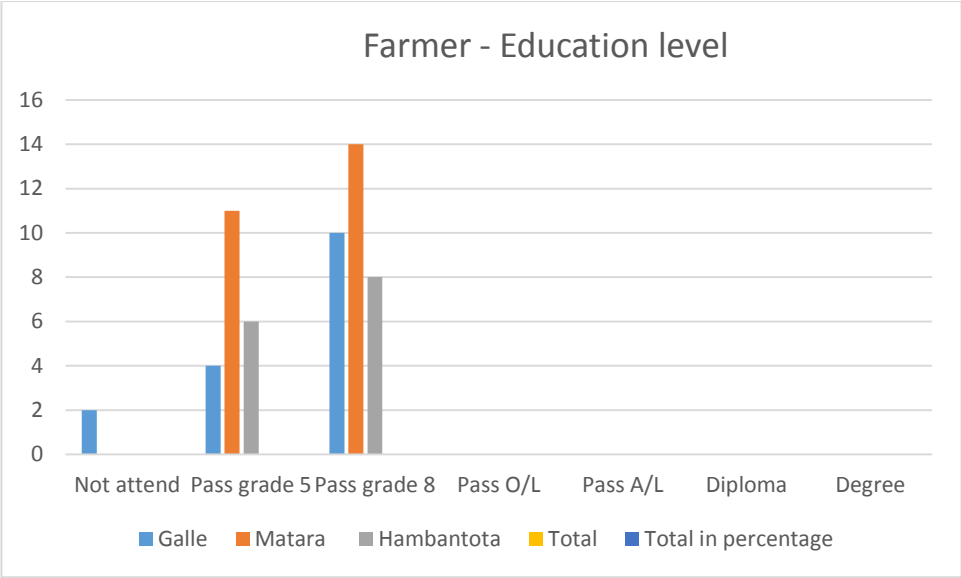


Figure 4.4 Farmer–Education level

According to the survey data express in table 4.4, there are more famers fallen under pass O/L category as their highest education level, which is 59%.Next highest education level is pass A/L, which has 25%.Next highest education level is pass grade 8 ,which is 7% from the total sample. The graphical representation is available in figure 4.4.

Farmer - ICT literacy Vs Primary education level

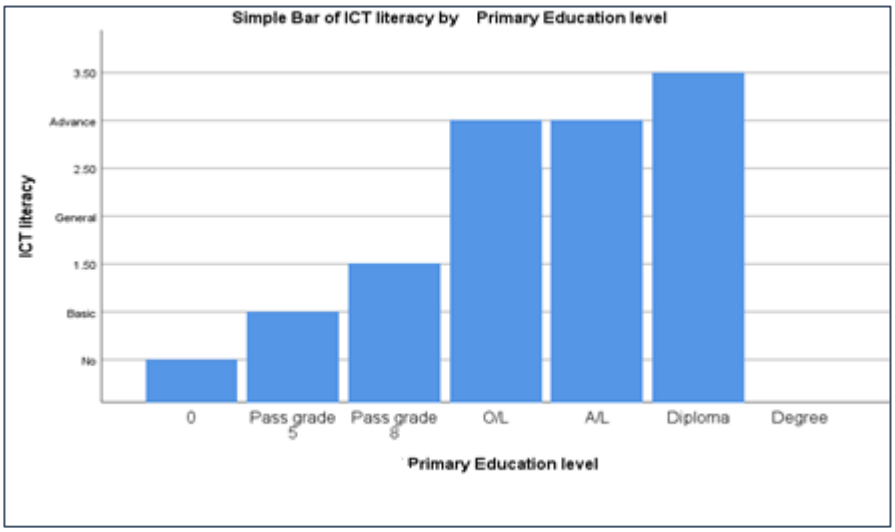


Figure 4.5 Farmer–ICT literacy Vs Educational level

The graphical representation of the farmer education level vs ICT is express in figure 4.5 chart. The results confirm that when level of education is high, then ICT literacy is also high.

Farmer -Level of experience

According to the figure 4.6 Farmer–ICT literacy Vs duration of experience highest ICT literacy was with the farmers who have less than 5 years of experience. Less than 5 years' experience indicate that they are the younger farmers in the village, who are mostly below 30 years old.

