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Information Dissemination for Farming Communities in Thailand

A dissertation submitted in fulfilment of the requirements for the degree of

Doctor of Information Technology

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Date of submission: 18 August 2011

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

The use of information and communication technology tools has been applied in many disciplines, including agricultural sectors. It may be applied in many modules such as data gathering, data processing, information management and information dissemination.

One issue that cannot be neglected is the readiness of technology service users, or farmers in this case. It was found that most Thai farmers were poor and illiterate; therefore, offering them the best available tools and services may not be always what they would like to use.

To answer the research questions, action research methodology was selected in this study to find a practical way to deliver agricultural information to Thai farmers. Groups of participants from two villages in a northern Thai province were targeted; as a result, case study methodology was also used in this study.

Accordingly, a needs analysis using a survey technique, in conjunction with an analysis of the current situation and relevant documents, was conducted in order to find answers about the types of information truly required by Thai farmers. Additionally, questions about how Thai farmers currently received agricultural information, and factors affecting their information requirements, were to be answered.

Then, information dissemination through the short message service on mobile phones was found to be the most appropriate alternative for Thai farmers in this study. The free-of-charge experimental service was offered to participating farmers for a period of eight weeks. After that the user satisfaction survey and group interviews were conducted to determine the effectiveness of the system framework.

A number of findings and discussion points will be useful for policy makers, relevant government agencies and other researchers who attempt to conduct viable projects in the actual field. This study revealed that income, age and education were significant factors related to the success of the agricultural information dissemination project. Also, relationships between agricultural information extension workers and farmers affected the preferences for, and attitudes to, receiving information among Thai farmers.

Subsequently, a new framework was proposed and was obtained comments from agricultural extension workers in order to improve the framework for a wider scale. Finally, the main objective of this research, which was to find out how information and communication technologies can be used to enhance information dissemination to Thai farmers, was achieved. In summary, these outputs are likely to be useful and workable in practice, together with collaborations with third parties such as local councils, mobile phone service providers or academic sectors.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

i. incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;

ii. contain any material previously published or written by another person except where due reference is made in the text; or

iii. contain any defamatory material.

Sign

Date 23 January 2012

ACKNOWLEDGEMENT

Unconditional support from my family including my uncle, Mr. Naowarat Khananai, who facilitated all connections to the participants, was a great help to make this work accomplished.

This thesis cannot be completed without support from my supervisors, Dr.Leisa Armstrong and Dr.Judy Clayden. Thank you for helping me through all the difficult times.

Also, this work could not have been accomplished without the support from the Thai government that foresaw the importance of higher education at the international level including Phrae Provincial Organization which welcomed the researcher to conduct a study to improve resident‟s livelihoods.

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CHAPTER 1 INTRODUCTION

The global population increased from 3 billion to 6 billion within the 40 years between 1959 and 1999 (U.S. Census Bureau, 2009). Furthermore, it is forecasted that this number will reach 9 billion by 2043 (U.S. Census Bureau, 2009). This has resulted in a need to increase the production of food for human consumption. However, statistical data source has revealed that the percentage of farmers has gradually decreased from 50.4% of total world labour force in 1980 to 39.9% in 2010 (Economic and Social Development Department, Food and Agriculture Organization of the United Nations [FAO], 2011). In some countries, the number of agricultural workers has decreased due to unbearable poverty and the development of industrial sectors. China after the economic reform was an exemplar for rural-urban migration (Zhu & Luo, 2010). Although the number of agricultural workers is not as large as it used to be, advances in agriculture technology and farm machinery have compensated to some degree for the reduction in agriculture labours.

Enormous investments and efforts have been put into research, studies and projects in order not only to improve agricultural processes but also to enhance the livelihood of poor farmers in disadvantaged areas. Improvements in production methods in both developed and developing countries have been brought about through targeted programs (International Institute for Communication and Development [IICD], 2006). Basic infrastructure, language and literacy are outstanding examples of problems in needy areas of many developing countries. On the other hand, in developed countries these issues receive little attention.

Improvements in agricultural systems in both developed and developing countries have come about through tackling specific problems. For example, insufficient infrastructure and poor literacy levels are barriers to improve agriculture in some developing countries such as Ethiopia, India and Nigeria (Irivwieri, 2007; Kari, 2007; Opara, 2008; Sood, 2001); whereas the focus on marketing, plant varieties, choices and precision agriculture has greater relevance in developed countries.

Information and communication technologies (ICT) have proved to be a prominent key to improve both agricultural practices and farmers‟ livelihood. Information may function as a tool for acquiring knowledge, for making decisions and for communicating (Kalusopa, 2005). ICT embraces relevant technologies used for processing data and then communicating among participants.

Even though agricultural research has progressively improved production systems, useful findings from research have not always been delivered to the farmers who could benefit from these findings. Useful information and suggestions have been circulated among researchers and academics rather than disseminated to people who should be the target of these research results. Without new knowledge, farmers have been left with traditional agricultural approaches and oral recommendations from other farmers (Kalusopa, 2005). A combination of traditional practices, personal experience and trial-and-error approaches was the only one option left without access to information sources (Mittal & Tripathi, 2009). This means there will only be slow improvement in agricultural practices among increasingly needy farmers. Poor information dissemination may also result from insufficient agricultural extension workers, low levels of literacy, different languages and farm locations far from agricultural research centres.

These barriers may be alleviated by employing ICT tools to provide an information bridge 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 could reduce the need for travelling to remote areas, the costs of travelling and the time spent with those farmers. Agricultural extension workers may thereby assist more farmers in the same period of time.

This thesis will report on research which examined the dissemination of information for two groups of Thai farmers. A background to the study, a discussion of its significance and a review of literature will set the scene for the research questions and the justification of the

research methods employed. Subsequent chapters will describe the research processes undertaken and analyse the findings, before recommending further development.

1.1 Background of the Study

1.1.1 Thai farming

Countries such as Thailand and India, which rely heavily on agriculture based commodities, are usually described as developing. According to the United States Department of Agriculture - USDA (2009), Thailand has been the largest rice exporter in the world since 2004, with the highest amount of rice exported being 10011 million tons in 2007. In 2006, Thai rice exports made up about 25 percent of the world rice trade; since then the share has increased to 35 percent in 2008 (Department of Agriculture, 2009). Moreover, in 2006 the total value of Thai exports was about 4937372 million baht, of which 1071543 million baht were received for agricultural products. In other words, about one fifth of Thai export value was derived from the agricultural sector.

The population in Thailand was about 66.5 million in 2008 and increased to 66.9 million in 2009 (Office of the National Economic and Social Development Board [ONESDB], 2010a). Of this number, in 2008 approximately 24.572 million people were in the agricultural sector and this became 24.863 million farmers in 2009 (Agricultural Information Center, Office of Agricultural Economics [OAE], 2010). This number of people accounts for approximately 39 percent of the Thai population; in other words, nearly one third of the Thai population are farmers.

In general, Thai farm revenue is relatively low compared to national income per capita. On average, each Thai person earned 101,216 baht in 2008 and the annual income reduced to 97,351 baht in 2009 (ONESDB, 2010a). In contrast, Thai farmers‟ income in 2009 was 223,296 baht per household and after considering other expenditure only the amount of 42,710 baht remained per household (Agricultural Information Center, OAE, 2011) More seriously, a debt, on average 54,409 baht per household, still needed to be paid off (Agricultural Information Center, OAE, 2011). Thai farmers still encounter the problem of income shortage although their production has been at top of the world export ranking. In

general one quarter of the Thai people, those who are farmers, can be considered to be impoverished.

The amount of land used for rice production in Thailand was about 28.75 million acres in 2009 while the total rice production was about 32.11 million tons (Agricultural Information Center, OAE, 2011). An acre of land in Thailand could produce only approximately 1.097 tons of rice. In the United States of America (USA) one acre of rice can produce approximately 7,082 pounds or 3.2 tons (International Rice Research Institute [IRRI], 2009). It can be seen that a developed country like the USA can produce almost three times more rice than Thailand within the same area of land.

Furthermore, the total number of government officials in the Department of Agricultural Extension working in regional area throughout the country was 11465 in 2009 whereas the number of farmers all over Thailand was 24.863 million (Agricultural Information Center, OAE, 2010). As a result, one agricultural extension worker takes care of approximately 2168 farmers. Therefore, face-to-face knowledge transfer only will not be adequate for all farmers. The implementation of available and familiar ICT tools may be an alternative to improve Thai farmers‟ knowledge which will lead to higher yields and better quality of produces.

1.1.2 Thailand social structure at the village level

Since an announcement by the Ministry of Interior, Thailand in 1996, populous communities should have at least either 1200 people or 240 households in order to establish a village (Division of General Administration, 2009). In less densely populated areas, communities should include either 600 people or 120 households to form a village. The village, called Moo Baan in the Thai language, consists of a village chairman, village chairman assistants, village committee and village members (Division of General Administration, 2009). The village chairman assistants can be either administration assistants or security assistants. In addition, the village committee consists of the village

chairman, the administration assistants and another five to nine village members. Each position will typically be held for a period of five years. After that, an election will be held.

1.1.3 Use of ICT in Thailand

In 2008, only 3.9% of Thai farmers used a computer in their households and only 2.1% also surfed the Internet (National Statistics Office [NSO], 2009a). By 2009, the number of computer users and Internet surfers among Thai farmers had decreased to be 3.4% and 1.9%, respectively (NSO, 2010a). These numbers contrasted to industrial sectors which increased from 10.6% to 14.3% in the use of computers and from 4.8% to 7.8% in the use of the Internet. In comparison, in 2008 about 18.4% of the overall Thai workforce had a computer and 13.2% of them surfed the Internet (NSO, 2009a). By 2009, this number had changed to be 18.7% and 14.1%, respectively (NSO, 2010a). The growth of computer users and Internet surfers in Thailand in general is still taking place at a relatively slow rate.

In contrast to the number of computers, the number of households owning a television has increased from 94.0% in 2006 to be 96.1% in 2008. It may be assumed that almost all Thai households possess a television (NSO, 2010b).

In addition, the number of mobile phone users in Thailand has rapidly increased from 52.8% in 2008 to be 56.8% in 2009 (NSO, 2010b). In other words, more than a half of the Thai population has a mobile phone whereas the number of landline telephone users has gradually decreased from 23.5% in 2008 to be 22.4% in 2009 (NSO, 2010b).

1.2 Significance of the Study

While information supporting agricultural production and processes is available, the major proportion is published in English and not in the local languages of developing countries. Most developing countries do not use English as the formal or the first language. This problem hinders the learning process among needy farmers in rural areas. This issue is

exaggerated by illiteracy, poor infrastructure plus scarce information and communication technologies and tools. A number of poor farmers still use traditional methods inherited from their descendants. These methods are sub-optimal as far as production efficiency is concerned and can result in low crop yields. This results in farmers‟ profits being reduced and increased difficulty in covering farm production costs. This may in turn lead to other problems such as debt traps and land abandonment. Learning new techniques and more profitable agricultural production methods through using ICT tools may encourage farmers to adapt their practices and to improve their agricultural processes. Disseminating agricultural information effectively to farmers in formats that they find easy to use will be a suitable approach for this study. In order to do so, research activities including data collection, data analysis, framework development and actual field implementation are necessary. This study may inspire and encourage Thai farmers to acquire valuable information and eventually adapt their rural lifestyle. As a result, farmers‟ livelihoods may be enhanced and agriculture will become more sustainable.

1.3 The Purpose of the Study

This study aims to define a framework for the improvement of the dissemination of agricultural information among farmer groups in Thailand. Information and communication technologies will be utilised to deliver information in easily understandable formats to rural groups. Thai farmers and their families may thereby become aware of the usefulness of information and communication technologies for enhancing their access to the information that will assist them to improve productivity and enhance the sustainability of their farming.

1.4 Research Questions

The central research question of this study may be specified as the following:

How may modern information and communication technologies be used to enhance the delivery of timely agricultural information to selected groups of Thai farmers?

Additionally, the main question leads to five sub-questions:

1. What kinds of information are most necessary for these Thai farmers?
2. How is agricultural information delivered at present to these Thai farmers?
3. What factors need to be considered if information delivery to these Thai farmers is to be improved?
4. How effective were the implementations of information and communication technologies in the agricultural areas studied?
5. How may the outcomes of this study be implemented on a wider scale?

1.5 Definitions of terms

Action Research

"Action research entails studying your own situation to change the quality of processes and results within it." (Schmuck, 2006)

Agricultural Information System (AIS)

"An AIS is therefore defined as a system in which information is generated, transformed, transferred, consolidated, received, and fed back in such a way that these processes function synergically to underpin knowledge utilization by agricultural producers" (Ro ling 1990 cited in Castillo, 2000).

Agricultural Extension Worker (AEW)

"AEW serves as an administrative leader and coordinator for formulating, developing, implementing and evaluating agricultural extension programmes as well as develop farmers in managing resources in the rural areas. He guides the extension education activities for farmers as groups or individuals towards the purposeful pursuance of given objectives within a particular situation by means of extension communication methods" (Khalil, Ismail, Suandi, & Silong, 2008).

Delivery

"the carrying and turning over of letters, goods, etc., to a designated recipient or recipients." (Dictionary.com, LLC, 2009).

Developed country

Developed countries present an average income of $11906 or more in Gross National Product (GNI) per capita except Hong Kong (China), Israel, Kuwait, Singapore and the United Arab Emirates. Usually they are highly industrialised and most people in these countries have a high standard of living (World Bank Group, 2004; World Bank Group, 2009).

Developing country

Developing countries present an average income of lower than $11906 in GNI per capita including Hong Kong (China), Israel, Kuwait, Singapore and the United Arab Emirates. Developing countries contain 80 percent of the world‟s population (World Bank Group, 2004; World Bank Group, 2009).

Disseminate/Dissemination

"to spread or give out something, especially news, information, ideas, etc., to a lot of people" (Cambridge University Press, 2009).

Information and Communication Technology (ICT)

Electronic facilities used to create, store, manage and disseminate information (Gerster & Simmermann, 2003 cited in Curtain, 2003).

1.6 List of Abbreviations

Table 1

List of Abbreviations

Abbreviation	Full name
3G	the third generation
AEW	Agricultural Extension Worker
AIS	Agricultural information system
AGMARKNET	Agricultural Marketing Information Network
AgrIDS	Agricultural Information Dissemination System
ARSONET	Africa Regional Standards Organization Network
BAAC	Bank for Agriculture and Agricultural Co-operatives

Abbreviation	Full name
CD-ROM	Compact disc read-only memory
CSIRO	Commonwealth Scientific & Industrial Research Organization
DAE	Department of Agricultural Extension
DEFRA	Department for Environment, Food and Rural Affairs
DVD	Digital video discs
FKDSF	Farmer knowledge decision support framework
ICG	Information and Communication Group
ICT	Information and communication technology
IDRC	International Development Research Center
IFFCO	Indian Farmers Fertilizer Cooperative Limited
IKSL	IFFCO Kisan Sanchar Limited
IICD	International Institute of Communication and Development
IIT-Madras	Indian Institute of Technology Madras
IIR	Internet Information Research
IRRI	International Rice Research Institute
GIS	Geographic Information System
GNI	Gross National Product
GPS	Global positioning system
MSSRF	M.S. Swaminathan Research Foundation
MICT	Ministry of Information and Communication Technology
NSO	National Statistics Office
OAE	Office of Agricultural Economics
ONESDB	Office of the National Economic and Social Development Board
OPS & NECTEC	Office of the Permanent Secretary of Ministry of Information and Communication Technology & Strategy Research and Industry Indicator Division of National Electronics and Computer Technology Center
RFID	Radio-frequency identification

Abbreviation	Full name
RINAF	Regional Informatics Networks for Africa
RML	Reuter Market Light
Rs	Indian Rupee
SIM	Subscriber identity module
SMS	Short message service
SPSS	Statistical Package for Social Sciences
TV	Television
UN	United Nations
UPS	Uninterruptible power supply
USDA	United States Department of Agriculture
USA	the United States of America
VCD	Video compact disc
VHF	Very high frequency
VKC	Village Knowledge Centre
VoIP	Voice over Internet protocol
VSAT	Very small aperture satellite terminal
WLL or WiLL	Wireless-in-Local-Loop

CHAPTER 2 REVIEW OF THE LITERATURE

This section will provide a review of literature relevant to the research questions. Firstly, there will be an examination of research into the use of the ICT tools used in agriculture. This will be followed by a discussion of the types of agricultural information required by farmers. Then the agricultural situations of developing and developed countries will be contrasted. Next, drivers and barriers to the introduction of ICT tools for the purpose of agricultural development will be analysed. Finally, two outstanding case studies of the use of ICT in the agricultural sectors of developing countries will be discussed.

2.1 ICT tools used in agriculture

This section will provide a review of research studies related to ICT tools used in agricultural industries. This section will examine telephony, networking and the Internet, television (TV) and radio, Video Compact Disc/Digital Video Disc (VCD/DVD) and other ICT tools.

2.1.1 Telephones and mobile phones

The telephone system is not only a fundamental communication infrastructure but also a basic facility which supports the use of other technologies. For example, in some African areas, the telephone was the only ICT tool used by most farmers (Bertolini, 2004 cited in Munyua, Adera & Jensen, 2008). Its advantages included adaptability and the capability of transferring both voice and data at gradually decreasing cost (Mangstl, 2008).

Additionally, mobile communication technologies have become gradually more important in many parts of the world, especially in improving the delivery of information about agriculture (Munyua, Adera & Jensen, 2008). These communication devices present several advantages such as portability, wide range of coverage and instantaneous two-way communications. For instance, mobile phones were used to communicate among Ghanaian

fishermen with the purpose of providing each other with information about where to fish, weather conditions and market prices. Real-time agricultural information and fish prices were also provided through mobile phones in Senegal (Munyua, Adera & Jensen, 2008). The advice communicated about best place to sell their catch was also utilized by Kerala fishermen in India (Abraham, 2007 cited in Mittal & Tripathi, 2009; Jensen, 2007 cited in Mittal & Tripathi, 2009).

Furthermore, the availability of state-of-art technologies, which are now integrated into mobile phones, has further improved communication. Built-in global positioning systems (GPS), high-resolution digital cameras and short-length video recorders are exemplary embedded technologies. These advances facilitate the use of mobile phones for sending and receiving voice, text, image and video information (Munyua, Adera & Jensen, 2008). In addition, most respondents in Hassan et al.‟s (2008) study claimed that telephone and mobile phones have become ubiquitous. Other studies have found that mobile telephony is regarded as the most successful ICT tool used in attempts to develop the global agricultural sector (Mangstl, 2008).

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 (Hafkin & Odame, 2002 cited in Munyua, Adera & Jensen, 2008). Moreover, market information in voice mail formats is delivered to Kenyan farmers (Munyua, Adera & Jensen, 2008).

Other 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.

2.2.2 Networking and/or the Internet

For geographically remote locations, connectivity through computer networks may be an appropriate way to provide information to farmers. For example, each village centre could communicate with the outside world, nearby villages, other countries or other continents, via several types of communication tools, such as dial-up telephone connections, wireless networks or a satellite communication system called very small aperture terminal (VSAT).