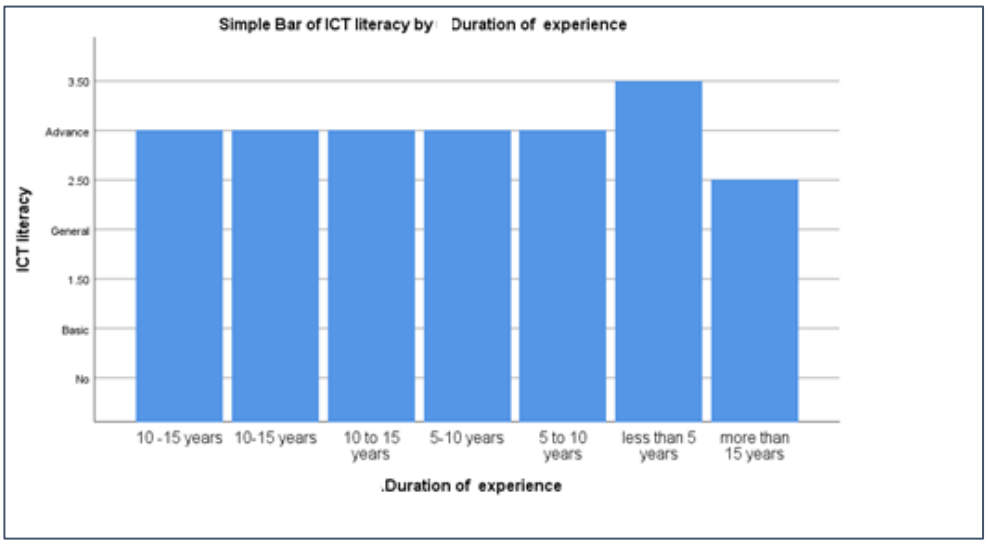
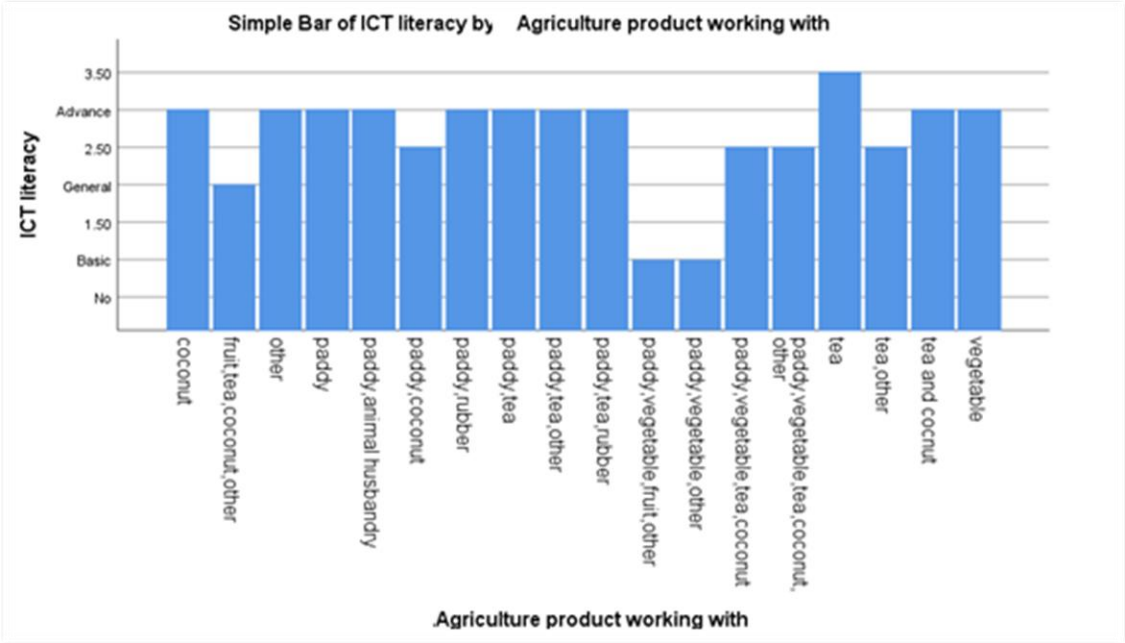


Figure 4.6 Farmer–ICT literacy Vs duration of experience

Agriculture product working with Vs ICT literacy

With reference to the Figure 4.7 Farmer–ICT literacy Vs Agriculture product working it shows that highest ICT literacy associated with Tea farmers and lowest ICT literacy is associated with Paddy, Vegetable, Fruit and Other farmers. The reason for that is full time farmers do not have time or interest on ICT as they are old farmers.

Figure 4.7 Farmer–ICT literacy Vs Agriculture product working



Source: Survey Data

ICT Infrastructure

According to the Figure 4.8 Farmer– ICT infrastructure, it shows that highest popular ICT tool is Television in southern province, next is Radio. Apart from these two next popular ICT tool is Mobile phone –analogue. During the field survey observed that farmers were like to use analogue mobile phone rather than smart phones .Because they were fear about the smart phone.

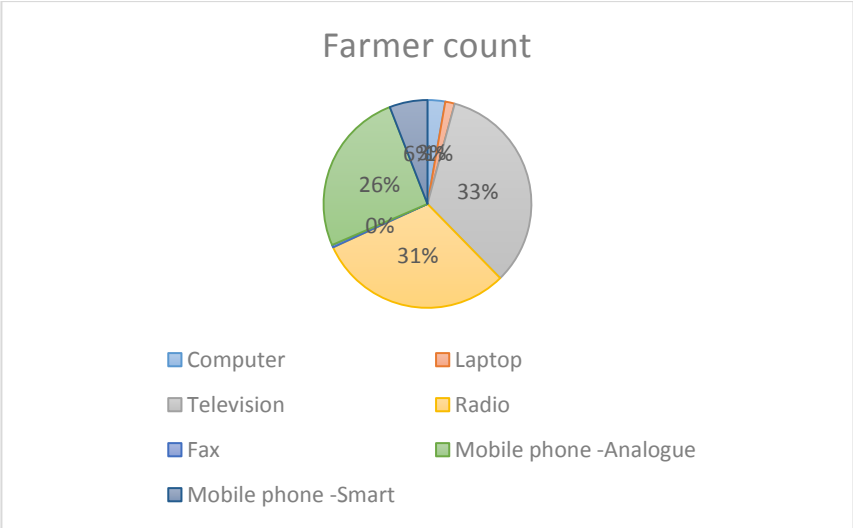


Figure 4.8 Farmer– ICT infrastructure

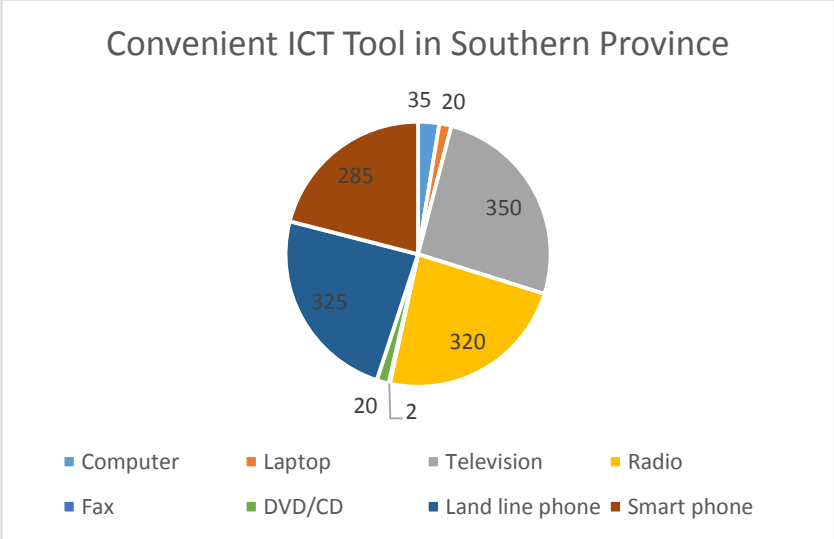


Figure 4.9 Farmer – Convenient ICT tool in Southern Province

Table 4.5 Farmer– Convenient ICT tool in Southern Province

ICT Tool	Number of farmers
Television	350
Land line phone	325
Radio	320
Smart phone	285
Computer	35
Laptop	20
DVD/CD	20
Fax	2

The most popular convenient tool is the Television and least popular tool is fax. Land line phones, radio and mobile phone also other major popular tool in the Southern province.

4.3 Correlation Analysis

The correlation coefficient of Pearson was calculated to measure the relationship/s among selected variables in this study. Interpreting values for correlation coefficient, initially it is accepted that when the coefficient becomes positive, the relationship is considered as positive; and vice versa. Similarly, when the coefficient value is close to 1, the relationship is considered as strongly correlated and when it is close to 0, the relationship becomes weakly correlated.

4.3.1 Correlation between farmer age and ICT empowerment.

According to the results shown in Table 4.5, Farmer age has a negative correlation between ICT empowerment. Negative correlation is a relationship between two variables in which one variable increases as the other decreases. The correlation for farmer age is -.426, therefore, farmer age will affect ICT empowerment in a negative way. This explain that ICT empowerment for young age farmers are easier than old

aged farmers. So that the target group for ICT empowerment should consists with young farmers.

Table 4.6 Correlation between Farmer age and ICT empowerment.

	Mean	Std. Deviation	N
Age	44.42	10.085	370
ICT Empowerment	2.5311	0.67151	370

Correlations			
		Age	ICT Empowerment
Age	Pearson Correlation	1	-.426**
	Sig. (2-tailed)		0
	N	370	370
Empowerment through ICT	Pearson Correlation	-.426**	1
	Sig. (2-tailed)	0	
	N	370	370

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.2 Correlation between farmer income per month and ICT empowerment.