The Internet‟s popularity, its efficiency in communication and the reducing price of hardware have resulted in the implementation of Internet connectivity in several projects such as the iKisan.com project (Tiwari, 2008), the TARAhaat project (Tiwari, 2008) and the e-Choupal project (Rao, 2007) in India. These projects have applied a variety of connectivity based technologies to the needs of each project. Telephone dial-up connections may be a simple answer for limited budget projects with low amounts of data transferred within telephone line-covered areas. Examples are the i-Village and the Gydanroot projects (Tiwari, 2008).

Other studies have reported how the Internet has assisted farmers. The i-Community by Hewlett-Packard project chose VSAT to solve the „last mile‟ connection problem (Tiwari, 2008). This solution accords with the e-Choupal and the i-Village project (Tiwari, 2008). Additionally, the VSAT was also an alternative mode of connection used by the Zee Interactive Learning System for its communication satellites (Sood, 2001). Wireless networks are another alternative for limited and unstable telephone lines in rural areas. For instance, a wireless system has been used occasionally to transfer off-line contents in a project in Pondicherry (Sood, 2001). Furthermore, Wireless-in-Local-Loop (WLL), which is able to transfer both data and voice simultaneously across long distances, was an option implemented by the Indian Institute of Technology Madras (IIT-Madras) (Sood, 2001).

These channels have been applied to disseminate agricultural information in local languages which were more attractive to Internet users (Sheriff, 2009). Furthermore, alternatives of preferred languages have been made available for users (Rao, 2004). Web

portals, agricultural databases and Internet kiosks presented in local languages have been developed and then introduced to needy farmers in order to encourage them to develop more knowledge (Rao, 2004; Tiwari, 2008).

Both private and public networks have been established for use by the agricultural industry. For example, private networks have been set up in African countries. The Regional Informatics Network for Africa (RINAF), for instance, has been shared among Kenya, Malawi, Tanzania, Uganda, Zimbabwe and Zambia (Kiplang, 1999). The Africa Regional Standards Organization Network (ARSONET) project which connects Ethiopia, Egypt, Kenya and Senegal is another good example (Kiplang, 1999). Additionally, private networks for communicating between business and farmers or among villages are another option.

2.2.3 TV/radio

The lack of accessibility to other communication technologies and funding has led to a combination of broadcasting and narrowcasting media which has been used to deliver agricultural information in a number of research projects. These media also work well for people who are not highly literate because they are attractive, easy to understand, especially with visual and animated materials; in addition to needing only modest reading fluency skills. Studies reported that television was the most popular tool in terms of ICT usage (Hassan et al., 2008).

Community radio for broadcasting information has also been widely used in several programs, both on its own and along with other methods (Kweku, 2006 cited in Munyua, Adera & Jensen, 2008; Parikh, 2009). With the popularity of radio broadcast, it is also reported that the radio is not only one of the top four widely used ICT tools but its importance also has increased in improving rural agriculture. (Hassan et al., 2008; Munyua, Adera & Jensen, 2008).

Radio has been used to broadcast much useful agricultural content. For example, discussions related to agricultural problems and solutions have been broadcasted in Zambia. This was found to be useful for the target audiences: the disadvantaged farmers (Bobblili, 2006 cited in Munyua, Adera & Jensen, 2008).

Radio has been used to broadcast in multiple languages in many areas; for example, in Nigeria English and several local languages, such as Hausa, Igbo and Yoruba, were used in broadcasting 14 radio programs along with three television programs (Ekoja, 2004). Using radio to report produce prices in local languages is another example of successful radio use in Bolivia (IICD, 2006).

2.2.4 VCD/DVD

Agricultural knowledge also can be transferred through learning modules in offline Compact Disc Read-Only Memory (CD-ROM) format which was not only used in Sujhi et al."s project (2009) but also has proved viable in several other studies (Pye et al., 2003 cited in 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). Furthermore, mobile cinema in local language or narrated by local extension workers were also used to provide information to farmers in rural areas (Irivwieri, 2007).

2.2.5 Other technologies used for agricultural developments

Besides the technologies mentioned above, other types of ICT tools also have been applied in agricultural studies. These technologies also have been used in order to improve information provision for agricultural sectors. For example, radio-frequency identification (RFID) was employed to capture data about livestock and to transmit the data to a corresponding database for keeping records for farmers themselves, veterinarians and health authorities (Munyua, Adera & Jensen, 2008). A geographical information system, another example, was applied to gather relevant information about 70 villages nearby in the Warana Wired village project (Tiwari, 2008).

Furthermore, multi-media software containing livestock-related knowledge encouraging farmers to improve their livestock understanding was implemented on a touch screen platform and employed in an Indian rural area (Lin & Heffernan, 2010).

Expert systems and artificial intelligence have also been used to assist agricultural production and farmers. For example, a maize expert system was created by using a number of relevant data such as variety selection, land preparation, irrigation and fertilization to provide suitable suggestions to users (Sivakami & Karthikeyan, 2009).

2.2 Types of agricultural information delivered

In order to maximize the agricultural productivity of their land, farmers need to be aware of the best practices and advancements in agronomy and plant breeding. This information provides the farmers with information on general practices such as seeding, use of fertilizers, pest management, harvesting and marketing.

Studies have reported on the types of agricultural information that has been delivered to farmers. The relevant information during the before-planting period may be crop management or scheduling of crop activities (Krishna Reddy, & Ankaiah, 2005; Tiwari,

2008), improved seedlings (Irivwieri, 2007), input price and availability (Rao, 2004; Tiwari, 2008) and soil fertility (Ekoja, 2004).

During the growing season, other types of useful information may play crucial roles in improving the amount and the quality of products. This may include weather information (Rao, 2004; Tiwari, 2008), fertilizer supply (Ekoja, 2004), fertilizer use in terms of amount and timing (Krishna Reddy, & Ankaiah, 2005), pest surveillance and management (Ekoja, 2004; Ratnam, Krishna Reddy & Reddy, 2005; Rao, 2004; Tiwari, 2008), type and dosage of pesticides (Krishna Reddy, & Ankaiah, 2005), weed control (Ekoja, 2004), and disease management (Ratnam, Krishna Reddy & Reddy, 2005; Tiwari, 2008).

Following the harvest, information about market opportunities (IICD, 2006), financial planning and market prices may be required (IICD, 2006; Irivwieri, 2007; Tiwari, 2008). Continuous support for relevant information from various sources, such as authorities or related government department web sites, may improve agricultural effectiveness and the efficiency of use of ICT tools.

2.3 The sources of agricultural data and information

Information may be provided to farmers from a variety of sources and information providers. For instance, weather conditions and forecasts can be retrieved from local meteorological organizations (Jensen & Thysen, 2003) or the national meteorological department (Narula & Arora, 2010).

Other information may be obtained from information providers such as the agricultural expert advice services of national or regional agricultural research institutes (Jensen & Thysen, 2003), the information departments of state or federal ministries or departments of Agriculture (IICD, 2006), research organizations such as the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia, the United Nations (UN) agencies, universities and agriculture consultants. Agricultural Marketing Information Network

(AGMARKNET), for example, a web portal, offers daily reports of the price of of 300 products consisting of 2000 varieties (Malhan & Rao, 2007a). Furthermore, the same portal has also been used by a private company, the Indian Farmers Fertilizer Cooperative Limited (IFFCO), to deliver required information straight to the company‟s kiosks in rural areas (Malhan & Rao, 2007a).

However, collecting information about price and farming availability, conducted through portable computers at the farm level or at actual local markets, then distributed nation wide via the Internet or web portals, is another source of farming information (IICD, 2006). In a Jamaican project, this agricultural information was further customised to suit each target group (IICD, 2006).

Agriculture-related information has been produced and published by a number of government agencies and academic sectors as well as relevant private companies. The agricultural information has been available in either primary or secondary form according to the purpose of use. Product market price, for example, may be more accurate if it is directly gathered from local markets. On the other hand, a proper use of new agricultural technology, for example, dissemination of real-time data or information through wireless sensor network, may be more reliable if it is proved and delivered from government bodies or research centres.

2.4 Use of ICT in agriculture in developing countries

Most developing countries‟ economies are based on an agricultural or food industry. For example, growing rice for consumption is the main agricultural activity among impoverished families in Thailand (Office of Agricultural Economics [OAE], 2009). However, small farm activities cannot cover all expenditure; an OAE‟s (2009) study found that about 80% of Thai farmers were still in debt. Poor farmers thus need income from other sources, such as out-of-farm jobs.

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. Karnka‟s (2006) study, which provided computer sets connected to the Internet for a specific farmer group, revealed that most participants had positive attitudes toward the use of ICT for supporting their learning activities. These respondents also regarded the Internet as not only a useful information source but also as a more credible information provider (OAE, 2009). Furthermore, the success of innovations in learning also depends on the communication channels used (Elsey & Sirichoti, 2003). Karnka‟s (2006) study found that after becoming familiar with using the Internet, the respondents positively changed their mind toward the complications of using ICT tools.

However, at first, attitudes toward the use of ICT tools and the Internet among farmers were expressed as novel, extravagant and too modern for them (Karnka, 2006). These attitudes can be seen as a challenge to overcome in order to encourage needy farmers to adopt innovations. Moreover, foreign languages, and too generalized information in conjunction with low-speed and unstable Internet connection were seen as barriers to access to required information by impoverished farmers in a developing country (Karnka, 2006).

2.5 Use of ICT in agriculture in developed countries

Although a number of studies in developing countries showed that TV was a main source of agricultural information among poor and illiterate farmers, TV did not show this kind of significant role in some developed countries such as New Zealand and the USA (Field et. al, 2007; Locke, 2005). The use of the Internet for agricultural purposes, such as record keeping, online selling or purchasing and searching for information, was about 31.8% of the farmers in Locke‟s (2005) study. This finding was in accordance with Pickernell et. al‟s (2004) study that 71% of respondents used information technology for business purposes. In details, 33% of the respondents had their own web sites and customers were able to perform their purchases online on 18% of the respondents‟ web sites (Pickernell et. al, 2004). The ICT networks also facilitated the knowledge transfer, in forms of either

technical information or advice, between farmers and experts in a training programme held in the Northwest of England (Lowe, 2011).

In contrast, American farmers were more likely to use traditional media, such as print media and interpersonal sources, compared to electronic information sources (Diekmann & Batte, 2009). In detail, it was also found that print media were more preferable to Ohio farmers than interpersonal sources and broadcast media (Diekmann & Batte, 2009). Additionally, it was supported in an American study that even a number of agricultural information available in various forms, other farmers were considered as one of the most important information sources (Velandia et al, 2011).

Despite reports that the number of computer and Internet users in developed countries was much greater than those in developing countries (Warren, 2004), some barriers to technology adoption among farmers in developed countries still occur. Reason behind those obstacles is the lack of appropriate hardware: for example, a number of farmers in the USA and the United Kingdom did not have a computer; or had a low-performance computer (Warren, 2004). In addition, only a half of the English farmers who owned a computer used their computer for business purposes (Department for Environment, Food and Rural Affairs [DEFRA], 2002 cited in Warren, 2004). In England, farmers surfed the Internet for both business and non-business purposes including checking the weather reports, checking input and productivity prices, searching for farming information, sending emails to friends and family and general browsing (Warren, 2004).

Moreover, lack of awareness of ICT capabilities is another issue in agricultural development in developed countries (Warren, 2004). Even in developing countries such as New Zealand, a difficulty on ICT infrastructure could be found in rural areas which partly caused a delay in adapting ICT for agricultural purposes (Shiblaq & Fielden, 2008). It was also reported that the level of education as well as household income related to the tendency of adopting new technology (Archer, 2004 cited in Shiblaq & Fielden, 2008; Warren, 2004).

Nevertheless, it is found that family members play a significant role in ICT adoption by passing relevant information to other members who were not confident about ICT tool usage (Warren, 2004). Additionally, family members tended to realise ICT potentials and had positive attitudes toward using ICT tools for their business, especially if a child or a spouse had skills in using a computer and the Internet (Warren, 2004).

Furthermore, it was found that the importance of information sources in farmers‟ point of view may be affected by their age, land tenure and income (Velandia et al, 2011). Additionally, extension officers were more influential to decision making than other farmers in high income or old farmers‟ point of view (Velandia et al, 2011).

In terms of information types needed, crop farmers in Ohio State required information related to soil tillage, water management and soil fertility management including pesticide application and safety (Diekmann & Batte, 2009).

Computer wireless connections and the third generation (3G) mobile telephone networks were expected to be crucial means in improving agricultural sectors in developed countries by combining a mobile phone with a handheld computer to transfer a variety of information types at a higher rate (Warren, 2004). Additionally, e-Commerce was anticipated to be a key distribution channel for agricultural businesses (Pickernell et. al, 2004).

2.6 Drivers for the use of ICT in agriculture

To encourage a group of people to try something new requires effective drivers and benefits to convince them. Turkish farmers in Sindir‟s (2005) study were a good example of a group resisting the adoption of new technologies until the consequent advantages were realised. Relative advantages from the changing behaviours were considered as the most important factor among trained farmers in Elsey and Sirichoti‟s (2003) study. These advantages may be better yields and incomes from adopting new technologies or practices including cultivating other types of in-demand crops or even other types of farming (Kalusopa, 2005;

Sheriff, 2009). For example, some community members in Sheriff"s (2009) project, who gained new knowledge about rabbit farming and dairy farming by watching provided CD-ROMs, earned higher revenues than previously.

Reliability of information sources is also an important issue for adopting new knowledge. Poor credibility or unfamiliar information channels are likely to cause illiterate farmers to be reluctant to take any risks or to experiment with new methods and practices. Moreover, it is confirmed in Elsey and Sirichoti"s (2003) study that the source of information was ranked second for adopting new knowledge into practices.

Furthermore, appropriate agricultural information may directly reduce costs of agricultural inputs, improve quality of the fresh produce and increase chances to get higher selling prices (Kalusopa, 2005).

ICT also plays a role as an assistant for information flows from senders, who usually are researchers, academia, government officers in the Department of Agriculture and agricultural extension workers, to receivers who mainly are farmers and agricultural workers. In some situations, as shown in an IICD"s (2006) project, knowledge senders and receivers can be farmers transferring experiences from one group to other groups.

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, Krishna Reddy & Reddy, 2005).

Most farmers in developing countries are not able to earn adequate incomes to cover all expenses for living and carrying out agricultural processes. Therefore, all revenue is saved for necessary expenditure such as food and agricultural supplies. In many studies, even fundamental communication tools such as radios, televisions and telephones were viewed as extravagant assets and had to be shared among community members (Irivwieri, 2007; Opara, 2008). Moreover, in some areas, other more expensive ICT tools like computers and mobile phones could not be taken into account unless provided by the project supporters (Sheriff, 2009; Sindir, 2005). This issue exacerbates the lack of useful information dissemination through ICT tools.

Illiterate unskilled workers are also a vital problem for information delivery via ICT tools in many developing countries (Curtain, 2003). It is also claimed that poor people in developing countries did not necessarily have fluency in their own language (Mangstl, 2008). In some areas, all members of the community disclosed that they have not used computers before (Sheriff, 2009). Additionally, use of many state-of-art devices may require some level of capability or experience (Sindir, 2005). This may hinder knowledge transfer processes, particularly scientific concepts. In the worst case, farmers may be forced to move into other types of agriculture in which they have not been involved previously (Irivwieri, 2007).

This problem is aggravated when it comes to valuable information resources at the global level in which English is typically used (Rao, 2004; Mangstl, 2008). Unavailability of agricultural information in local languages may hinder the improvement of agricultural information dissemination (Curtain, 2003). Even in some countries where different local languages have been used, communicating and transferring information is not always easily done. In Nigeria, different twenty five local languages had been used in different thirty seven states (Oladele, 2006). This causes inconvenience when it is necessary to produce materials in many different languages in order to provide the same contents. While there is a large amount of information freely available on the Internet, financial and hardware supports only; cannot help people in many countries to understand those contents what are provided in a foreign language.

Fundamental infrastructures and ICT devices may be insufficient or poorly-functioning in rural areas in many developing countries, for several reasons such as inadequate support from government and private sectors, unstable or restricted power supply, unavailability of landline phones, delayed restoration of communication networks after failure and insufficient network connectivity (Sood, 2001; Tiwari, 2008). In an on-going project, unreliable connectivity and hardware malfunctions also amplified the levels of displeasure among users (IICD, 2006). These issues limit the optimal use of ICT tools for disseminating information to needy people. Additionally, inconsistent national policies were also claimed to be an obstacle for progress of agricultural development (Kizilaslan, 2007; Sindir, 2005).

Besides infrastructure, information and other supports from government or government officers, have not fulfilled the requirements of needy farmers. Insufficient information support and weak links between information users such as farmers, researchers and extension workers were reported to be major factors for low agriculture yields (Ministry of Agriculture, Republic of Kenya, 1997 cited in Kiplang‟at & Ocholla, 2005). The relationships between extension workers and farmers in some areas needed to be strengthened because some farmers had the perception that the extension workers do not provide the necessary agricultural information; or use technical and scientific terms which could not be easily understood (Kalusopa, 2005; Irivwieri, 2007).

Ill-timed recommendations from experts or agricultural support systems are one of the difficulties reported in several studies. Useful information which arrives belatedly may be considered as useless. This situation may cause unfavourable yields from agricultural activities or result in sub-optimal incomes (Krishna Reddy & Ankaiah, 2005). Moreover, complaints in regard to behind-schedule market prices were raised among project participants (Rao, 2007).

Farmers unaware of the advantages and benefits from utilising ICT tools presented another difficulty to be overcome (Rao, 2004). This issue may cause a large amount of investment and effort to become worthless. There was no point in broadcasting agriculture programmes

if no farmers were listening or paying attention (Irivwieri, 2007). Research also highlighted that many participant farmers neglected expert suggestions during agricultural procedures (Ratnam, Krishna Reddy & Reddy, 2005). The case of Turkish farmers who were not satisfied with keeping data records, which are important for ICT processes and development, may emphasize this concern (Sindir, 2005). If the farmers do not realise the benefits of ICT utilisations, it will be more difficult to run any agricultural projects targeting them.

In addition, different cultures and beliefs in different areas may encumber knowledge transfer and agricultural improvement. For instance, in some areas females are literally not allowed to join the community or attend the meeting at provided access points (IICD, 2006; Sheriff, 2009). A report from IICD stressed that majority of participants in agricultural development projects are male (IICD, 2006).

2.8 Impacts

Attempts to apply technological tools and techniques along with agricultural knowledge result in a number of benefits. At first, the ICT tools improve the accessibility of valuable information in a broad range which may lead to improving agricultural productivity and quality (Rao, 2004). The tools along with appropriate training, also emphasise the approachability of government resources and services which will eventually lead to continuing growth of the e-government concept (Rao, 2004). Furthermore, the technological training not only affects the improvement of agricultural practices among farmers but also enhances their skills in using ICT tools for other purposes such as long distance education, life-long learning and online services (Rao, 2004). Eventually, when the farmers are familiar with the use of ICT technologies, the opportunities for livelihood development will be gradually increased with minor supports from outside. Further, with the confidence, it will be easier to adopt recent and advanced ICT tools.

2.9 Case Studies

Although a number of agricultural improvement projects have been conducted throughout the world, three pivotal examples are the e-Sagu, the e-Choupal and the village knowledge centres in Pondicherry projects in India. This section provides an analysis of the successes and potential of these examples to be adapted in a wider scale.