According to the results shown in Table 4.6, Income per month has a positive correlation between ICT empowerment. The correlation is 2.89, therefore, Income per month will affect work collaboration in a positive way. When the income per month is high then there will be high potential for ICT empowerment.

Table 4.7 Correlation between Farmer income per month and ICT empowerment.

	Mean	Std. Deviation	N
Income per month	44.42	10.085	370
ICT Empowerment	2.5311	0.67151	370

		ICT literacy	Monthly income
ICT Empowerment	Pearson Correlation	1	.218**
	Sig. (2-tailed)		0
	N	370	370
Monthly income	Pearson Correlation	.218**	1
	Sig. (2-tailed)	0	
	N	370	370

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.3 Correlation between farmer level of education and ICT empowerment.

With reference to the table 4.7, there is a positive correlation between farmer level of education and ICT empowerment. That is .924 which is strongly correlation. The value of sigma (2-tailed) indicate that there is a strong correlation between level of education and ICT empowerment. It has proven that farmer level of education is strongly positively correlated with ICT empowerment.

Table 4.8 Correlation between Farmer education level and ICT empowerment.

Descriptive Statistics

	Mean	Std. Deviation	N
ICT Empowerment	2.5311	0.67151	370
Primary Education level	3.41	0.924	370

Correlations

		ICT Empowerment	Primary Education level
ICT Empowerment	Pearson Correlation	1	.910**
	Sig. (2-tailed)		0
	N	370	370
Primary Education level	Pearson Correlation	.910**	1
	Sig. (2-tailed)	0	
	N	370	370

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.3 Correlation between Type of information need and ICT empowerment.

According to the results shown in Table 4.8, type of information need has a negative correlation between ICT empowerment. The correlation is -0.009, therefore, type of information will affect work collaboration in a negative way. But very weak relationship is exists between type of information need and ICT empowerment.

Table 4.9 Correlation between Type of information need and ICT empowerment.

Descriptive Statistics

	Mean	Std. Deviation	N
ICT Empowerment	2.5311	0.67151	370
Type of info	4.6523	0.46052	370

Correlations

		ICT Empowerment	Type of info
ICT Empowerment	Pearson Correlation	1	-0.009
	Sig. (2-tailed)		0.865
	N	370	370
Type of info	Pearson Correlation	-0.009	1
	Sig. (2-tailed)	0.865	
	N	370	370

5. DISCUSSION AND CONCLUSION

5.1 Introduction

The aim of this study was to recommend possible approaches to empower farmers through ICT considering the status of the farmers in the selected areas. Explore and identify the current level of ICT knowledge of farmers as part of the entry in to research.

After gathering all required data for the study, Pearson's Correlation and were applied in analyzing and interpreting collected data, which is recorded in chapter four. This chapter has utilized the information derived from chapter four in order to make conclusions and to provide suggestions for both academic context and for business context.

5.2 Discussion of Research Findings

Data gathered covering three major districts in southern Sri Lanka and 384 farmers were randomly selected as source of information. The farmers were selected covering all major sectors of the agriculture sectors such as vegetable and fruit cultivators, paddy farmers, farmers with animal husbandry. The usage of ICT related equipment is at the highest level among the farmers in the district of Galle, while usage of ICT related equipment is at the minimum level in Hambantota district compared to other districts. 71.3% of farmers from Matara district use an ICT related equipment or facility in their agriculture related activities. While the percentage of usage of ICT related equipment is at 62.9% and 53.5% among the farmers coming from Galle and Hambantota consecutively.

According to the final outcome of the research –section 4.2 ,the 71.2% of participant's shows reluctance to embrace the modern high-tech equipment's and methodologies due to lack of awareness of the benefits resulted through usage ICT, poor infrastructure (electricity, telecommunication). Initial cost has not being identified as a major factor that hindering the usage of ICT related equipment among the farmers in these districts. The survey shows that usage of ICT related equipment is affected by 55.1% in Matara

district, 64.9% in Galle district and 82.3% in Hambantoa district due to the lack of awareness. Lack of education to use ICT related equipment and language has been also identified as a major obstacle to introducing ICT equipment to the agriculture sector. There is a high demand for information related to agriculture such as Pest management, Use of fertilizer, Soil improvement, Market price, Use of insecticide, Weather forecast, Financial management, Organic farming among the farmers but large number of farmers still depend on their neighbors, relatives, friends and others of farming community to find out information as well as solutions for the problem arise in the agriculture business. It shows that still large number of farmers is not ready to trust the information available through the ICT as they are uncertain of the accuracy of the information coming through those channels. They are very keen to find out new markets for their products lack of knowledge in effective marketing methods have been identified as a fact that limits their earning potentiality. Usage of mobile phones is at very high rate among the farmers in all 3 districts, while usage of TV is the most important medium to collect data among the men, Usage of other ICT related applications such as Internet, Email, as well as World Wide Web.