2.9.1 e-Sagu

This project was established with the purpose of reducing the digital divide between farmers and agricultural experts. This was achieved by obtaining field information via coordinators to experts in order to provide personalized and timely advices to the farmers (Krishna Reddy, Ramaraju & Reddy, 2007). The e-Sagu system consisted of five components: farmers, coordinators, agricultural experts, agricultural information systems and communication systems (Ratnam, Krishna Reddy & Reddy, 2005). Firstly, the farmers registered into the system by providing requested farm information to the coordinator. Then, at weekly intervals, the coordinators would visit each corresponding farm to gather crop situations and feedback about the previous advice, in order to send to the agricultural information system (AIS) through the communication system using text and digital photographs. Usually, one coordinator was responsible for several farmers or some educated farmers might act as coordinators as well. After receiving farm data and crop situational data, agricultural experts prepared specific advice for each farm. Then, all the advices were stored in the AIS, ready to be retrieved by the coordinators for their corresponding farmers.

This project offered several benefits to both farmers and agricultural experts. At the first point, it conserved of time, money and energy because the agricultural experts were able to serve a greater number of farmers in less time whilst staying at the agricultural centre (Ratnam, Krishna Reddy & Reddy, 2005). Next, the agricultural information system, which kept the records of the advices and other relevant information, supported the agricultural experts to determine current circumstances and then created better suggestions (Krishna Reddy, Ramaraju & Reddy, 2007). Finally, feedback from farmers also played a significant

role in improving the system performance by supporting the farming history, recommendation provided and corresponding outcomes.

However, the project found some problems related to actual practices. For instance, the farmers did not strictly follow the expert advice either neglecting it or doing unnecessary activities (Ratnam, Krishna Reddy & Reddy, 2005). These situations resulted in below-optimum productivity and extra costs. The reasons for these problems included lack of financial support, lack of confidence in the information technology system, illiteracy and attitudes of the farmers themselves.

2.9.2 e-Choupal

This project was launched by a private company in order to establish a direct connection to farmers by bypassing local government middle-markets (Das & Dutta, 2004). A set of kiosk facility containing a personal computer, Internet connection, uninterruptible power supply (UPS) including solar-powered battery backup and a printer was provided by the company but then operated and maintained by local villagers (Narula & Arora, 2010; Singh, 2006). In each kiosk, farmers were able to log on and retrieve provided information they were interested (Narula & Arora, 2010).

With the corporations between the company and meteorological department, agricultural universities and input suppliers (Narula & Arora, 2010), the company was also able to offer input supplies in reasonable prices, provided free agricultural expert advice including relevant information such as weather forecasts, market price and farming practices through the company ICT networks along with the technology training to make contact with the company (Das & Dutta, 2004; Narula & Arora, 2010). After harvesting, farmers had choices where to sell their produces either at local markets or at collection shops managed by the company (Narula & Arora, 2010).

The e-Choupal project was reported to create a “win-win” situation because the company was able to control farming processes including quality of input supplies and produce while

the farmers got agricultural supports and suggestions free-of-charge (Upton & Fuller, 2004). Consequently, farmers gained more knowledge regarding agricultural practices and price mechanism (Singh, 2006).

Moreover, due to the processes bypassing local intermediaries, the company was able to directly purchase produce from farmers at a lower price, while the farmers got higher selling prices (Singh, 2006; Upton & Fuller, 2004).

On the other hand, a last-mile connectivity problem caused high initial costs for VSAT connectivity. Additionally, other hindrances such as unreliable power supply, insufficient infrastructure and a lack of Internet and computer skills among rural villagers were encountered in this project (Narula & Arora, 2010; Singh, 2006). Furthermore, the company had to deal with State legislation related to local middle markets (Upton & Fuller, 2004).

2.9.3 Village knowledge centre (VKC) in Pondicherry, India

This project was established with supports from the International Development Research Center (IDRC) in Canada and the M.S. Swaminathan Research Foundation (MSSRF) in India (Balaji, Kumaran & Rajasekarapandy, 2002). One of the project‟s main objectives was to form up a framework to disseminate and exchange information in rural areas through ICT tools (Balaji, Kumaran & Rajasekarapandy, 2002). Each centre where contained facilities such as personal computers, printers, scanners, modems, Very High Frequency (VHF) radio devices, and telephone lines, was connected to other centres either wired or wireless connection (Arunachalam, 2002; Rao, 2004). Additionally, these village knowledge centres were able to connect to the Internet through a main hub (Chaudhary, 2004).

However, these supports needs some conditions to operate the ICT centres in villages; namely, villages had to provide a proper location which allowed every community

members to use without discrimination and villages had to accept the burden on electricity and telephone connection bills (Subramanian & Arivanandan, 2009).

At the early stage of the project, local voluntary teams gathered information requirements in their villages (Arunachalam, 2002). Locale-specific information included input price and availability, pest surveillance, cattle disease, agronomic practices, produce market price, weather and health care (Arunachalam, 2002; Rao, 2004). Websites containing requested information were designed and developed to provide the knowledge service to villagers along with trainings to use these knowledge repositories (Balaji, Kumaran & Rajasekarapandy, 2002).

According to the VKC project, villagers were empowered by knowledge enhanced from using ICT tools to obtain new information in conjunction with confidence earned from operating modern technologies (Balaji, Kumaran & Rajasekarapandy, 2002; Rao, 2004). The success of this project may be contributed to an attempt to obtain villagers‟ participation to demand and create local contents including the use of native language for better understanding among farmers and the use of multimedia formats to facilitate illiterate groups (Arunachalam, 2002; Chaudhary, 2004).

On the other hand, a drawback revealed from an interview was a caste difference in Indian society which hindered some villagers to join the VKC operating by lower-caste villagers (Subramanian & Arivanandan, 2009).

These three projects successfully employed ICT tools and computer networks to directly disseminate agricultural knowledge to farmers even though they were based on different purposes and approaches. As a result, farmers have gained both agricultural and technological knowledge to improve their agricultural practices, produce and quality.

2.10 Literature Summary

An examination of the literature has located examples of successful projects which have taken local and national factors into account. Local factors affecting the success of the use of ICT tools for information dissemination purposes might differ in each rural area. Farmers‟ literacy levels, income, ICT knowledge or skills, awareness toward ICT advantages, educational background, social caste, role of gender, community cultures, particular information requirements, relationships between information users and provides, and local languages are exemplars of local factors which must be considered. National scale factors included availability of networks, infrastructure, financial support and roles of markets and middlepersons.

It can be seen from the literature that localised content, the use of native languages and participation by villagers supported the success of ICT projects. In contrast, many issues became barriers in the ICT implementation for disseminating agricultural information. These hindrances included poverty, illiteracy, insufficient support from government bodies, untimely or irrelevant information, inadequate infrastructure, unreliable networks, lack of awareness toward ICT advantages and community cultures.

Each of the successful projects has relied on an analysis of existing conditions. The next chapter will discuss the methodology needed to carry out this study, specifically an action research approach.

CHAPTER 3 METHODOLOGY

This chapter will explain the research methodologies and research techniques employed in this study. Then, the four stages of research activities (situational analysis, further analysis, framework development and framework improvement) will be described and the techniques appropriate to each stage identified.

This study mainly employed the concept of action research in terms of practical and continuous development. The participants of this study included two specific villages; therefore, case study methodology was also applied. Some techniques were employed throughout multiple stages of this research study, including questionnaires or surveys, attitude measurement, interviews and documentary analysis.

3.1 Action Research

This project used an action research methodology in order to achieve the purpose of the study, which was to improve the agricultural learning process in the long term. Action research is practical; it starts with a thorough investigation of current circumstances, followed by an intervention planned to improve processes and outcomes, a subsequent evaluation or reflection, followed ultimately by the decision whether another iteration of the cycle is necessary (Koshy, 2005; Schmuck, 2006).

Action research is therefore not a one-stop procedure. Additionally, existing practices may be continuously improved through action research processes (Schmuck, 2006). In order to improve practices in real circumstances, all bodies including researchers and participants need to be involved and participate in the research (Schmuck, 2006). As a result, the practices will be empowered by collaboration between researchers and participants (Schmuck, 2006). A model of the action research process is included in this chapter as shown in Figure 1 on page 32.

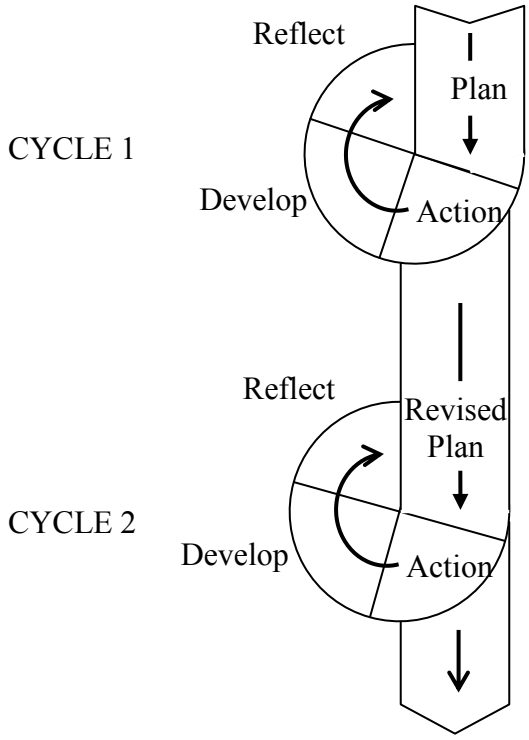

Figure 1. An action research model (adapted from O'Brien, 2001 and Mertler, 2009).

Each action research cycle can be divided into four stages which are the planning stage, the acting stage, the developing stage and the reflecting stage (Mertler, 2009). The planning stage includes a process of identifying and limiting the topic, gathering information, reviewing related literature and developing a research plan (Mertler, 2009). The process to identify and limit the research topic is the first step to make a decision what area should be investigated then narrow down to specify the topic (Mertler, 2009). After that, gathering relevant information is the next step to obtain a better understanding and to clarify the research problem (Mill, 2007 cited in Mertler, 2009). The literature review is also important in research planning. Related information from various sources such as professional books, research journals, complete web sites and district documents are good materials to begin with (Creswell, 2005 cited in Mertler, 2009; Johnson, 2008 cited in Mertler, 2009). To

obtain information for making decisions about the research focus and plan is the main objective of the literature review (Mertler, 2009). Furthermore, reviewing a range of literature helps researchers obtain guidance for narrowing down the research problem in conjunction with designing the appropriate research plan and deciding on data collection instruments and techniques (Parson & Brown, 2002 cited in Mertler, 2009).

The action stage involves implementing a plan, collecting and analysing data (Mertler, 2009). At this stage, data variables, data collection techniques or instruments and procedures to obtain these data are determined, then data analysis approaches will be applied to derive findings (Mertler, 2009).

All information and data gained from earlier stages will be employed to plan the implementation or actual practices. At the same time these practices are implemented, they may be monitored, assessed and revised according to the cyclic nature of action research (Mertler, 2009). The main objective of the action research is to establish a particular workable approach to solve an existing problem and to improve a current situation (Mertler, 2009).

Next comes a reflecting stage, which covers sharing research results and reflecting on the procedure as the last part of the action research cycle (Mertler, 2009). After each action research cycle, the results and findings from the study should be shared, presented or communicated with other researchers or relevant communities in either formal or informal presentations (Mertler, 2009). Furthermore, this stage enables researchers to review the practices utilised in their studies, evaluate the practices‟ effectiveness and revise the practices planned for the next cycle of the action research project (Mertler, 2009).

3.1.1 Advantages of action research

Action research offers several advantages, especially for specific circumstances (Koshy, 2005). Furthermore, adjustment and continuous evaluation which can be done throughout the progress may improve the effectiveness and efficiency of the project. Additionally, action research emphasizes improvement of processes and outcomes rather than the

findings of relationships among variables and a research population (Tomal, 2003). Action research can result in the confirmation of previously formulated theory and also newly disclosed novel theories (Koshy, 2005).

3.1.2 Disadvantages of action research

Conducting a study using a concept of action research may consume a long period of time (Waters-Adams, 2006). Activities in the action research, such as closely monitor participants and repeatedly improving the action, demand continuously involvement. This issue should be considered before applying action research into the study because it may cause a delay of research plan. Moreover, the research action was set for a particular circumstance or environment (Waters-Adams, 2006). Therefore, the results may not be able to generalize for a wide scale.

3.2 Case Study Research

A case study is an investigation of particular settings to obtain deep understandings of related entities in a particular process or context (Gillham, 2000; Woodside, 2010). Case study research can investigate either single or multiple cases (Yin, 2009). Also it can be appropriately employed in many study environments. For instance, it may be used to explain causal relationship in real-life circumstances which are too complicated to use only questionnaires or experiments (Yin, 2009). Moreover, it is useful to provide better understandings in vaguely-defined situations (Yin, 2009).

The use of combined types of information sources, which have their own strengths and weaknesses, is an outstanding feature of case study research (Gillham, 2000). However, sources of information or evidence used in case study research may be divided into six categories, namely documentation, archival records, interviews, direct observations, participant observation and physical artefacts (Yin, 2009).

3.3 Questionnaire

A questionnaire is not just a list of questions but a set of well-designed questions which will lead to the attainment of study objectives (Oppenheim, 2001). Every issue, topic and variable of the study is explored, investigated and measured in terms of questions in various forms (Oppenheim, 2001). Instruments for data collection can be standardized interviews, postal questionnaires, self-administered questionnaires or group-administered questionnaires (Oppenheim, 2001).

The self-administered questionnaires are presented to participants to explain the purpose of data collection; then participants alone complete the questionnaires which are gathered afterwards (Oppenheim, 2001). To name a few, high response rates, minimum bias from interviewing and accurate sampling, are advantages of this method (Oppenheim, 2001). After considering the current situation in this study, this method was chosen as one of the data collection strategies in this research project.

Types of questions within the questionnaire can be roughly divided into open questions and closed questions (Oppenheim, 2001). Open questions allow participants spontaneously to answer the question according to their thoughts at that time; consequently its advantage is the freedom of answers (Oppenheim, 2001). It is recommended when anticipated answers from the respondents can be in a broad range including unpredictable responses (Ian, 2008). However, loss of answer richness usually occurs after all answers are classified and analysed later (Oppenheim, 2001). Additionally, responses returned from open questions may be ambiguous and difficult to analyse (Schmuck, 2006). Additionally, participants may only partially recognize the past experiences or may struggle to articulate their actual answers; consequently, it may cause loss of answer richness (Ian, 2008). To answer this type of question takes more time and more effort from respondents; this may lead to less contribution to the participation (Oppenheim, 2001).

On the other hand, closed questions provide choices of possible answers to participants, who are asked to select the most fitting one (Oppenheim, 2001). It is an appropriate option if all possible responses can be defined in a set of answers (Ian, 2008). Answering the

questions is easy, simple and quick, together with requiring no writing (Oppenheim, 2001). Also, the collected data are easy to process in order to make a group comparison (Oppenheim, 2001). However, bias may arise from the choices provided and lead to distorted results, while selecting from prepared alternatives may cause a loss of spontaneity and expressiveness (Oppenheim, 2001; Schmuck, 2006).

Questionnaires are also appropriate for understanding participants‟ situation, perceptions, attitudes and feelings (Schmuck, 2006). In addition, a questionnaire is not only convenient collecting data in a short period of time but also helps participants to remain anonymous (Schmuck, 2006). However, using a questionnaire with closed questions to collect data means the researcher has no chance to clarify any answers with respondents (Schmuck, 2006).

3.4 Attitude Measurement

"An attitude is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli" (Oppenheim, 2001, p.174). The attitudes are based on beliefs and evaluative responses toward entities (Eagly, & Chaiken, 1993; Oppenheim, 2001). When individuals are stimulated by an entity or occurrence, it will be psychologically evaluated and affect their feelings and then lead to particular behaviours or emotional responses (Eagly, & Chaiken, 1993; Oppenheim, 2001).

There are many techniques proposed to measure or assess individual or group attitude toward issues or variables in research studies. However, attitudes are too complex to be evaluated by using only a clear-cut acceptance-rejection answer (Oppenheim, 2001). The Likert scale is a well-known and easily understandable means of providing answers for researchers (Ian, 2008). Using the Likert scale, a list of statements regarding variables in the study is offered to participants (Oppenheim, 2001). In each statement, participants are provided five levels of agreement which are often strongly agree, agree, neutral, disagree and strongly disagree. A score running from 5 to 1 or vice versa is assigned to each level, respectively (Ian, 2008; Oppenheim, 2001). After data are gathered, the score for each

statement of each question will be calculated as a total and an average score, to enable the researchers to interpret the responses. This way of offering choices gives the participants alternatives that more accurately reflect their feelings than straight cut answers like yes or no; consequently, the results from Likert scales are somewhat more reliable (Oppenheim, 2001). However, different scores from entire participants‟ responses may result in the same total or average scores; therefore, the pattern of responses is also interesting (Oppenheim, 2001). In addition, the language used in the attitude statements should be neutral and unbiased to avoid any psychological effects (Ian, 2008).

3.5 Interviews

An interview is not just a conversation, but one that aims at acquiring certain kinds of information, either factual replies or attitudes and responses to feelings (Oppenheim, 2001). An interview is an effective way to extract information from participants who usually do not explain their thoughts, feelings and attitudes in writing (Schmuck, 2006). This method is also suitable for gathering data from participants‟ intention, actions and attitude (Hanneke, 2000). It broadens the understanding of the memory, circumstances and thoughts (Mears, 2009). It can be categorized into two types, which are standardized interviews and exploratory or in-depth interviews (Oppenheim, 2001). The standardized interview is usually used for the purpose of fact or data collection whereas the exploratory interview aims at understanding participants‟ thoughts and feelings about a particular issue; or in the other words, idea collection (Oppenheim, 2001). In either standardized or exploratory interviews, interviewers should not interfere in the conversation by introducing their own attitudes and personality (Oppenheim, 2001)

To understand participants‟ attitudes and opinions, this researcher chose to employ exploratory interviewing. The exploratory interview requires flows of spontaneous conversations with participants or interviewees through research issues (Oppenheim, 2001). The exploratory interview also helps in the formulation of research problems, the extended view of the situations studied and even suggestions of new ideas and hypotheses (Oppenheim, 2001).

Usually, a small typical group of participants is the main target of exploratory interviews (Oppenheim, 2001). In addition to a group from a typical sample, key informants in study areas may be included in the exploratory interview (Oppenheim, 2001). However, in some studies, using two different groups of interviewees can be employed in order to compare and contrast results between these sub-samples (Oppenheim, 2001). Even though the number of interviews needed is not exactly specified, it was accepted that the interviewing process should no longer continue when there were no new ideas or viewpoints proposed (Oppenheim, 2001).

The interview may be arranged at the interviewer or interviewee‟s home, at an office or a place where there will be no interruption or distraction for a certain period (Oppenheim, 2001). Additionally, the place setting should be private, pleasant and quiet to make interviewees relax and feel spontaneous (Oppenheim, 2001). At the beginning of the interview, awkwardness may normally occur (Mears, 2009). As the interview continues on, the awkwardness should be reduced. Meanwhile, both interviewer and interviewees should gain more confidence and comfort (Mears, 2009). A simple way to increase the response validity is that all respondents should be treated in the same environment or setting (Hanneke, 2000). In the exploratory interview, although fixed question lists are not necessary, the interviewer needs to conduct the interview naturally by adding questions according to the interviewee‟s responses and guiding them to focus on the topics of the interview (Oppenheim, 2001).

Moreover, a group interview session is also useful for certain circumstances; for instance, it may encourage some interviewees to express more on their thoughts and feelings when they get ideas from other interviewees‟ responses (Oppenheim, 2001). It may also reduce potential awkwardness if two strangers, interviewer and interviewee, have to confront each other alone. Although the group interview is more economical in terms of expenses and time, domination of the conversation by some interviewees may occur due to their personalities or social roles (Oppenheim, 2001). Therefore, the interviewer should ensure that the conversation includes all interviewees, without breaking into the flow of the conversation (Oppenheim, 2001).

Nevertheless, when interviewing is used in research, some concerns may arise. For instance, this technique is time consuming; consequently not every participant is selected for the interview which may affect the proper selection of interviewees from entire sample (Schmuck, 2006). Another issue is the interviewer"s personality and social status which may hinder interviewees from truthfully expressing their thoughts and feelings (Hanneke, 2000; Schmuck, 2006).

3.6 Documentary Analysis

Contents in relevant documents can be analysed to find out themes and meanings (Schmuck, 2006). This type of evidence may provide useful background and context of the study, in addition to unexpected insights (Koshy, 2005). Furthermore, collecting relevant data through documents is not complicated in most cases (Koshy, 2005). Additionally, documents can be reviewed multiple times without changes of contents (Yin, 2009). However, it is inevitable that some documents may contain bias; therefore researchers should always carefully analyse information from documentary sources (Yin, 2009).

Applying at least two data collection approaches is one of several possible ways to increase the validity of research projects (Schmuck, 2006). Consequently, this project employed questionnaire, interview and documentary analysis to collect data and analyse the current situation.

3.7 Research Activities

According to Tomal (2003), action research may be broken down into six stages, which are the problem statement or initial diagnosis, data collection, analysis and feedback, action planning, taking action or implementation, and evaluation and follow up. These steps will be adapted in the following research activities into situational analysis, further analysis, framework development and framework improvement, as shown in Figure 2 on page 40.

Each research stage employed one or more research methods; therefore, for simplicity Table 2 presents the summary of research techniques used in each stage. It is followed by more detailed elaboration or each stage of the research process.

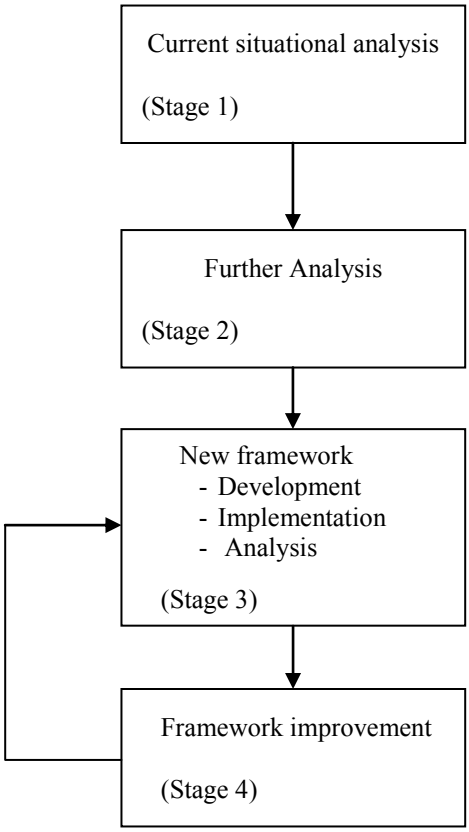

Figure 2. Overall research activities.

Table 2

Research Techniques Employed in Each Stage of Research Activities

	Questionnaire	Interview	Attitude Measurement	Documentary Analysis	Statistical Calculation
Stage 1	✓		✓	✓	
Stage 2					✓
Stage 3	✓	✓	✓	✓	✓
Stage 4		✓			

Note. Statistical calculation includes percentages, mean scores, standard deviations and cross-tabulation analyses using Pearson Chi-square.

The first stage was the situational analysis to understand and evaluate the current circumstances. It involved both study from existing documents, including other research projects, and data collection through questionnaires. The documentary analysis, attitude measurement and questionnaires were two methods applied in this stage. Stage One research activities are presented diagrammatically in Figure 3.

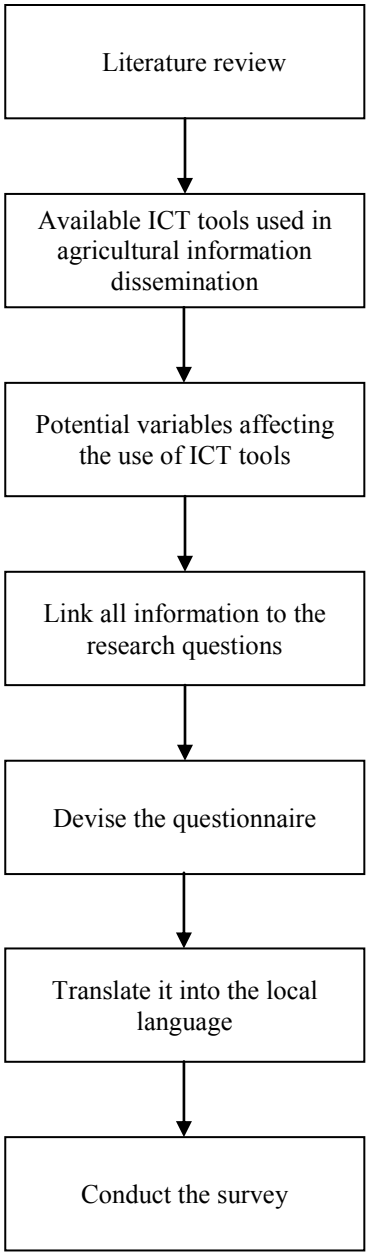

Figure 3. Processes in research activity – Stage One.

Then, in Stage Two, the data collected in Stage One were statistically analysed and examined to assess the relationships amongst variables. This was carried out using Statistical Package for Social Sciences (SPSS) tools. A variety of fundamental statistical techniques, such as percentage, mean, standard deviation and cross-tabulated analysis using Pearson Chi-Square technique, were applied to the gathered data. Additionally, due to skewness of some variables such as age, income and education; newly grouped categories were applied in order to equate data distributions. Figure 4 below outlines processes accomplished in Stage Two.

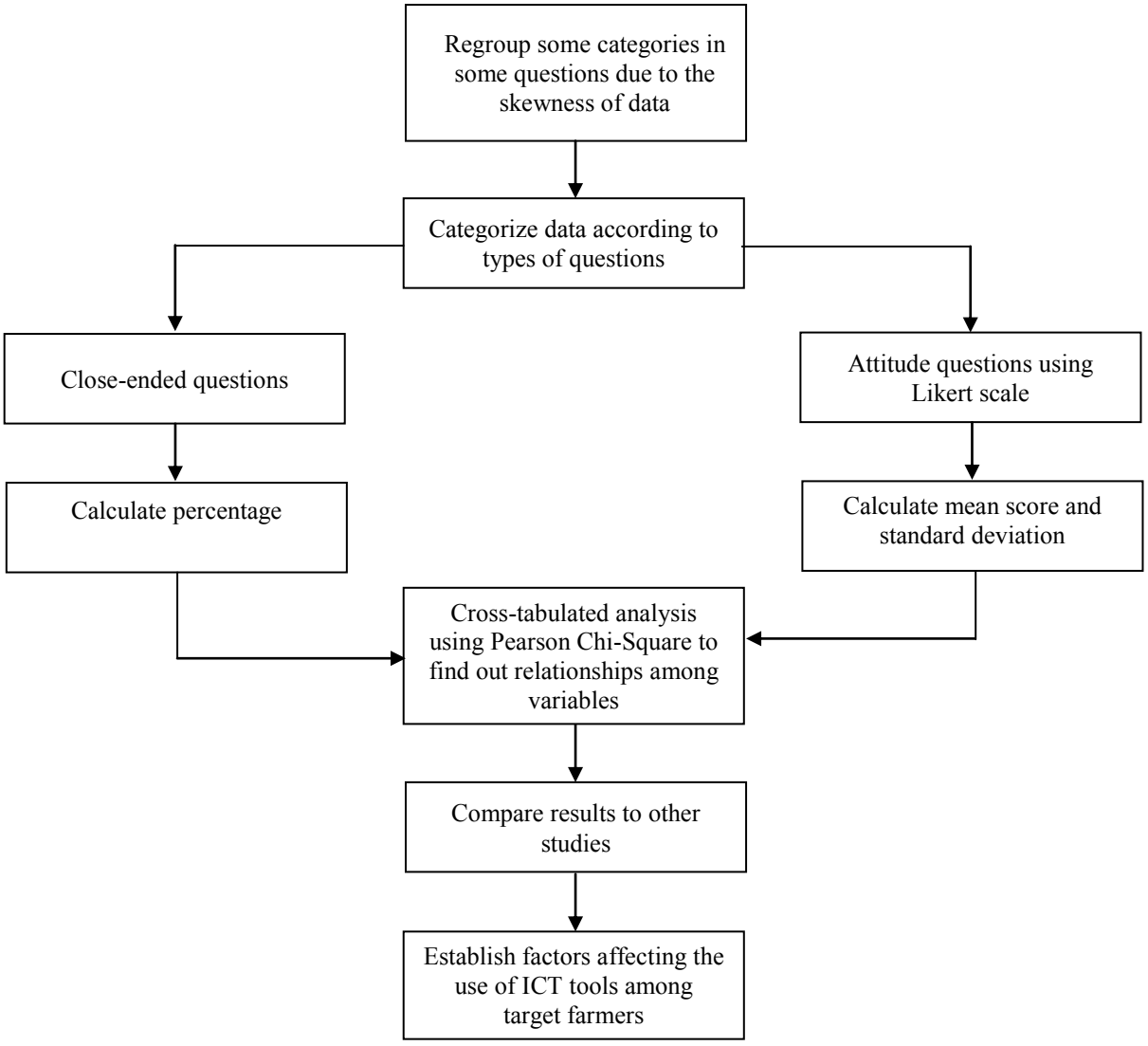

Figure 4. Processes in research activity – Stage Two.

Next, all relevant documents, publications, articles, journals and results from Stage Two, including on-going projects in Thailand, were carefully examined in order to analyse the effectiveness of the implementations of information and communication technologies in the two agricultural areas. Figure 5 on page 44 presents all activities in Stage Three.

All information derived from the previous stages was used to design a framework in order to determine an appropriate and effective approach to disseminate agricultural information to the target farmer groups.

The framework implementation was examined using user satisfaction questionnaires in order to gather and analyse the effectiveness and efficiency of the framework. The collected data were statistically analysed using SPSS tools. Then other related studies were referred to compare results from the user satisfaction survey.

Group interview sessions were then conducted with participants in each district separately to encourage them to reveal their attitudes toward the experiment unreservedly. The results were analysed to contribute towards a feasible framework which would enhance ICT tool usage among Thai farmers.

All outcomes from all previous steps were examined to form a framework for a wider scale which aimed to answer the main research question as illustrated in Figure 6 on page 44. Additionally, other related studies and research frameworks were analysed and compared to find out an appropriate framework for disseminating agricultural information to rural farmers in the Thai context. The interviews with agricultural extension workers as an expected role of project administrators in the implementation in a wider scale were arranged to obtain the validities of the framework. Limitations in current technologies available in Thailand, and ICT adoption readiness of farmers, were also determined to create the framework which may be adapted to a wider scale.

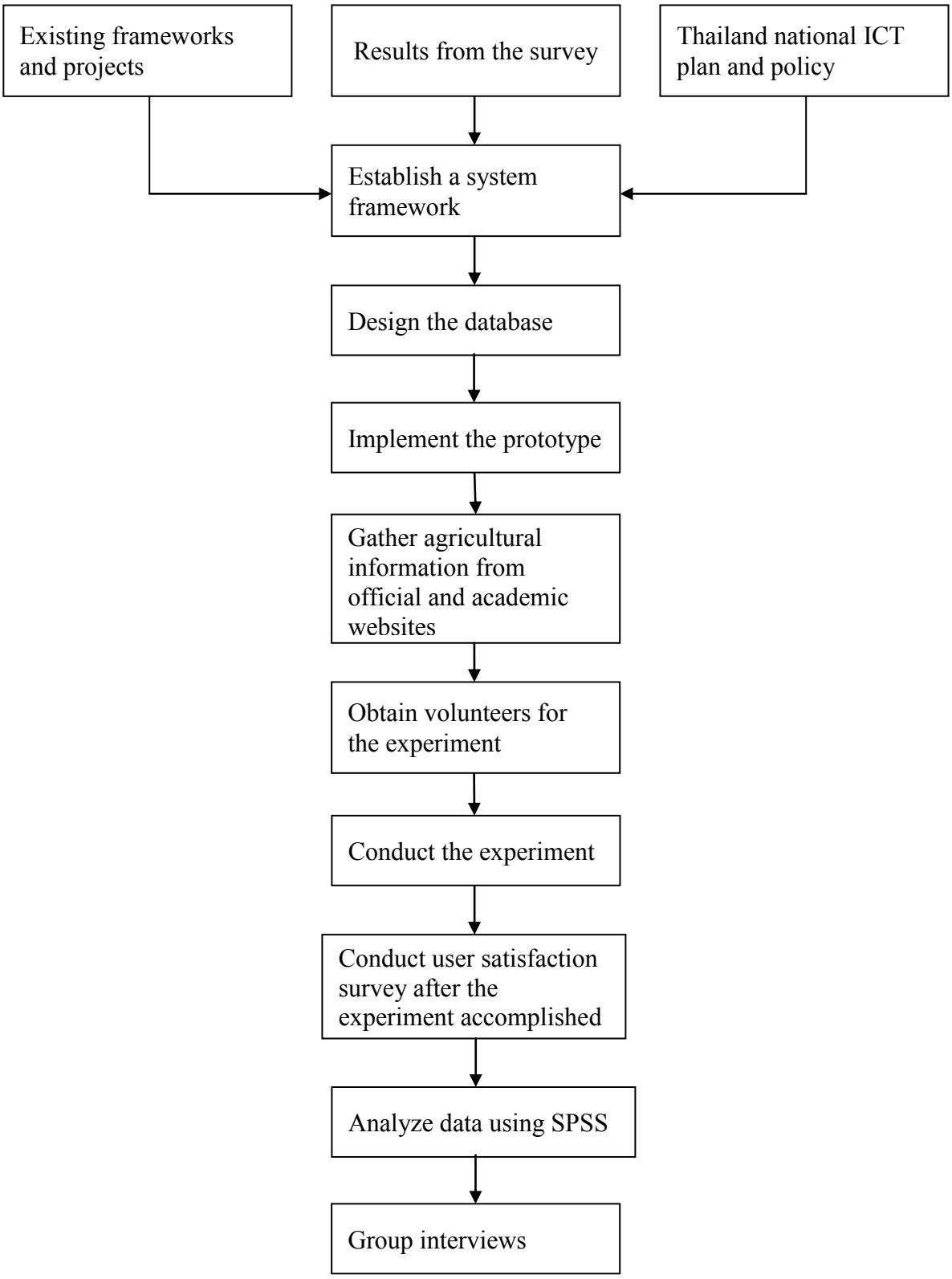

Figure 5. Processes in research activity – Stage Three.

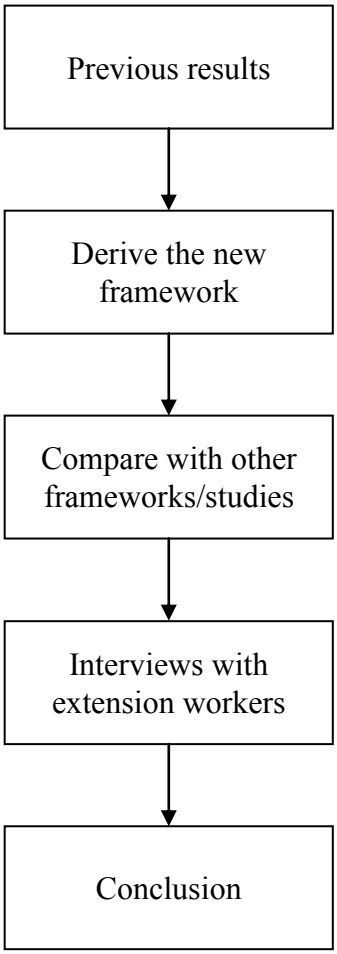

Figure 6. Processes in research activity – Stage Four.

3.8 Limitations

Action research still involves limitations in some situations. Obtaining deep understanding and planning research actions must also relate to ethical considerations (Koshy, 2005). In addition, at the beginning researchers need to specify the relevant parameters within the project carefully due to the flexibility of the action research method.

This study targeted only specific groups of farmers in rural Thailand. The results of the study including preferences expressed by the participants may vary from publications about other agricultural villages in Thailand.

CHAPTER 4 PARTICIPANTS

4.1 Background of the study areas

At present, there are 77 provincial areas in Thailand; Phrae is one of 17 northern provinces (Foreign Office, The Government Public Relations Department, n.d.). Phrae Province is approximately 551 kilometres north of the capital city of Bangkok as illustrated in Figure 7 on page 48 (Information and Communication Group [ICG], Phrae Provincial Office, 2010).

Phrae Province contains 8 districts divided into 78 sub-districts or 708 villages with a total population of 462,698 people (ICG, Phrae Provincial Office, 2010). The eight main districts are Denchai, Long, Muang, Nongmuangkhai, Rongkwang, Song, Soongmen, Wangchin as presented in Figure 8 on page 49 (ICG, Phrae Provincial Office, 2010). The total area is 6538.58 square kilometres and the cultivation area accounted for 22.23% of total provincial land (ICG, Phrae Provincial Office, 2010). The province is surrounded by mountains in all four directions (ICG, Phrae Provincial Office, 2010). Three seasons in Phrae Province are winter, from November to February, summer from March to May and rainy from June to October (ICG, Phrae Provincial Office, 2010). In the last five years, the average temperature was 26.43 degrees Celsius and average rainfall was 1126.94 millimetres per year (ICG, Phrae Provincial Office, 2010).

Agriculture is one of the main industries in Phrae and a major section of the workforce was in the agricultural and fishery sector, with 84,449 people or 28.5% of the entire Phrae Province workforce (ICG, Phrae Provincial Office, 2010). Main crops grown in Phrae Province include corn, rice, mung beans, tobacco, tangerines and soy beans; moreover, on average each farming household occupies about 3.5 rai for agricultural purposes (ICG, Phrae Provincial Office, 2010). One rai is approximately 0.16 hectares. Among these farmers, 72.46% own their land for agricultural procedures while 18.98% have rented arable land and the rest have both owned and rented (Office of Northern Science Park, n.d.). In terms of economics, people in Phrae Province earned about 47,830 baht annually

(ICG, Phrae Provincial Office, 2010). In comparison at national level which the annual income per person in 2009 was 97,351 baht, Phrae residents can be considered impoverished (ONESDB, 2010a).

Figure 7. A map of Thailand. (adapted from Davies, 2008).

Figure 8. A map of Phrae Province showing eight districts. (ICG, Phrae Provincial Office, 2010).

Muang District and Soongmen District were selected for this study. Muang District consists of 116 villages while Soongmen District has 110 villages. One of villages in each district was selected; however, to retain confidentiality the chosen villages were referred, henceforth, as Muang and Soongmen districts, respectively. Although they were one of many villages in both districts, in this study they were chosen to be representative villages for these districts.