Results and Discussion section 4.3 shows a down-ward trend in the usage of ICT with the increase of age. And it shows very strong relationship between the usage of ICT and level of education, 99% of the farmers that use ICT have completed at least the secondary education.

5.3 Research Findings and Recommendations

ICT related education come to fore-front that should be addressed to introduce ICT among the farmers in Sri Lanka. Negative trustworthiness on information available through the ICT is major obstacle to implement ICT related services among the farmers of higher age. But the farmers that represent younger generation is very much enthusiastic about the ICT and believes it would help them at large to reap more benefits through agriculture. Positive improvements can be achieved by using the variables such as email, Internet, smart phones, which are easy to use. According to the research results section 4.2 large number of farmers still has fear of using ICT for

agriculture related activities due to the lack of trustworthiness on information disseminated through ICT. As the agricultural sector advances constantly with implication of new technologies and ICT, it has become very important to adopt those improvements to achieve a sustainable growth in the sector.

The persisting issues related the agriculture sector such as low productivity, low quality of products; wastage etc. can be easily minimized by usage of ICT, for instance the dairy farmers hand over their daily milk collection to the collecting centers every day and they are brought to the main processing plant in the area by the collectors. The report issued by the processing centers on the milk samples is sent to the respective farmer, but these reports are received by farmers after many days. Since the report available after a significant delay the farmers are not in a position to ascertain the reasons for the low or high quality of their particular collection and take measures to improve the quality of their product. This type of delays can be easily overcome by introducing a method of communication using ITC between the company and the farmers. Usage of ICT helps greatly for the farmers to collect data as it happens and when it happens, information such as weather forecast is an important fact to decide on the type of crop to plant in the coming months. The best time to use pesticide, insecticide and fertilizer can be easily judged through the data gathered through the high-tech equipment. ICT can be used to minimize the crop-damage resulted in unsuitable weather conditions that reported in many parts of the island often.

One of the most important barriers to introduce ICT to farmers is the lack of knowledge on ICT and it should be addressed with effective educational programs. With the participation of government sector an effective educational programs should be facilitated to farmers free of charge or at least at a very nominal fee. As the farmers are more aware about the ICT and more educated on ICT, the trustworthiness on information available through ICT is heightened, which is identified as a major barrier to introduce ICT. It is a well observed fact that usage of ICT is closely related to the level of education, therefore educating farmers through a well-planned system effects positively on popularity on ICT among the farmers and also I presume they will gradually start to use high-tech ICT methods and tools as they ascertain the benefits. Private companies can be also encourage to plan awareness programs on ICT specially

targeting the farmers that produce products for those companies assuming that the companies are benefited with high quality products. Organizing training programs for farmers is an effective method to enhance the ICT knowledge among farmers.

Effective marketing methods with use of ICT such as World Wide Web, Email, and Social media can be very useful for farmers to find new markets and get the best price. Especially the social media is not only a communication tool anymore and it has become a medium to find customers without any geographical barrier. Internet marketing methods using www will be a useful tool in this endeavor and it also helps consumers to get agricultural products at the best price as the role of middle-man can be avoided.

One important fact that observed throughout the research was the heavy dependency on fellow farmers for information.(section 4.2) Providing a tool to enable intercommunication among the farmers helps to increase the information flow among the farmers. It is suggested a chat system with real-time video to be implemented initially among a small farmer community and expand it in the time to come. This system expected to cover Entire Island with participation of farmers covering Entire Island in the years to come. And this tool expected to be a large network of farmers, who share information each other on various subjects covering agriculture industry. It is suggested this tool will be implemented in the future as a part of ongoing research.

Providing financial support through government funding is suggested in order to encourage farmers to use ICT in their farming activities. There had been several farmers who were reluctant to use ICT due some financial limitations. Therefore financial support would be good solutions for farmers, who are not ready to use ICT due cost factor.

Strong inter-relationship among the farmers is one of the major findings in the research and farmers are heavily depending on each other for assistance required during their farming activities according to the findings in section 4.2. Farmers are always preferred to find solutions for their problems within their designated farmer community. These farmer communities are consist of several farmers to dozens of farmers. Moreover these farmers are strongly believe the instruction coming on their

way through the acquaintance. Having understood this trend, a communication platform was formed with a 3rdpartly tool and enabled 5 farmers to have video and voice chats. The experiment proved to be very successful and farmers were using the tool very effectively and enthusiastically

That main intention of this survey is to find out the use of ICT to empower the farming community of Sri Lanka. Making a well-educated farming community on ICT is one of the most important priorities to achieve a sustainable grown in the sector. Very well planned ICT system in agriculture sector resulted in many positive outcomes such as achieve a positive growth in carrier for farmers. Consumers are able to reap benefits such as reaching new products, quality products and get best prices while companies able to increase, quality, productivity and profit.