The village in Muang District has 762 residents comprising of 356 males and 406 females whereas the village in Soongmen District contains 1083 community members consisting of 514 males and 569 females (NSO, 2009b).

4.2 Research Participants

In the preliminary survey, farming dwellers in Muang District and Soongmen District were asked to complete the questionnaire. Volunteers were composed of 181 participants from Muang District and 150 participants from Soongmen District.

For the implementation phase, only the participants from the preliminary survey who owned mobile phones were asked to join the information dissemination. However, due to reluctance to try something new and different from what they were familiar with, only 57 farmers from Muang District and 59 farmers from Soongmen District agreed to join this service. When the experimental service was accomplished, all 116 participants were asked to complete another questionnaire regarding their fundamental demographic data and attitude toward this service to find out their satisfaction. It can be seen that participants in the first questionnaire were not exactly the same as the participants in the second questionnaire. In other words, the participants in the second questionnaire were only a subset of the participants in the first survey. However, opinions from the participants who tried out this service were all collected by the second questionnaire.

CHAPTER 5 CURRENT SITUATIONAL ANALYSIS AND FURTHER ANALYSIS

To understand the current situation, documents about ICT policies in Thailand, such as *The 10th National Economics and Social Development Plan (2007 – 2011)*, *The Summary of the Direction of the 11th National Development Plan (2012 - 2016)* and *The Second Thailand Information and Communication Technology Master Plan (2009 - 2013),* were assessed to determine feasibilities for the project planning. Moreover, annual reports from relevant government agencies such as the Ministry of Information and Communication Technologies, the Department of Agricultural Extension, the Ministry of Agriculture and Cooperatives including statistical data from the National Statistics Office, were gathered to examine agriculture-related or ICT projects and policies which were accomplished, have been in progress, or will be included in future plans.

5.1 Current ICT situation in Thailand

At present, Thailand is implementing *the 10th National Economics and Social Development plan (2007 – 2011)* which extensively supports Thai agriculture activities in knowledge exchange and transfer, including research and development concerning agricultural technology (ONESDB, 2006). However, it does not precisely state how information and communication technology tools should be applied to these purposes.

The Summary of the Direction of the 11th national development plan (2012-2016) has been framed to cope with immense global changes (ONESDB, 2010b). Subsequently, implementations of information and communication tools are mentioned in various strategies, including agricultural support. The use of information technology for the purpose of enhancing living standards will be promoted, along with other strategies to support the grass-root economy and farmers‟ capability to produce higher quality and quantity of yields (ONESDB, 2010b).

In addition to *the 11th national development plans, The second Thailand Information and Communication Technology Master Plan (2009 – 2013)* also presents several strategies in using ICT to support agricultural sectors (Office of the Permanent Secretary of Ministry of Information and Communication Technology & Strategy Research and Industry Indicator Division of National Electronics and Computer Technology Center [OPS & NECTEC], 2009). The development of farming information, including the promotion of ICT learning networks for farmers is one of the strategies related to ICT support for agriculture. Additionally, studies on farmers‟ information needs, coupled with pilot projects for precision agriculture, will be promoted and supported. Moreover, ICT infrastructure and information development in the local language, Thai, will be undertaken by related agencies in order to accelerate the processes of using ICTs for improving livelihoods.

Furthermore, agencies related to the promotion and support of ICT usage for agricultural sectors also undertaken the responsibility for achieving these goals. The Ministry of Information and Communication Technology, the Department of Agricultural Extension under the supervision of the Ministry of Agriculture and Cooperatives, and the Ministry of Agriculture and Cooperatives itself are the most directly concerned organisations.

According to the Ministry of Information and Communication Technology [MICT]‟s annual report for 2008 (2009), a hi-speed internet extension project is being installed to cover all areas of Thailand. Additionally, the 3G mobile phone network project has been making some progress (MICT, 2009). A community ICT learning centre project is considered to be successful in meeting its objectives. Forty community ICT learning centres were established, along with properly trained ICT personnel to maintain the centre and to support community users. Furthermore, 4100 community users across the country were trained to use the facilities provided (MICT, 2009).

The Department of Agricultural Extension [DAE] under the supervision of Ministry of Agriculture and Cooperatives is also another body directly responsible for information dissemination coupled with knowledge and technology transfer to farmers. For example, the DAE managed a project regarding announcements on pest outbreak warnings via

community speakers, local radio channels and DAE‟s websites (Department of Agricultural Extension [DAE], 2010). Agricultural information was available through a call centre service, DAE‟s website and email coupled with agricultural documentaries in VCD format and e-books. TV documentaries were also broadcast on two channels for 67 times in total all year round and on 10 radio channels for more than 7000 times (DAE, 2010). Additionally, a farmer registration database system was established and promoted to farmers throughout the country in order to keep their records for further analysis and future plans (DAE, 2010). However, information technology skills development training courses, including ICT facilities such as computer servers and computer sets, were arranged for departmental staff only rather than for farmers themselves (DAE, 2010).

Moreover, the Ministry of Agriculture and Cooperatives also provided overall support to farmers via departments under its supervision. The Ministry facilitated information and technology transfer through broadcasting on TV and radio channels, publications, call centre services and websites (Ministry of Agriculture and Cooperatives, 2009).

It can be seen that ICT implementations for transferring information and technologies to farmers are in the government interests and are planned to achieve tangible outcomes. Research development and studies regarding this issue are also being encouraged. However, according to the summary of Thai ICT indicators published by the National Statistical Office of Thailand (2007), it indicated that TV and radio can be considered as providing nearly universal access, reaching 95.3% and 60.3% of the population, respectively. However, only one TV programme created by the DAE was broadcast, along with radio broadcasts through 10 channels across the country (DAE, 2010). Although related government bodies tried to publish valuable agricultural information on the Internet (DAE, 2010; Ministry of Agriculture and Cooperatives, 2009), the percentage of Thai residents using computers and the Internet were rather low at 29.3% and 20.1%, respectively (NSO, 2010a). The percentages of these ICT users were even worse in the agricultural sector at only 3.4% and 1.9%, respectively (NSO, 2010a).

The percentage of mobile phone users in Thailand has rapidly increased from 47.2% in 2007 to 56.8% in 2009 (NSO, 2010a; OPS & NECTEC, 2009). However, it seems that the third generation (3G) mobile phone concession contract has encountered many problems which caused delays and timing of the completion of the rollout remains uncertain (Chantanusornsiri, 2011; Tortermvasana, 2011).

5.2 Analysis of similar systems

Attempts to deliver useful information to farmers or rural communities using mobile phone technologies in the hope of enhancing rural livelihoods and lessening the digital divide have succeeded. IFFCO Kisan Sanchar Limited (IKSL) and Reuter Market Light (RML) projects were two exemplars for employing mobile phone services to disseminate information directly to farmers.

The Indian Farmers Fertiliser Cooperative (IFFCO) collaborated with a leading telecommunication company, Bharti Airtel, to establish a project called IFFCO Kisan Sanchar Limited (IKSL) in June, 2007. (Mittal & Tripathi, 2009; Sulaiman, Kalaivani, Mittal & Ramasundaram, 2011). After purchasing a Green subscriber identity module (SIM), farmers received five free voice messages a day at un-predefined times regardless of location and crop types. These messages related to agricultural information such as weather, market price, fertiliser availability and crop advice (Mittal & Tripathi, 2009; Sulaiman et al., 2011). If the farmers did not listen to the voice messages when they were first delivered, the messages remained available for the farmers to listen to them at a cost of one rupee per minute (Mittal, Gandhi & Tripathi, 2010). These mobile phone users were also eligible to call for customised advice to the helpline service at a cost of one rupee per minute (Mittal & Tripathi, 2009).

Reuter Market Light (RML) is another agricultural information service which has been available to Indian farmers since October 2007 (Mittal & Tripathi, 2009). Subscribers had the choice of receiving market price information for two crops through four text messages a

day at specific times (Mittal & Tripathi, 2009; Sulaiman et al., 2011). Information related to the weather was delivered every morning for the entire year, while crop advisory messages were available from the beginning of sowing to the end of harvesting (Sulaiman et al., 2011). The subscriptions were available for a period of 3, 6 and 12 months with a cost of Rs175, Rs350 and Rs650, respectively (Mittal & Tripathi, 2009).

RML‟s strengths were the options for the farmers to choose the crops in which they were interested, and to receive market information in their local language (Rao, Ramamritham & Sonar, 2010).

The IKSL voice messages needed farmers to act at the time they received the messages. This caused the receivers some inconvenience, particularly if they were not available at the time the messages arrived. On the other hand, text messages can be stored in the mobile phones until the farmers were available to check and read them.

However, voice messages were more suitable for illiterate residents because they did not require high literacy levels. It was reported in Mittal and Tripathi‟s (2009) findings that most voice message subscribers preferred the service because of their illiteracy.

5.3 Results of Questionnaire of Representative Farming Groups

A preliminary survey concerning farmers‟ information needs, their farming data and ICT usage behaviours was conducted to frame a study implementation. This idea was suggested by the success of other projects which had ensured the participation of users at an early stage (Arunachalam, 2002; Chaudhary, 2004).

The questionnaire contained three types of questions, namely closed questions, open-ended questions and opinion questions using Likert scales. General demographic data including education, age, gender, marital status, the number of family members and income level were collected through a questionnaire (see Appendix A).

Within the questionnaire‟s detail, as the Internet became commercialized in Thailand by 1995 (Palasri, Huter & Wenzel, 1999), the number of Internet users in Thailand has gradually increased from 1.5 million in 1999 to 18.3 million in 2009 (Internet Information Research [IIR], 2009). These figures show that the Internet has recently become popular nation-wide; therefore, it may be assumed that young users use more Internet than older generations. Furthermore, the number of computer users and Internet users was highly different among each age group (NSO, 2010a). Consequently, the age of farming participants in this study should be collected to determine if there was any relationship with the use of ICT tools.

Although the percentages of male and female computer users and Internet users in Thailand were somewhat similar (NSO, 2010a), it was reported in many studies that the farming sector is male-dominant (Elizabeth & Zira, 2009; Cidro & Radhakrishna, 2006). As a result, participants‟ gender should be considered, to see whether it is related to the use of ICT among farmers.

Additionally, the use of computers and the Internet in Thailand showed remarkable differences among each educational category (NSO, 2010a). It was also revealed that most farmers were illiterate (Kari, 2007); hence, the relationship between educational background and the use of ICT tools among target farming groups should be taken into account.

It was stated in many studies that a number of rural residents had to share even basic communication tools. They had a chance to use high technology tools, such as computers and mobile phones only when they were offered free by research projects (Irivwieri, 2007; Opara, 2008; Sheriff, 2009; Sindir, 2005). It may be assumed that affordability is another reason affecting the use of ICT tools among rural community members. Therefore, the relationship between income and the use of ICT tools for obtaining new agricultural knowledge should be determined to see whether earlier findings are true for this study‟s participants.

Moreover, other characteristics of farmers, such as family size, farm size and marital status, were included to examine whether these factors affect the use of ICT tools for obtaining agricultural information. In addition, the types of information required, ICT availability in the target areas, farmers‟ ability to use ICT tools, expectations and attitudes toward information delivery using ICT tools and preferred methods for information delivery were included. Participants‟ awareness of currently available agricultural information in several channels was examined, as were their recollections of positive and negative outcomes after applying agricultural advice they had previously obtained.

The ethics-approved questionnaire was translated into the local Thai language by the researcher and then checked by a lecturer in the Department of Foreign Languages, the Faculty of Humanities, Rajabhat University of Kamphaengphet, Thailand. The researcher then made appointments with the target groups in order to distribute the questionnaires. The objectives and processes of this study were explained to farmers. In this stage of the study, 331 participants voluntarily agreed to complete the questionnaires. The consent letter (see Appendix B) was explained and provided to each farmer. Participants had responded to a general invitation to take part in this study. In order to obtain an idea of the real circumstances of the use of ICT tools for agricultural information among Thai farmers, no criterion to select participants was applied.

After all distributed questionnaires were collected; all data were encoded in a statistics analysis application, SPSS. Then, basic statistical approaches such as percentages, means, standard deviations and cross-tabulations using Pearson Chi-square were performed to obtain findings.

The data analysis was conducted using data gathered from a sample of farmers from Thailand who were requested to supply information on their sources of information, their preferences toward receiving information via ICT tools and devices such as television, radio, computer, mobile phones and the Internet. Also their perceptions of the impacts of applying agricultural information, received before the study commenced, were gathered. The raw data collected in this survey were presented in Appendix E.

5.3.1 Demographic data

The data set was from a total of 331 survey respondents which consisted of 181 from the Muang District and and 150 from the Soongmen District, respectively. This number accounts for 23.7% and 13.8% of residents in each district, respectively. Both study groups were comprised of male and female participants in similar proportions. Figure 9 shows the percentages of male and female participants between both districts and the comparisons.

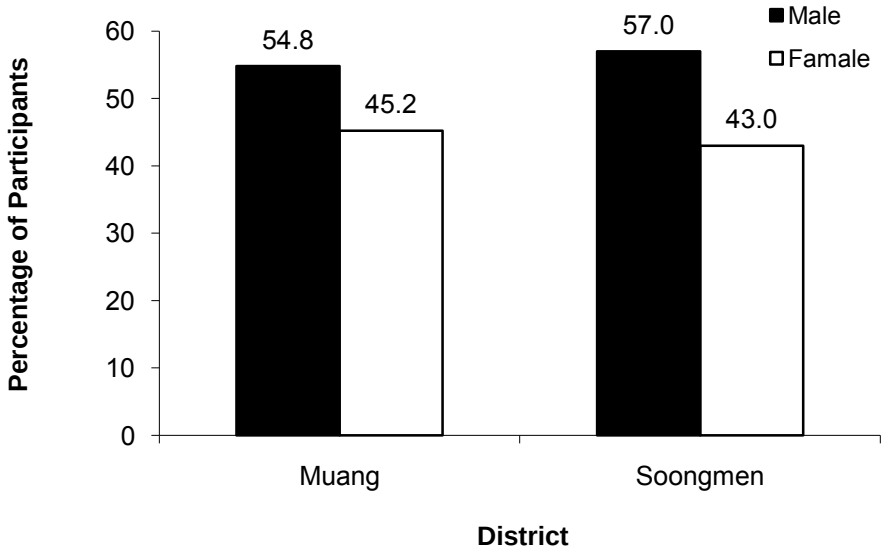

Figure 9. Percentage of male and female participants between Muang and Soongmen District.

Overall, most participants (73.4%) were 46 year of age or older. In particular, most participants in Muang District were either in the 46 to 50 years old category, or were 61 years old or above. On the other hand, the majority in Soongmen District were between the ages of 46 to 55 years old. Figure 10 shows percentage of each age group for each of the two districts.

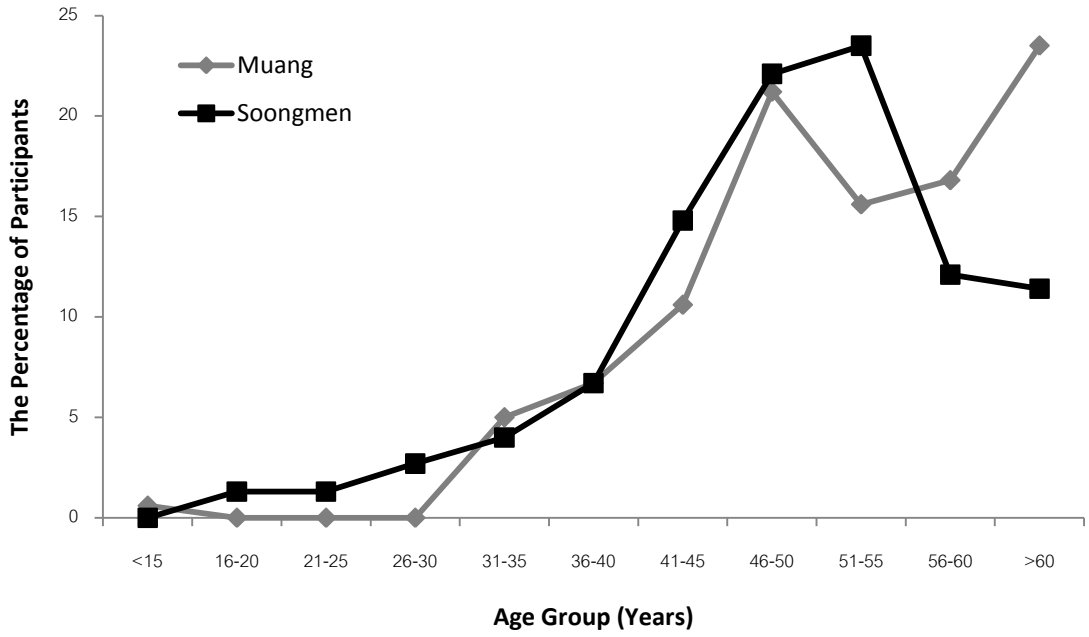

Figure 10. A graph presenting a percentage of participants in each age group compared between two villages.

Characteristically, most participants (67.6%) were educated only to the primary school level. However, this number is slightly higher when compared to general. 62.09% of Thai residents overall received an education to a primary school level (NSO, 2009a). When taken together with participants who also completed junior high school, that figure rose to 80.7% of all participants. This figure is quite comparable to Kari‟s (2007) findings which showed that 90% of Nigerian farmers surveyed were illiterate.

The majority of participants (84.0%) were married and 65.4% had four or more members in their household. This survey found that 73.5% of the participants earned 5000 baht or less a month, which equates to an annual earnings of up to 60,000 baht. A monthly income of 5,000 baht can be calculated to be 167.5 Australian dollars, as at the 6th of April, 2010. This compares to the general Thai national average annual income per person of 97,351 baht in 2009 (ONESDB, 2010a). Additionally, it was revealed that a number of farmers (39.7%) in this survey earned approximately 3001 – 5000 baht a month. Furthermore, only 13.2% of the participants earned more than 8000 baht a month or 96,000 baht per annum. In

summary, a majority of participating farmers earned much less than the national average. This result is in agreement with other international studies of developing countries that concluded that most farmers were poor (Kari, 2007).

In terms of agricultural activities, it was found that 85.6% of the entire group of participants grew rice. However, it was found that rice culture was more extensive in Soongmen District, involving 92% of its participants, compared to Muang District where rice was grown by 80% of the participants. Interestingly, few participants in Muang District were growing other crops with only 15.9% growing soya beans or other crops. Participants from Soongmen District were more flexible in their crop choice. Twenty eight percent of the participants in Soongmen District grew corn and 73.3% also grew soya beans with a few participants also growing sugarcane, cassava and mung beans. While 28% of the participants in Soongmen District grew corn, none of the participants in Muang District did so.

The participants from both districts were also shown to engaged in other farming activities such as raising poultry (54.1%), pig farming (7.2%) and cattle farming (15.9%). However, cattle farming was more prevalent in Muang District (22.4%) as compared to Soongmen District (8.7%).

In terms of agricultural land usage and arable areas, most participants from both groups (54.6%) were found to use only two acres or less. Furthermore, 36.1% of farmers in the two districts used two-to-four acres for their agricultural activities. Although both groups of the participants used the land in similar proportions, all participants in Muang District used 12 acres or less while 3.5% of participants in Soongmen District used more. Comparing to Sirdir‟s (2005) study, about one-third of Turkish farmers (34.9%) used two hectares or less whereas up to 90.7% of Thai farming participants carried out their agricultural activities on two hectares or less. Moreover, only 1.6% of Thai farming respondents used an agricultural area larger than five hectares, compared to 33.0% of Turkish farmers.

However, according to World Bank (2011) data regarding the percentage of agricultural land in total country land, in 2007 Turkey contained 51.3% of agricultural land throughout the country while only 38.7% of Thailand areas are used for agricultural purposes. Consequently, it is reasonable that Thai farmers may own smaller agricultural areas than Turkish farmers.

The participants either owned or rented the land for agricultural purposes in similar percentage, with 42.0% owning land and 41.3% having to rent. The remaining 16.7% of the farmers both owned and rented land for agriculture.

5.3.2 Presently used ICT tools and the preference

In terms of ICT tools currently used by the participants, Table 3 shows the percentage of ICT tools used between two districts. The survey showed that television (73.6%) was the most popular ICT tool used as an agricultural information source. This conforms with Irivwieri"s (2007) conclusion that television and radio programmes were the main sources of agricultural information among illiterate Ehtiopian females. Its popularity may be due to the high incidence of illiteracy among farmers. This type of communication needs only simple conversation skills supplemented with visual presentations in television programmes. It helps farmers better understand agricultural information and material.

By contrast, this result was different to Tarnoczi and Berkes" (2010) findings which showed that television and radio as mass media only played an additional role to other sources of information. The supporting roles of television and radio were shown in a New Zealand survey (Locke, 2005); using television as a source of agricultural information accounted for only 10.8% of farmers in 2003, then reduced to be 4.3% in 2004 along with only 5.9% and 7.4% receiving information via radio in 2003 and 2004, respectively. Additionally, radio and television were reported as the least communication channels among urban farmers (Ogunlade, Oladele & Falaki, 2006).

Table 3

Currently Used ICT Tools Between Two Groups of the Participants

ICT tools	Muang District	Soongmen District
Television	68.5%	79.6%
Radio	44.2%	52.8%
VCD	13.9%	33.8%
Landline phones	16.4%	16.2%
Mobile phones	38.8%	68.3%
Computers	7.3%	14.8%
Internet	6.1%	13.4%
Community loud speakers	32.1%	36.6%

Contrary to many international studies that rural farmers rarely received agricultural information from television due to their poverty (Kari, 2007), or lack of electricity and infrastructure (Ekoja, 2004), 95.3% of Thai people have a television at home and 60.3% have a radio (NSO, 2007). However, the different percentages between television possession and the use of television as an information source may support IICD‟s (2006) findings that a majority of the participants regarded television and radio as a source of entertainment rather than information.

Although each participant group provided different percentages of ICT tool used, both the groups revealed similar distribution in the rankings, except the regard to the use of mobile phones and radios. In Soongmen District, the participants preferred the use of mobile phones (68.3%) as compared to radio (52.8%). On the other hand, participants in Muang District showed a preference reversal of 44.2% for radios and 38.8% for mobile phones. Even though the proportions of radio usage amongst the participants from both groups were similar, the farmers from Soongmen District used the radio more. In Muang District, 44.2% used radios for receiving agricultural information with the remaining 55.8% did not use it all for this purpose. Conversely, 52.8% of participants in Soongmen District mentioned that they used the radio for agricultural information and the remaining 44.2% of them did not. This result was consistent with the usage of mobile phones to get agricultural information.

Approximately one third of the participants (38.8%) in Muang District used mobile phones for this purpose whilst the remaining 61.2% did not. In contrast, the majority of the participants (68.3%) in Soongmen District used mobile phones. In addition, 20% more participants in Soongmen District used VCD as an ICT tool to obtain information.

The use of computer and the Internet were ranked at the bottom for both groups of participants. These results were in an agreement with Cecchini (2002, cited in Malhan & Rao, 2007b) that for developing countries the Internet was less useful for improving farming decisions. In contrast, developed countries such as the United Kingdom and USA, show higher percentages of computer access in farms at 60% and 55%, respectively (the Department for Environment, Food and Rural Affairs, 2002 cited in Warren, 2004; the United States of America Department for Agriculture (USDA), 2001 cited in Warren, 2004).

When they were asked about their willingness to learn or to use various types of ICT tools in order to improve agricultural productivities, each group returned opposing results. Table 4 depicts comparisons about preferred ICT tools between two districts.

Table 4

Preferred ICT Tools Between Two Groups of the Participants

	Muang District		Soongmen District	
ICT tools	Average	SD	Average	SD
Television	4.50	0.598	4.54	0.530
Radio	4.21	0.698	4.33	0.688
VCD	3.61	1.014	3.87	0.829
Landline phone	3.43	0.826	3.85	0.903
Mobile phone	3.65	0.957	4.27	0.693
Community loud speaker	4.35	0.918	4.26	1.035
Computer	3.72	1.008	3.72	1.017
Internet	3.86	0.749	3.89	0.824

Note. Values are mean scores on a 5-point scale on which the lowest score is 1 and the highest score is 5.

Both groups revealed similar preference toward the use of ICT tools to gain agricultural knowledge, except with regard to mobile phone. From the 5-point scale, Soongmen participants obviously preferred to use mobile phones, compared to Muang participants, with average scores at 4.27 and 3.65, respectively. Additionally, the standard deviation value of each group strengthened the preference toward the use of mobile phone among Soongmen participants, with values of 0.693 and 0.957 for Muang participants.

5.3.3 Information channels

Moreover, the most frequently cited main sources of agricultural information were as follows: the participants themselves (62.9%), their spouses (24.3%) and their children (6.4%), whereas other family members played an insignificant role in passing on relevant information, ranging from 0.35 to 2.6%.

Additionally, other agricultural information providers also played an important role among the participants, even though the first, extension workers, and the third, neighbours, most mentioned information sources were different between the two districts. The comparison between the rankings of other agricultural information providers in both districts is shown in Table 5.

Table 5

The Use of Agricultural Information Providers Between Two Groups of the Participants

Information Provider	Muang District	Soongmen District
Extension workers	65.6%	46.2%
Local councils	57.1%	57.3%
Neighbours	46.6%	68.5%
Government officers	28.7%	31.5%
Sales agents	12.3%	20.3%
Related web sites	5.5%	8.4%
Private company	0.6%	6.3%

It can be seen from Table 5 that the participants in Muang District mainly depended on extension workers (65.6%) while neighbours (68.5%) were the main information providers in Soongmen District. The results from Muang District was in line with those of Banmeke and Ajayi (2007), Opara (2008) and Ekoja (2004) where extension agents were the highest ranked among available information providers. Nevertheless, the most popular information provider in Soongmen District was consistent with the findings of Tarnoczi and Berkes (2010) that farming neighbours were the most common sources of information. Contrary to this finding, extension agents were considered as one of the least used information sources among urban farmers in Nigeria (Ogunlade, Oladele & Falaki, 2006). This highlights different approaches to information provision in different cultural and national contexts.

Furthermore, sales agents, web sites and private companies were minor information sources for this group of the participants. It also paralleled results from Banmeke and Ajayi (2007) in Nigeria, that commercial agents and the Internet occupied the two bottom ranks of nine information sources.

In terms of information provider credibility, participants in both districts ranked them in the same order, as shown in Table 6.

Table 6

The Credibility toward Information Providers Between Two Groups of the Participants

	Muang District		Soongmen District	
Information Providers	Average	SD	Average	SD
Extension workers	4.34	0.685	4.24	0.673
Local councils	4.24	0.659	4.14	0.783
Government officers	4.11	0.750	4.07	0.768
Neighbours	3.95	0.666	4.02	0.567
Related web sites	3.55	0.753	3.64	1.008
Sales agents	3.31	0.767	3.53	0.885
Private companies	3.04	0.601	3.47	0.924

Note. Values are mean scores on a 5-point scale which the least credible score is 1 and the most credible score is 5.

It can be seen from Table 6 that participants in both districts placed more trust in government-related bodies. Table 6 showed that extension workers, local councils and extension workers were placed at the top three ranks in both district.

According to Tarnoczi and Berkes‟ (2010) study, industries regularly provided information related to their product demonstrations or by their own extension workers; this may be the reason why sales agents and private companies were ranked last in terms of information credibility.

5.3.4 Types of agricultural information required and the delivery preference

All participants really needed relevant agricultural information in order to improve their productivity, although their requirements were slightly different. Table 7 presents agricultural information needs compared between the two villages.

Table 7

Agricultural Information Requirements Between Two Groups of the Participants

Information Requirements	Muang District	Soongmen District
Use of fertilizer	68.7%	64.6%
Organic farming	62.7%	41.0%
Soil improvement	62.0%	59.7%
Pest management	56.6%	65.3%
Market price	56.6%	59.0%
Use of insecticide	32.5%	36.1%
Financial management	28.9%	34.7%
Weather forecast	16.9%	11.1%

From Table 7, it can be seen that nearly two third of the participants (62.7%) in Muang District needed information related to organic farming while less than a half of the participants (41.0%) in Soongmen District showed an interest for this type of information. As shown in Table 7, information topics related to the use of insecticide, financial

management and weather forecasts were the least required information among both groups, on average at 34.2%, 31.6% and 14.2%, respectively.

This survey had similar findings to several other studies (Ekoja, 2004; Elizabeth & Zira, 2009; Ogunlade, Oladele & Falaki, 2006) where the use of fertilizer and pest management occupied the top ranks of information needs. Furthermore, it is in conformity with Aboyade (cited in Ekoja, 2004) that the use and the procurement of fertilizer was the highest ranked request from farmers. The need of information relevant to soil improvement and pest management from these participants was also similar to those in Banmeke and Ajayi (2007) and Ozawa (cited in Ekoja, 2004).

Participants were asked for feedback about the frequency of information transmission and the time devoted to that transmission. Their opinions about various frequencies and times were sought. Similar results were obtained from both groups. Nearly a half of the participants (45.3%) preferred a 5-minute-information session for daily transmission, whereas another 32.1% preferred the length of 15-minute long information sessions. When asked about a potential weekly transmission, the majority of the participants (43.6%) also had a preference for 15-minute information sessions while another 29.3% favoured 30-minute long information sessions. In addition, 36.3% of the participants preferred a 30-minute long information session for a fortnightly transmission. However, a smaller percentage of the participants (31.9%) also preferred to keep the information session at a length of 15 minutes. Furthermore, 43.8% of the participants preferred a 60-minute information session to be transmitted once a month while another 29.0% preferred only a 30-minute long information session monthly. Overall, it can be seen that the longer the length of information, the less often it was preferred by the participants as shown in Figure 11.

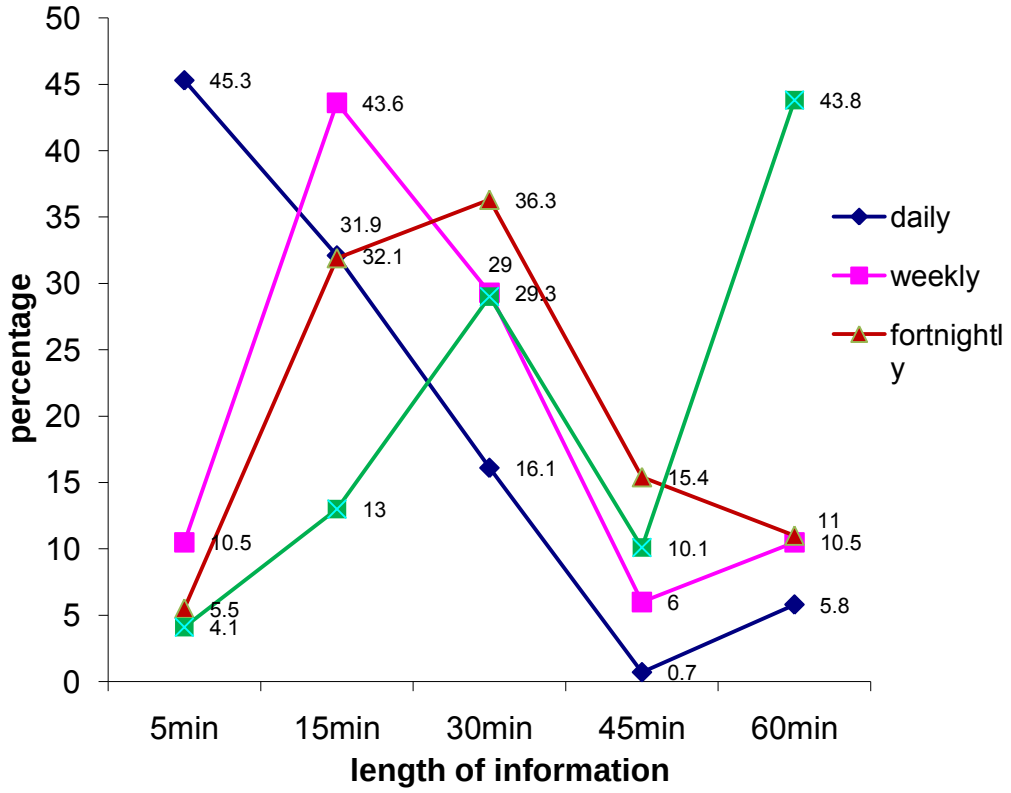

Figure 11. Percentage of participant preference towards the length of information and frequency of information dissemination.

The time of the day that participants preferred for receiving information was also an interesting factor which should be considered. It was found that for the majority of the participants (46.8%), it was convenient to obtain information between six and nine o"clock in the evening whereas another 22.7% preferred to receive the information in the morning between six and ten o"clock. Even though both groups of the participants resulted in similar preferences, the group from Muang District preferred the early morning information session twice as much as the group from Soongmen District, with percentages of 30.6% and 14.2%, respectively.

5.3.5 Previous experiences from applying agricultural information received

Participants received positive outcomes from applying the information that they received and this included higher quality of productivity (69.3%), increased amount of productivity (68.0%), higher selling price (51.5%) and lower cost (42.9%). However, it seemed that participants from Soongmen District (72.1%) enjoyed more positive experiences in terms of increasing productivity after applying agricultural information received than those from Muang District (64.1%). A reverse trend was noted for the higher quality of productivity where Muang District recorded 76.9% while Soongmen District showed 61.2% for this benefit. Figure 12 presents the comparison between two districts in terms of percentage of participants having positive results from utilizing the received information.

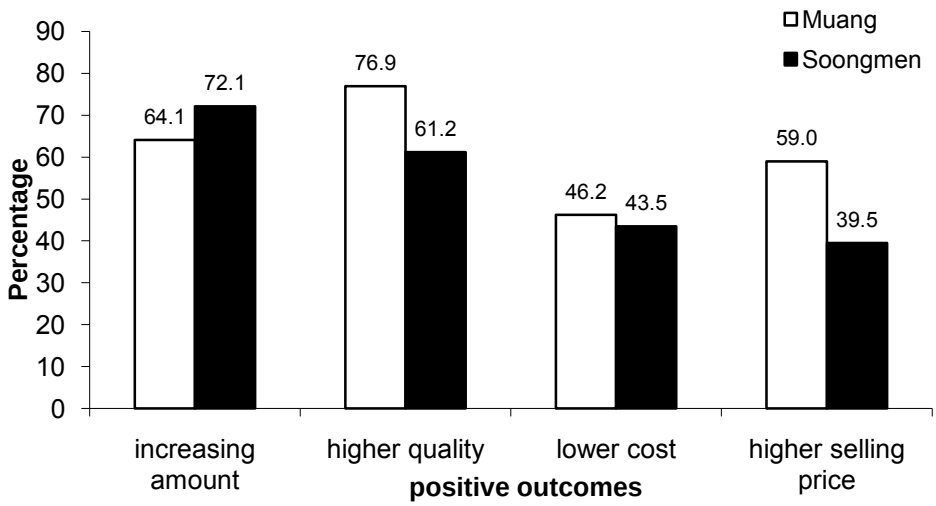

Figure 12. The bar chart shows a comparison between two districts in each positive outcome.

The negative outcomes that participants had after utilizing the received agricultural information were low selling prices, and/or higher costs together with lower productivity and the lack of follow-up from information providers after the information was received. For both districts, 45.8% cited low selling price, with 45.5% recording higher costs but lower productivity and 45.2% listing the lack of follow-up after information delivery as the negative outcomes.

It can be seen that the participants had these three experiences at similar percentages. However, on closer examination, apart from the failure of productivity, participants in both groups provided totally opposing results, as shown in Table 8.

Table 8

Negative Outcomes After Applying the Received Information Between Two Groups of the Participants

Negative Outcomes	Muang District	Soongmen District
Higher cost but lower productivity	55.1%	35.2%
Low selling price	53.8%	37.2%
No follow-up process to stimulate the success	41.7%	49.0%
Complicated process	30.8%	44.8%
Failure of productivity	23.1%	23.4%

The participants described support from the information providers which was designed to help them increase their productivity. Respondents, questioned about the type of support they received, revealed that they got the most support through the medium of VCD/DVD (51.4%). Its popularity amongst participants far exceeded other types of support, such as receiving the market price via mobile phone service (27.2%), weather forecast on the web (14.4%) and agricultural forums and web boards (12.1%).

5.3.6 Newly-grouped variables for statistical balance

It was found from the gathered data that data in some variables such as age, income and education were skewed only in a few categories. In order to analyse data statistically, those variables therefore were regrouped to make the distribution balance. Table 9 – 11 present newly grouped variables. In detail, Table 9 depicts a comparison between age groups and newly-grouped age categories. Due to the small number of participants aged 35 years and below, the participants in every under-35-year-old age group were aggregated into one group. This situation confirmed that the agricultural workforce in these villages has been

shifting to older age groups, while only a small amount of younger aged workers contributed to agricultural activities.

Table 9

Newly-Grouped Age Categories for Balancing the Statistical Weight

Age groups	New age groups
Below 15 years old	
16 – 20 years old	
21 – 25 years old	Below 35 years old
26 – 30 years old	
31 – 35 years old	
36 – 40 years old	36 – 40 years old
41 – 45 years old	41 – 45 years old
46 – 50 years old	46 – 50 years old
51 – 55 years old	51 – 55 years old
56 – 60 years old	56 – 60 years old
over 61 years old	over 61 years old

Also due to the imbalance in the percentage of each educational group, some groups were combined together to balance the groups as shown in Table 10. The certificate and undergraduate diploma group were aggregated as well as the bachelor degree and the master degree and higher group. It supports results from other studies (Banmeke & Ajayi, 2007; Irivwieri, 2007; Kari, 2007) that most farmers have low levels of formal education and were considered as illiterate.

Furthermore, the percentage of farmers in each income group was imbalanced. The percentage of farmer groups earning more than 8001 baht a month was disproportionate comparing to other income groups. Therefore, the participants who earned 8001 baht monthly or higher were assembled as shown in Table 11. This circumstance also replicated results from similar international studies of developing countries (Kari, 2007) that most farmers were very poor.