5.4 Research Limitations

The way to empower farmers through ICT have a huge scope. Due to wide range of Agriculture activities and wide range of ICT tools and application. Out of those the focus of this research was only to identify some factors that can utilize to empower farmers through ICT. Agriculture is spread in province of Sri Lanka and out of those only Southern province were selected for the research. The below listed points highlight the limitations of this research.

1. It was not possible to measure all variables associate with the empowerment through ICT, therefore, the information gathered during literature review has been used to define variables.
2. There were numerous factors identified to implement ICT related environment in agriculture during the data gathering of the research, but all of them were not mention in the report due to scope limitations.
3. Social media implement was done by using third party tool and limited functionalities tested using only 5 farmers.
4. This findings totally applicable for Southern Province only.

5.5 Future Research

The research was conducted under the above discussed research limitations (Section 5.4). While working on the limited scope due to limited time frame, it was identified that within Sri Lankan agriculture industry the below listed research areas can be focused by the researchers who are interested empower farmers through ICT in Sri Lanka.

1. It can be studied in the future how existing social media can be applied for work collaboration in farming communities.
2. Implement new social media with wide range of functionalities to facilitate communication between farmers and government and vendors.

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Appendix A:

Survey Questionnaire

Questionnaire for farmers

Survey questionnaire to be used for interviews with the farmers

A research survey investigating the use of ICT in agriculture

This survey's aim is to investigate and assess the use of ICT (for example, computers, Internet, fax, printer, e-mail, websites, landline/mobile phones, e-commerce and other computerized agricultural systems) in agriculture. It will focus on the use of different forms of ICT, ICT access and factors influencing the use of ICT among agricultural communities in the Southern Province.

The results of the study will portray how ICT is deployed for agricultural purposes. This will help us better to understand the ICT needs of agricultural communities in Southern Province. With the final output from the survey, a Master's thesis will be developed and submitted at the end of the academic year 2016.

The questionnaire is expected to take approximately 25 to 30 minutes.

Informed consent

Participation of farmers in this survey is completely voluntary. Participants are assured that all their information will be strictly confidential and anonymous. No references will be made to specific individuals. All the responses will be used for academic purposes only. All questions are answered to your satisfaction. Your honesty and cooperation is greatly appreciated. We would be grateful for your favorable contribution towards the success of this survey.

K.K.Pavithra Subashini, MBA Research Student, Computer Science and Engineering Dept, University of Moratuwa	Dr.Shantha Ferando, Supervisor and Senior Lecture, Computer Science and Engineering Dept, University of Moratuwa

Part A: Demographic Data

1. Please tick the response that describes yourself

Age:

Below 20 years	20-30 years
31-40 years	41-50 years
Above 50	

2. Gender:

Male	Female

3. Primary Education level:

Pass grade 5	Pass grade 8
O/L	A/L
Diploma	Degree

4. Computer Literacy level:

Basic	Intermediate	Proficiency

5. Please specify the duration of your experience;

Less than 5 years	5- 10 years
10-15 years	More than 15 years

6. No. of employees working with you;

None	Only family members
1-5	5-10
10-15	More than 15

7. Do you own the land you farm?

Yes	No (Rent)	Both

8. Agricultural areas

Less than 1 acres	1 acres -5 acres
5-10 acres	More than 10 acres

9. Agriculture product working with;

Rice	Vegetable	Fruits
Tea	Rubber	Coconut
Animal husbandry	Other (specify)	

10. Please indicate your monthly income.

a. Less than 10,000
b. 10000-25000
c. 25000-50000
d. 50000-75000
e. More than 75000

Part B: Data related to the use of information and communication (ICT) tools in agricultural Sector

11. Do you have your own devices?

	Yes	No
Computers		
Laptop		
Landline telephone		
Mobile -analog		
Mobile –smart phone		
DVD/CD drive		
Radio		
Fax		
TV		

12. Which of the following ICT are convenient to use?

	strongly agree	agree	Neutral	disagree	strongly disagree
Cell phone					

Land line phone					
Computer					
Internet					
Email					
Fax					
Television					
Radio					
TV					

13. Do you use the following ICT at your farm?

	strongly agree	Agree	Neutral	Disagree	strongly disagree
Computers					
email					
Internet					
Telephone					
Mobile					
DVD/CD					
Radio					
Fax					
TV					

14. Do you use the following ICT for personal purposes other than farming?

	strongly agree	Agree	Neutral	disagree	strongly disagree
Computers					
email					
Internet					
Telephone					
Mobile					
DVD/CD					
Radio					
Fax					
TV					

15. How do you purchase ICT for your farm use?

Personal decision	Expert advice(Other than government)

Government (Govi niladari,Samurdhi niladari/Extension service recommendations	Response to advertisements on TV/ radio & other media
Other	

16. Which ICT tools would you like to use or learn in order to improve your Agricultural productivity? Please fill in the following table for each type of tool.

ICT Tool	strongly agree	agree	Neutral	disagree	strongly disagree
Computers					
Email					
Internet					
Telephone					
Mobile					
DVD/CD					
Radio					
TV					

17. In your family, who plays the main role in conveying new agricultural information to you?

	Very frequently	Frequently	Occasionally	Rarely	Very rarely
Yourself					
Your spouse					
Your children					
Father					
Mother					
Brother(s)					
Sister(s)					

18. Other than your family, who or what are your main agricultural information Providers? (Can make more than 1 choice)

	Very frequently	Frequently	Occasionally	Rarely	Very rarely

Neighbors					
Extension workers					
Private company					
Agriculture-Sales agents					
Government officers – Grama niladari, Samurdi niladari					

19. Do you believe the following sources give you accurate information? Please fill in the following table for each source of information.

	strongly believe	believe	neutral	disbelieve	strongly disbelieve
Neighbors					
Extension workers					
Private company					
Sales agents					
Government officers					
Other					

20. What type of information would you like to acquire in order to improve your Productivity? (Can make more than 1 choice)

	strongly like	Like	Neutral	Unlike	Strongly unlike
Pest management					
Use of fertilizer					
Soil improvement					
Market price					
Use of insecticide					
Weather forecast					
Financial management					
Organic farming					

21. What are the preferred channels to receive information?

	Internet – web site	email	Land line telephone	Mobile	DVD/CD	Radio	TV
Pest management							
Use of fertilizer							
Soil improvement							
Market price							
Use of insecticide							
Weather forecast							
Financial management							
Organic farming							

22. What are the preferred days to receive new agriculture information?

	Mostly like	like	Neutral	dislike	Strongly dislike
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

23. What time of the day would you like to get the new information?

	Mostly like	agree	Neutral	disagree	Strongly disagree
Morning					
Midday					
Afternoon					

Evening					
Night					

24. Where do you access the Internet?

	Very frequently	Frequently	Occasionally	Rarely	Very rarely
Nearby Internet cafe					
community tele center					
In Town					
At home -ADSL					
At home -Donegal					
Access from other's computers					
Through Mobile phone					

25. What do you use the Internet mainly for?

	Very frequently	Frequently	Occasionally	Rarely	Very rarely
Accessing agricultural information					
Communication purposes					
Online transactions (e-commerce)					
Personal Tasks					

26. How satisfied are you with connectivity?

Please indicate internet connection bandwidth/Speed you use.
Answer the relevance rows only.

	Highly satisfied with no congestion	Satisfied with rare congestion	Accepted level of speed	Not satisfied with frequent congestion	Highly not satisfied with more frequent congestion
Nearby Internet cafe					
community tele center					
In Town					

At home -ADSL					
At home –Dongal					
Access from other's computer					
Mobile phone					

27. Do you advertise your products?

Yes	No

27. (A) If yes, which media do you use?

	strongly agree	agree	Neutral	disagree	strongly disagree
Website					
Television					
Posters					
Newspapers advertisement					
Radio					

28. Indicate the ICT that you mainly use for the following tasks?

	Land line	Mobile phone	Email
Communication with customers			
Communication with input suppliers			
Communication with marketing agent			
Communication with your bank			
Communication with other farmers			
Communication with your family			

29. What are the major problems that you encounter when using ICT, in general?

	strongly agree	agree	Neutral	disagree	strongly disagree
Language and content limitations					

Poor network and reception					
Time consuming					
Power problems(Electricity)					
Lack of ICT awareness					
Lack of ICT training					
Expensive to use					

30. Tick the appropriate on believes.

	strongly agree	agree	Neutral	disagree	strongly disagree
1.The benefits of ICT are greater than the costs					
2.Adoption of ICT improves agricultural development					
3.ICT facilitates the easy flow of and access to information					
4.ICT could enhance the profitability of farm enterprises					
5.ICT can be used to form farming business partnerships					