Table 10

Newly-Grouped Education Categories for Balancing the Statistical Weight

Education groups	New education groups
primary school	primary school
junior high school	junior high school
high school	high school
certificate	Certificate/Diploma
undergraduate diploma	
bachelor degree	Bachelor degree or higher
master degree or higher	

Table 11

Newly-Grouped Income Categories for Balancing the Statistical Weight

Income groups	New income groups
less than 3000 baht	less than 3000 baht
3001 – 5000 baht	3001 – 5000 baht
5001 – 8000 baht	5001 – 8000 baht
8001 – 10000 baht	More than 8001 baht
10001 – 15000 baht	
15001 – 25000 baht	
more than 25000 baht	

5.3.7 Cross tabulation analysis

Using cross-tabulated analysis between the use of computers and the use of Internet (Pearson Chi-Square, $p < 0.01$) in both groups, it was found that about two-third of the participants who used computers to obtain new information also used the Internet. However, the majority of participants (86.97%) did not use both computers and the Internet. This finding may be contributed to their poorly educated background and low

level of income. Statistics New Zealand (2004), cited in Locke (2005), found that household income and educational level were one of the most influential factors for farmers for determining Internet access at home.

Additionally, in terms of the relationship between income and the use of computer (Pearson Chi-Square, $p < 0.01$), it was found that the higher the income, the higher the percentage use of computers, increasingly ranging from 3.9% to 40.5%. This finding is in agreement with Sindir‟s (2005) findings that the higher income group used computers more than the lower income group.

Also this trend is in line with the other types of technology tools they used. There is a statistical significance between income and ICT tools such as radio, VCD, phone, mobile phone, computer, Internet and speaker (Pearson Chi-Square, $p < 0.05$). It was found that the higher the income participants earned the higher percentage of these technology tools they used to receive information. This result conforms to Sindir‟s (2005) study that the high-income group owned many more mobile phones than participants from low-income group. This type of finding also presented in the relationship between high income group and the use of Internet that the higher income group used the Internet much more than those from low income group (Sindir, 2005). It may be assumed the affordability of these technology tools is a main reason why the richer participants were more likely to get used to these technology tools.

Additionally, it is statistically significant that higher income group tends to receive information from other sources more than the poorer groups. Those information providers include neighbours, extension workers, suppliers, government officers and web sites. For example, 77.5% of the richest participant group received agricultural information from their neighbours whereas 49.5% of the poorest participant group did. Another example is agricultural information acquisition from responsible extension workers. Approximately 75% of the highest income group revealed that they obtained related agricultural information from the extension worker while only 46.5% of the lowest income group did

the same. This pattern also showed in suppliers, government officers and web sites as other information sources.

In addition, a relationship between participants‟ income and their educational background revealed that the percentage of participants in the lowest education group had decreased if the income level of the participants increased. In details, 83.3% of the lowest income group got only primary educational qualification and 75.8% of the next lowest income got the same educational level while only 23.3% of the highest income group did. Additionally, no graduate participants earned less than 3000 baht monthly and the percentage of graduate participants tended to increase from 18.8% to 62.5% in other higher income groups. In other words, it may conclude that the higher the education the participants had the higher income they earned.

Moreover, a statistical significance also existed in the relationship between income and the experience in using agricultural forums or web boards (Pearson Chi-Square, $p < 0.01$). About one-third of the highest income participants (35.7%) gained agricultural information from web sites whereas other groups used the Internet for this purpose varying from 5.1% to 13.9%. This relationship is in agreement with the percentage of computer and Internet use among this richest group. Therefore, it may be considered that their income supports their greater experience of ICT tools.

Although this survey consisted of male and female participants in similar proportions, male participants (71.4%) showed a statistically significant higher use of VCD than did female participants (28.6%) (Pearson Chi-Square, $p < 0.05$). However, this relation did not significantly show in other ICT tools.

Moreover, gender also affected roles in conveying new agricultural information to participants. Male were more likely to be the main source of information in household (72.5%) while 17.4% of male participants revealed that their wives played the main role. About a half of female participants (50.8%) stated that they mainly provided agricultural information to their family whereas 33.1% of them indicated that their husbands did. It can

be seen that male is more self-confident in terms of the leading role in the household; the female participants accept the leading role of their spouse more than the male participants do.

Moreover, several relationships between age groups and the use of ICT tools were found to be significant. It revealed that participants aged between 51- 55 years were the major users of radio (24.1%) and VCD (32.9%) among participants who also received agricultural information through these two types of ICT tools (Pearson Chi-Square, $p < 0.02$). However, relationships between this age group and other types of ICT tools did not show statistical significance. It may be assumed that people from this age group did not have as many responsibilities for their family and their work. Their successors should be adults who already have their own family and work. These participants‟ work may be in a steady status; therefore, these participants were able to spend time gathering information through radio and VCD. However, another study found that farmers may use ICT services for entertainment purposes rather than for knowledge enhancement (IICD, 2006).

The relationship between age groups and ICT tools also exists in the use of mobile phones. The majority of participants aged below 35 years (69.6%) and those between 36 and 40 years (80.0%) were more likely to use mobile phones to receive relevant information. However, only 30.8% of the elderly, who were more than 60 years of age, obtained information through mobile phones.

Additionally, the younger participants tended to use the Internet in order to receive information more than the older groups. About 30.4% of the youngest group, who were below 35 years of age, stated that they used the Internet; while the group of 36-to-40 year old participants reported that 15.0% of them used the Internet. In contrast, only 10% or less of each of the older groups of participants used the Internet. Furthermore, similar percentages also were apparent in the use of information from web sites, where groups of participants below 35 (26.1%) and between 36 and 40 years old (10.5%) received information from web sites, compared to less than 10% of each of the older groups.

The younger groups were more enthusiastic in their use of technology tools than the older groups. Another factor which should be considered is the time technology tools were introduced and became widespread in Thailand.

It was found that in almost all age groups the majority of participants stated that they were the main agricultural information providers for the household; except the participants aged 36-to-40 years (35.0%) who claimed that their spouse (60.0%) was the primary source of information. In addition, the role of their successors as an information provider increased following the age group of participants. Their children had no role at all in the group of below-40-year-old participants whereas their successors gradually played more roles from 2.5% in the 41-to-45-year-old group up to 16.1% in the oldest participant group. In other words, the older the participants the more strongly do their successors take on the roles of information providers.

It is noticeable that more than half of each age group received agricultural information from their neighbours; except the oldest group, 61 years old or above, which only 37.3% mentioned that they obtained information from their neighbours. This similarity also showed in receiving information from suppliers. Only a small number of the oldest group used information from suppliers (3.9%), which less than all other age groups.

It may be assumed that the member of oldest participants group tend to be confident in themselves as major source of information. This can be seen from their role of household information providers and because they rely the least on other information sources such as neighbours and suppliers. A reason behind this behaviour may be their own knowledge and skills in farming including previous experiences from other information sources.
A significant statistical relationship (Pearson Chi-Square, $p < 0.021$) between the age group of participants and the negative outcome related to the failure to increase the productivity also showed in this result. Nearly half of the 51-to-55-year-old participants (42.1%) experience this circumstance; however, a small percentage of other age groups faced this situation. It may be a connection between the use of specific information sources and this

experience of the 51-to-55-year-old age group which showed the highest percentage of receiving agricultural information from suppliers.

The education level of participants also related to the percentage use of ICT tools such as VCD, phone, mobile phone, computer and the Internet (Pearson Chi-Square, $p < 0.01$). In each of ICT tools mentioned above, a minority of the lowest educational participants group, which completed their schooling at the primary school level, used them to obtain agricultural information. This resulted in 14.8% for VCD, 12.3% for phone, 44.3% for mobile phones, 3.4% for computer and 3.0% for the Internet. In contrast, a majority of the well-educated group, each having at least a bachelor degree, used VCD (62.5%), phone (56.3%), mobile phone (75.0%), computer (62.5%) and Internet (62.5%) to receive useful information. Additionally, these findings, particular to the higher use of computer and Internet among well-educated participants compared to the illiterate group, are in line with Sirdir"s (2005) result. These obvious differences did not show between the other levels of education groups, all of which reported similar percentages of use of ICT tools.

A majority of well-educated participants (68.8%) also received more agricultural information from government officers than did other educational groups, especially the primary school educated participants of which only 22.5% received information from this kind of provider. Additionally, a high percentage of this second group (81.8%) also suffered because agricultural information providers failed to offer any follow-up process to encourage their success. Even though they needed to improve their farming activities and were enthusiastic about learning new techniques, their lack of skills and experience resulted in their need for monitoring from information providers to enhance their knowledge and skills. In this circumstance, user-friendly intervention in local languages may be an effective guideline for poor-educated farmers to follow the suggestions and monitor the outcomes.

However, none of the well-educated group reported that they received product market prices through the short message service (SMS) on mobile phones, while about one third of the least educated group (30.8%) and some participants in the other educational groups did.

It may be assumed that the well-educated group may have neglected this type of information source because they usually used information from other sources, such as government officers (68.8%) and web sites (68.8%). This assumption is in line with the use of web boards or forums for agricultural information. About a half of the well educated participants (53.3%) used this service, whereas few from the other less educated groups did.

5.4 Assessment of Current Situation

According to the needs analysis survey, types of agricultural information required by farmers were identified. The use of fertilizer, organic farming and soil improvement information were the most mentioned topics among farmers. Other topics, such as pest management and market price, also were requested by the majority of participants. However, information concerning the use of insecticides, financial management and weather forecast was required by less than a half of the participants.

The participants in this study were asked what kind of ICT tools they used to receive agricultural information. They revealed that television (73.6%) is the most popular ICT tool, followed by mobile phones (52.4%), radio (48.2%) and community loud speakers (34.2%). Other ICT tools, such as the VCD (23.1%), landline phones (16.3%), computers (10.7%) and the Internet (9.4%), were less popular sources of information.

Even though a huge percentage of the participants did not use computers (89.3%) or the internet (90.6%) to receive agricultural information, overall they were eager to try the Internet for this purpose. This intention was shown in their preference for using ICT tools to receive information, in these preferences the Internet was ranked above VCDs, computers and landline phones.

However, face-to-face communication was also a common channel among these participants. The participants still received agricultural information via extension workers, local councils, neighbours, government officers, and sales agents. From the survey results,

it was found that extension workers (56.5%), local councils (57.2%) and neighbours (56.9%) were highly ranked as sources of information.

When it came to the trustworthiness of face-to-face information providers, it was apparent that participants put their trust in extension workers first, followed by local councils, government officers and neighbours. Interestingly, average scores in Likert scale, the participants trusted information from government officers (4.09) more than that from neighbours (3.99), even though they obtained information from neighbours (56.9%) more often than from government officers (30.1%). It may be concluded that farmers in this study were more likely to put their trust in official information providers than in private sources.

Additionally, the participants reported that the use of ICT tools for the purpose of agricultural information dissemination occurred because of various public projects. They were:

1) receiving market price via mobile phone (27.2%)
2) VCD/DVD about agricultural improvement (51.4%)
3) online forum or web board (12.1%)
4) weather forecast announced on a website (14.4%).

This is in conformity with the DAE‟s annual report (2010) that it provided useful information on their web sites along with agricultural documentaries in a VCD format.

From the first survey of these two groups of farmers, it was found that many variables had relationships with other variables as previously mentioned. Some variables related to more than one variable such as relationships between income and ICT tools used; income and a variety of information sources; and income and education. In addition, participants in each age group differently responded to other factors such as ICT tools used, roles of household information provider and information sources chosen. A relationship between gender and

roles of household information provider is also shown in the data analysis. These relationships are depicted in Figure 13.

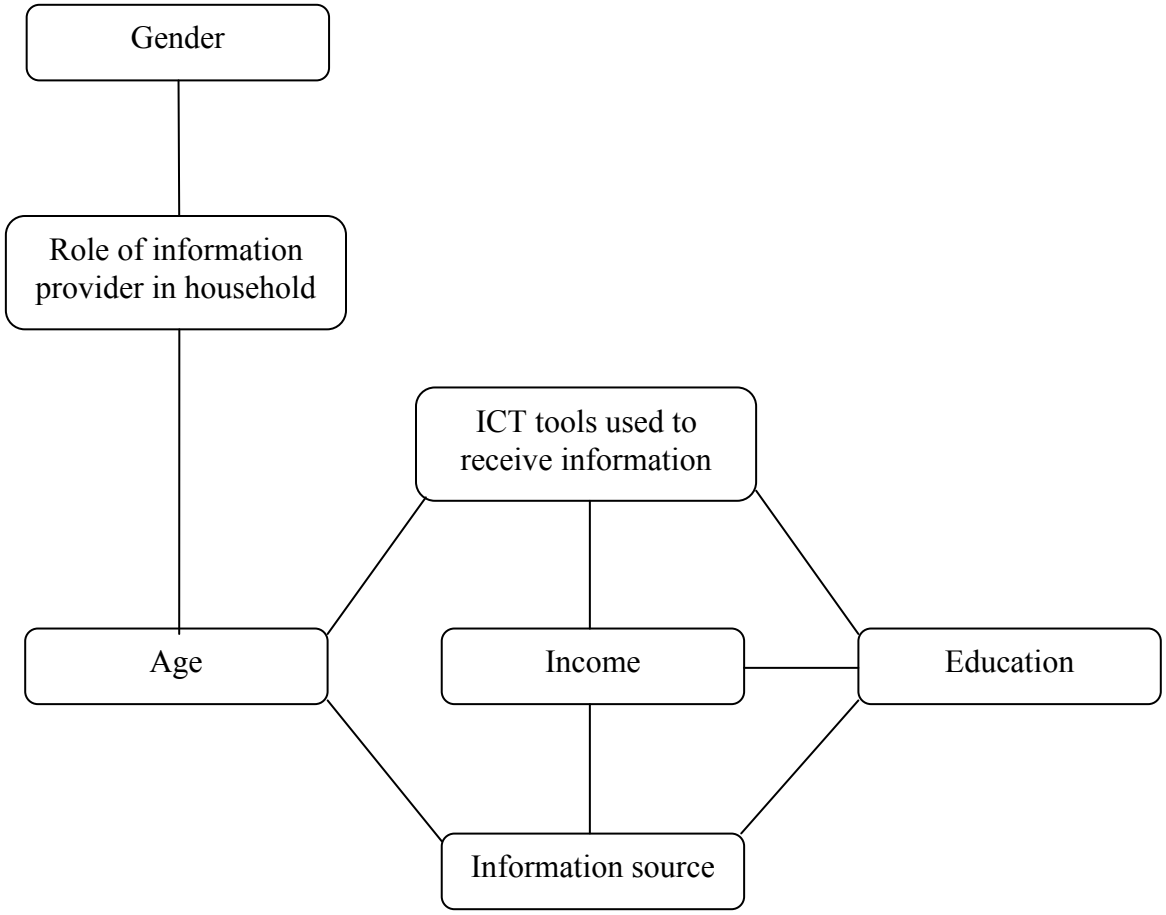

Figure 13. Relationships between variables in the needs survey.

CHAPTER 6 NEW FRAMEWORK

6.1 Introduction

Results from literature reviews, the farmers‟ needs survey and relevant documents were analysed to form a new information dissemination framework. The newly created framework was then implemented for a period of eight weeks, from mid June to mid August, 2010 during the rainy cultivation season. This chapter will provide detail of the design implementation and evaluation of the new framework.

6.2 Development of Framework

Television and radio were frequently used tools for receiving information. It can be seen from the preliminary survey that, of all the participants in this study, 73.6% used television and 48.2% used radio for receiving agricultural information. In addition nation-wide, TV and radio have been used as communication tools at 93% and 63.6%, respectively. However, only one TV programme and 10 radio channels throughout the country have broadcast agricultural information and news, under the production of the related government bodies (DAE, 2010). These tools may not be efficient if the programmes were broadcast at times that participants were neither available nor at home. This assumption was based on the results in Section 5.3 that the majority of participants preferred to receive agricultural information either between 6 and 9 AM or between 6 and 10 PM which were the prime times for TV broadcasting. Additionally, news and information delivered by these tools cannot be repeatedly watched or heard by the users themselves. After a while, the memory of the contents may fade. It may therefore be concluded that the use of television and radio as communication tools in this research may not be suitable.

Although computers and the Internet offered related information in attractive multimedia formats, they were expensive, unfamiliar, and somewhat beyond the farmers‟ daily lives. Moreover, the National Statistical Office‟s report (NSO, 2010a) revealed that only 3.4%

and 1.9% of the agricultural sector used computers and Internet, respectively which can be viewed as very low percentages. This number was in line with the needs survey‟s results which showed that computers and the Internet were the least used ICT tools among this study‟s participants at only 10.7% and 9.4%, respectively.

Furthermore, providing computer sets and Internet connections for free use at the local council still may be inconvenient for these farmers due to the office hours. Usually the offices are open from 8 o‟clock in the morning to 4 o‟clock in the evening. This time period is similar to the time that these farmers spend in their fields. By the time they returned from field work the council may have already been closed. Moreover, other studies found that a lack of computer or Internet skills was another major hindrance among rural residents in using these tools for agricultural purposes (for example, Narula & Arora, 2010). Therefore, these tools may not be considered as advantageous alternatives.

From the data analysis of the first survey, it was found that a majority of target groups (52.4%) had mobile phones along with familiarity in using mobile phones. Moreover, their preference for the use of mobile phones as an agricultural information channel was considerably higher, with a raw score of 4 out of a possible 5. Additionally, the growth rate of mobile phone users in Thailand was relatively high, from 36.7% in 2005 to 56.8% in 2009 (NSO, 2010a). Statistical data indicated that the percentage of landline phone possession in Thailand had decreased from 26.8% in 2005 to 22.1% in 2009 (NSO, 2010a). It can be seen that implementations based on the use of landline phones may not be as successful as the mobile phone-based applications. Agricultural information dissemination through mobile phones may be a suitable option to be considered.

However, most participants had an educational qualification at only a primary school level; consequently, they were considered as an illiterate group. Although audio contents through mobile phone service were proved to be effective for illiterate groups (Mittal & Tripathi, 2009), its success was limited by the time that audio information was fed to farmers. If the farmers were not available at that time, they might miss vital news or information. Also, the farmers did not have the option of listening again to the information provided at times when

they had forgotten what was said or did not hear it properly. Even if a call-back service was arranged for repeated listening, this created an extra expense for farmers to retrieve required information. It may hinder the full involvement in the experiment by needy farmers.

Due to lack of experience in using ICT tools for receiving agricultural information, a push technique to provide information directly to users was chosen. However, in another study it was found that a service providing options for users to opt out would be more successful (Rao, Ramamritham & Sonar, 2010). As a result, top agricultural information requirements from the needs analysis; namely use of fertilizer, organic farming and soil improvement, were selected as the information to be delivered to participants.

Although state of art communication tools, such as computers and the Internet, are commonly used around the world, their appropriateness within specific situations and the readiness of potential users are unavoidable concerns to take into account when offering new services to users. Most farmers in this study were poor and not accustomed to the use of computers and the Internet. A simple, effective and inexpensive ICT tool, such as the mobile phone, should be the most suitable tool for this study. Furthermore, as the users were considered to be almost illiterate, a short text should be proper for their reading skills. Even though video clips may be more appropriate to illiterate farmers than text messages, they require higher performance mobile phones which are usually unaffordable for poor farmers. Therefore, an application using a simple service called the short message service (SMS), which is supported in every model of mobile phones and does not require high bandwidth, was selected as the most appropriate option for this study. Additionally, contexts using local languages were proved to be more acceptable for non-English audiences (Arunachalam, 2002; Chaudhary, 2004; Rao, Ramamritham & Sonar, 2010); consequently, the messages should be delivered in Thai.

6.3 Implementation of Framework

An outline of the framework design is presented as Figure 14. The service prototype was developed with Visual Basic 6 tools connecting to a database using Microsoft Access 2007. This prototype connected to an assigned mobile phone via a Bluetooth connection in order to disseminate scheduled contents to participants‟ mobile phones on the list (See Appendix D for the prototype interfaces).