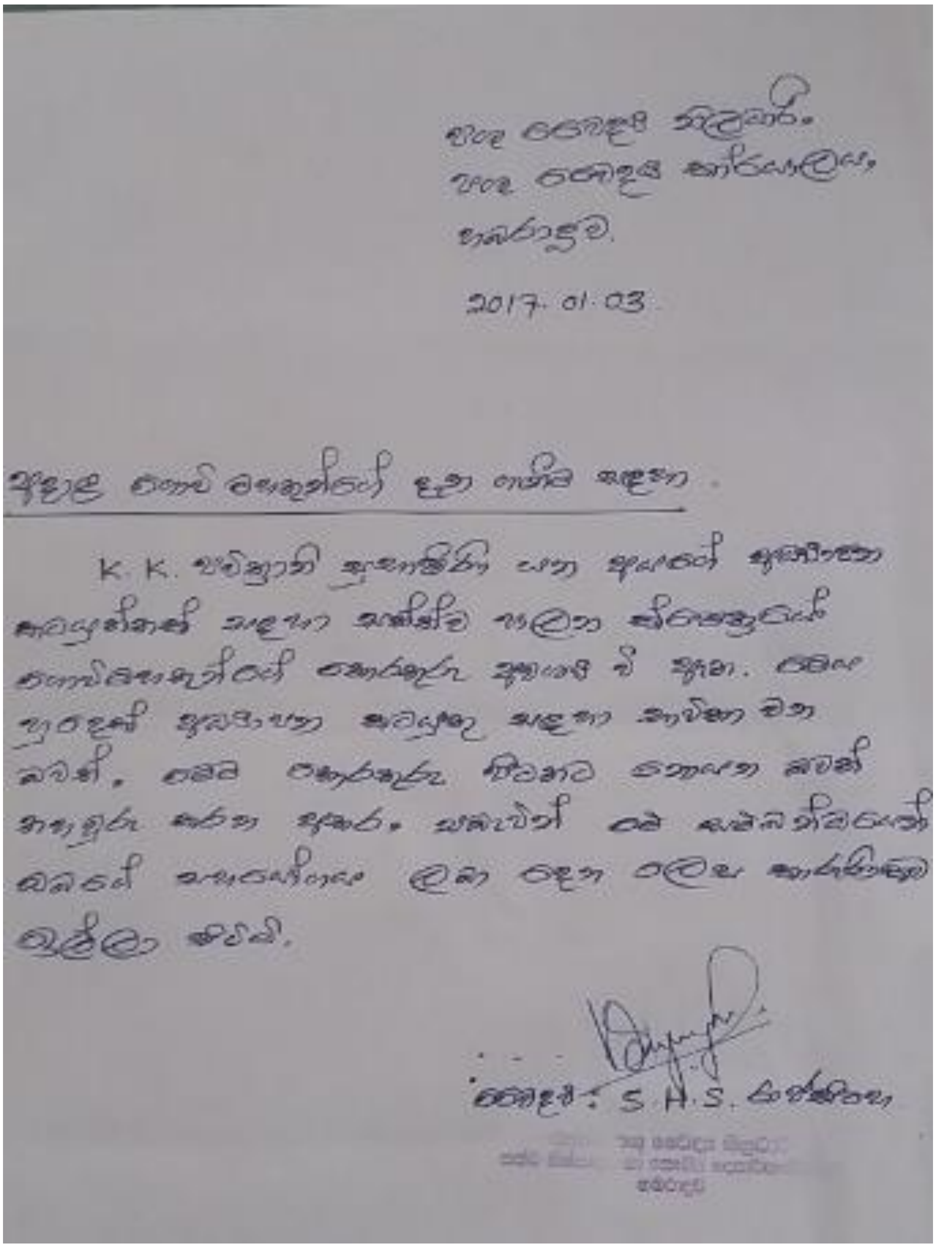
31. What are the ICT programs you are involved with.(ex: Nanasala,GNS etc)

32. What are the barriers affecting to use of ICT for agriculture activities?

33. What are the factors motivate you to work with ICT?

----Thank you-----

Appendix B: Request letter



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2017.01.03.

අදාළ ගොවි මහතුන්ගේ දත්ත ගැනීම සඳහා.

K.K. චමිනුනි කුමාරිහාමි යන අයගේ අධ්‍යයන කටයුත්තක් සඳහා සම්බන්ධ කලාප නිලධාරීන්ගේ ගොවි මහතුන්ගේ තොරතුරු අවශ්‍ය වී ඇත. මෙය උපාධි අධ්‍යයන කටයුතු සඳහා භාවිතා වන බවත්, එම තොරතුරු පිටතට නොයන බවත් සහතික කරන අතර. එබැවින් ඔබ සම්බන්ධීකරණයෙන් ඔබගේ සහයෝගය ලබා දෙන ලෙස කාරුණිකව ඉල්ලා සිටිමි.

ලේකම් : S.H.S. [illegible]