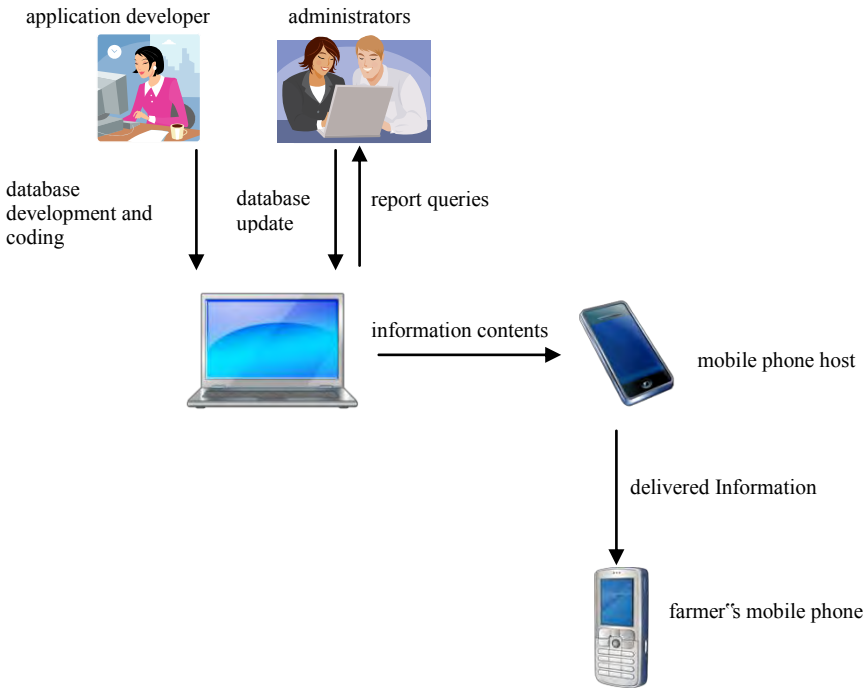

Figure 14. The proposed system framework.

The prototype application contained four main modules which were:

1) instant message delivery
2) information contents and delivery schedules
3) member management
4) Bluetooth connection

Firstly, the instant message delivery was designed to send a message out immediately to a mobile phone. Only the receiver‟s mobile phone number and a message were required to complete the text boxes provided then the messages were instantly delivered after the Send button was clicked.

Secondly, the information content management and the delivery scheduling were placed on the same interface for convenience. In the information content management, the administrator was able to create, update and delete the content topics, message subjects and details. However, due to Thai character encoding a message was limited to only 70 characters. The administrator might assign the delivery schedule for each message if required with two options which were now or date-time assignment. Later, these messages were able to be assigned in conjunction with receivers‟ mobile phone numbers. Therefore, the messages were disseminated to the assigned receivers at the times and dates specified.

Next, the membership management module supported the administrator to create, edit and delete the members of the system. Only the name and mobile phone number were necessary to manage each member‟s account. All member lists were displayed on the content management module to be linked with the messages delivered.

Finally, the Bluetooth connection module was used to configure the port used to transfer data to the connected mobile phone. After the Bluetooth connection between the computer and the mobile phone was connected on the Windows operating system platform, the assigned port would be shown. This port was assigned to this Bluetooth connection module afterwards.

There were three groups of users which were:

1) the system developer
2) the system administrator
3) farmers receiving information from the system

Firstly, the system developer worked on collecting agricultural information according to the target group‟s requirements. Then, the information from any formats was transformed into a database in order to be readily distributed to the target group through an SMS service on mobile phones. Furthermore, the developer was responsible for implementing a software application for connecting the agricultural information database to an information-sending tool like a mobile phone. In addition, the developer had all rights to access the whole system including any sub-systems within. These rights included implementing, editing and adjusting both the software application and the database. Moreover, the system developer was able to grant the system access to authorized officers in order to update the agricultural information and user registration within the database.

Next, the system administrator‟s main responsibility was to update the relevant recent agricultural information in the database. The administrator accessed information contents in the database in order to update agricultural data and mobile phone registration. However, the administrator was not able to modify the software application. In this experiment, the developer also covered the administrator‟s work.

Lastly, the farmers receiving information from the system were determined as the system users who obtained specifically required information via an SMS service on registered mobile phones.

Additionally, types of data within the database implemented were composed of agricultural information contents and user registration information. Three types of agricultural information, which were selected from the most required information in the previous needs survey, were the use of fertilizer, organic farming and soil improvement. The relevant contents were excerpted from government websites to ensure accuracy of information. Official websites of the Department of Agricultural Extension, the Department of Agriculture, the Land Development Department, all of which are under the supervision of the Ministry of Agricultural and Cooperatives, were the exemplar websites used.

Moreover, user registration information consisted of registered mobile phone numbers, and a set of coded required agricultural information topics.

In regards to the design of database, a relational database was applied. It consisted of four tables which were:

1) types of news (Table 12)
2) message (Table 13)
3) mobile phone user (Table 14)
4) message sending (Table 15)

Firstly, the types of news table contained news topics and their descriptions. Secondly, the message table contained the sub-topic, its contents and sending schedule. Each message was linked to the main topic in the types of news table via a topic identification number. Thirdly, the mobile phone user table consisted of registered recipients‟ names, mobile phone numbers and date-time of registration. Finally, the message sending table was used to link each message to be sent to each recipient.

Table 12
Detail of the Types of News Table

Field Name	Data Type	Description
id	auto number	topic identification number
name	text	topic name
detail	text	topic description

Table 13
Detail of the Message Table

Field Name	Data Type	Description
id	auto number	message identification number
type_news_id	number	topic identification number
message name	text	sub-topic name
message detail	text	message content
message type	text	either instantly or scheduled sending
message date-time	date-time	date and time to deliver the message
message created date	date-time	date and time that the message was created

Table 14

Detail of the Mobile Phone User Table

Field Name	Data Type	Description
id	auto number	recipient identification number
name	text	recipient's name
mobile number	text	recipient's mobile phone number
registration date	date-time	date and time that the recipient registered

Table 15

Detail of the Message Sending Table

Field Name	Data Type	Description
id	auto number	recipient identification number
message id	number	message id from the message table
mobile number	number	recipient id from the mobile phone user table
sending status	text	status either already sent or in schedule

After the development of the prototype was accomplished, participants from the needs survey were asked in a community meeting to try this service, at no cost. However, not all participants from the previous survey undertook this service. Then, only participants, who agreed on this trial, were asked to register into the service with their mobile phone numbers, one type of information request, frequency of receiving information and preferred time for receiving information.

All registration data were updated into the prototype system through the application interface; therefore, all participants in this experiment became members of the service. Then, an information dissemination configuration and schedule was assigned to participant, according to their requirements.

6.4 Analysis of Implementation

After conducting an experiment to deliver agricultural information according to participants‟ particular information requests, a survey to evaluate the participants‟ satisfaction with the prototype and means of information dissemination was carried out. The user satisfaction questionnaires (see Appendix E) were distributed only to the participants who joined the experiment. Therefore, these participant groups were subsets of the participants in the first questionnaire which was the requirement survey. The collected data (see raw data in Appendix F) were statistically analysed using SPSS tools with statistical techniques such as percentage, mean, standard deviation and cross-tabulated analysis using Pearson Chi-Square technique.

6.4.1 Demographic data

The participants were composed of 57 (49.1%) farmers from the Muang District and 59 (50.9%) farmers from the Soongmen District. In total, the number of male participants (71.6%) was many more than female participants (28.4%). However, the majority of participants from the Muang District (84.2%) were male, while male (59.3%) and female participants (40.7%) from Soongmen District were more similar in number (see Figure 15).

The proportion of male and female farmers in total was in line with many studies (Elizabeth & Zira, 2009; Cidro & Radhakrishna, 2006) that a majority of farmers are male. However, this experiment was involved with voluntarily using a mobile phone service. With some studies finding that females were less comfortable than males in dealing with technology tools (Saghir, Ashfaq & Noreen, 2009), the idea that some female farmers may have refused to participate in this experiment, could not be discounted.

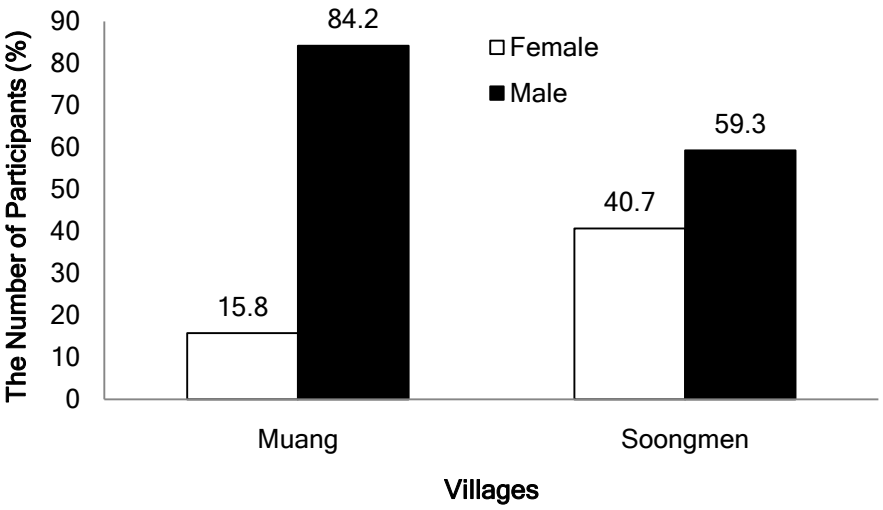

Figure 15. The percentage of male and female participants in each village.

Participants in this experiment were mainly between 41 and 60 years old (81.9%). There was no one younger than 30 years old. In comparison with the farmer group in Cidro and Radhakrishna‟s (2006) study, farmers under 50 years of age in their survey accounted for 63.1%; while participants in this study from the same age group accounted for 37.0%. The remainder were 51 years old or above. A majority of farmers in this experiment must be seen as middle-aged or elderly farmers. Most participants (76.7%) had completed only a primary school education, although 12.9% of participants finished at the level of junior high school. It may be considered that this group of participating farmers was illiterate, especially when compared with farmers in Cidro and Radhakrishna‟s (2006) study in which 50.6% of their farmers were educated at least to a college level and those of Ogunlade, Oladele and Falaki‟s (2006) survey which 75% of the participants had educational qualifications at least at post-secondary education level. However, this contradiction may also be attributed to a difference between urbanity and the countryside.

Nearly all of participants (91.4%) were married; meanwhile 84.5% of participants lived with less than four family members. It drew a picture of small farming families among these participants. Additionally, participants‟ monthly income from both districts was not much different among the income groups of 3001-5000 baht (20.7%), 5001-8000 baht (21.6%), 8001-10000 baht (29.3%) and 10001-20000 baht (17.2%). However, in

comparison the majority of participants from Muang District (77.2%) earned about 8001 – 20000 baht whereas 69.5% of those from Soongmen District earned 3001 – 8000 baht as shown in Figure 16. It may show that, in general, farmers from the Muang District are more likely to be richer than their counterparts from the Soongmen District.

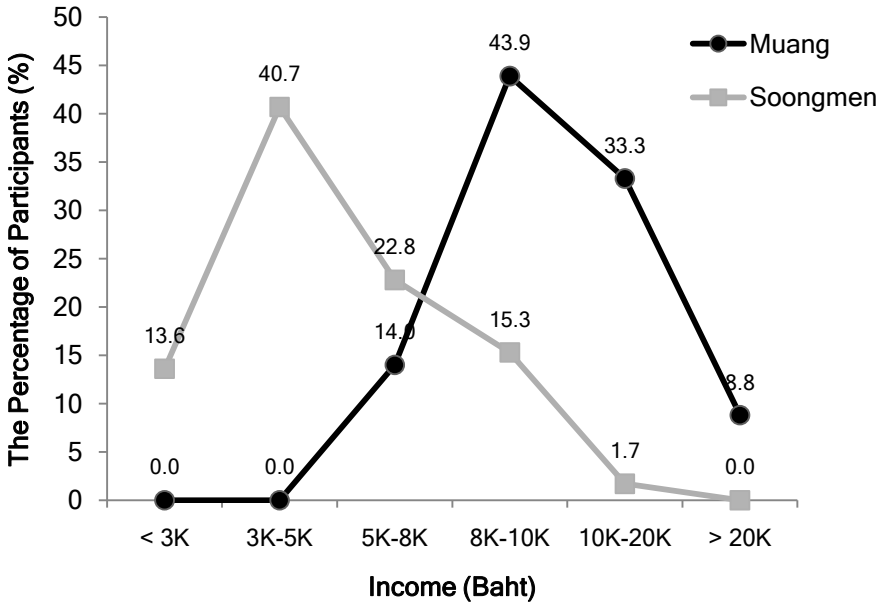

Figure 16. The percentage of participants in each income group between two villages.

6.4.2 Information and its dissemination in the experiment

In terms of information requests from participants in the experiment, the use of fertilizer (37.1%), soil improvement (34.5%) and organic agriculture (28.4%) were requested in a similar percentage, as depicted in Figure 17. Nevertheless, the types of information needs from both districts were very different. Muang District mainly required information related to the soil improvement which is account for 61.4% of those in the village; whereas participants from Soongmen District paid more attention in the use of fertilizer (47.5%) and the organic agriculture (44.1%).

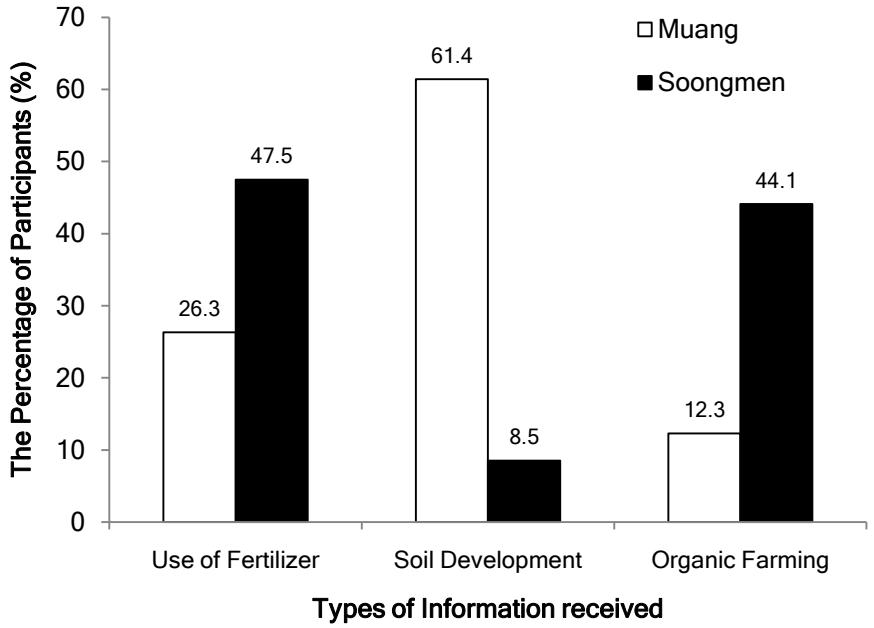

Figure 17. Percentage of participants receiving each type of information between two villages.

Preference toward the frequency of information received was totally dissimilar between two villages. Although receiving information weekly (63.2%) was the option chosen most among participants from Muang District, all of those from Soongmen District (100%) chose this frequency, as illustrated in Figure 18. This unusual circumstance may be affected by participants‟ uncertainty to the use of ICT tool features like sending and receiving short message service (SMS). Getting information daily may seem too often for them who were not familiar with technology; meanwhile monthly information may seem unworthy to try a new offered service.

Nevertheless, after the information dissemination experiment their preference of information frequency changed. Participants from Muang District mainly required agricultural information either daily (43.9%) or weekly (40.4%). In contrast, there was no a vast difference on preference of information delivery frequency among participants from Soongmen District twice-a-week (25.4%), weekly (23.7%), fortnightly (23.7%) and monthly (25.4%), as show in Figure 19.

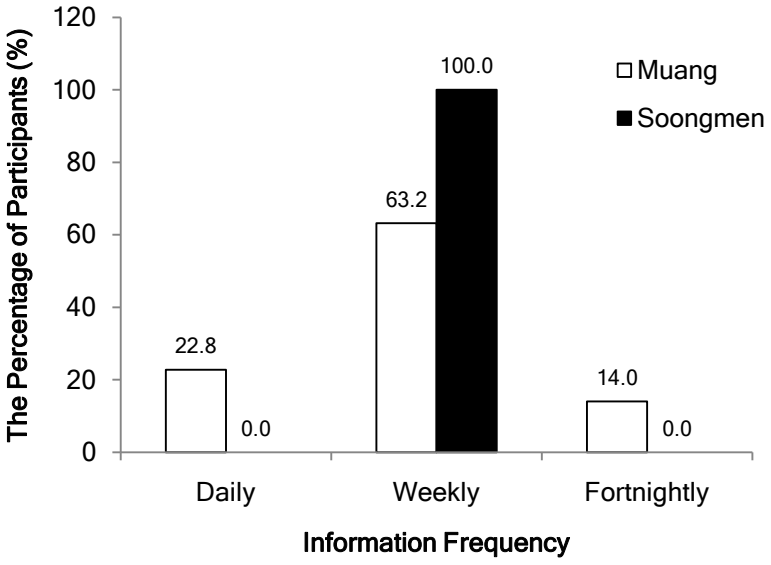

Figure 18. The percentage of participants choosing a frequency they preferred to receive agricultural information for the experiment in each village.

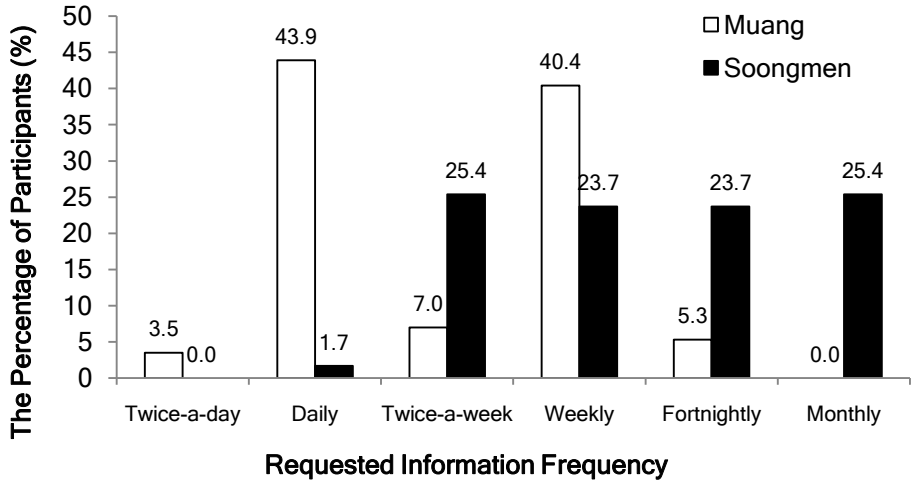

Figure 19. The percentage of participants requesting a new information frequency in each village.

Before the information delivery experiment all participants chose their receiving frequency according to their expectations of the service which was about to be provided. After the testing period, they were able to opt for the frequency that suited their own convenience

and interest. Figures 20 and 21 show their changes of preferences about receiving information before and after the experiment in each village.

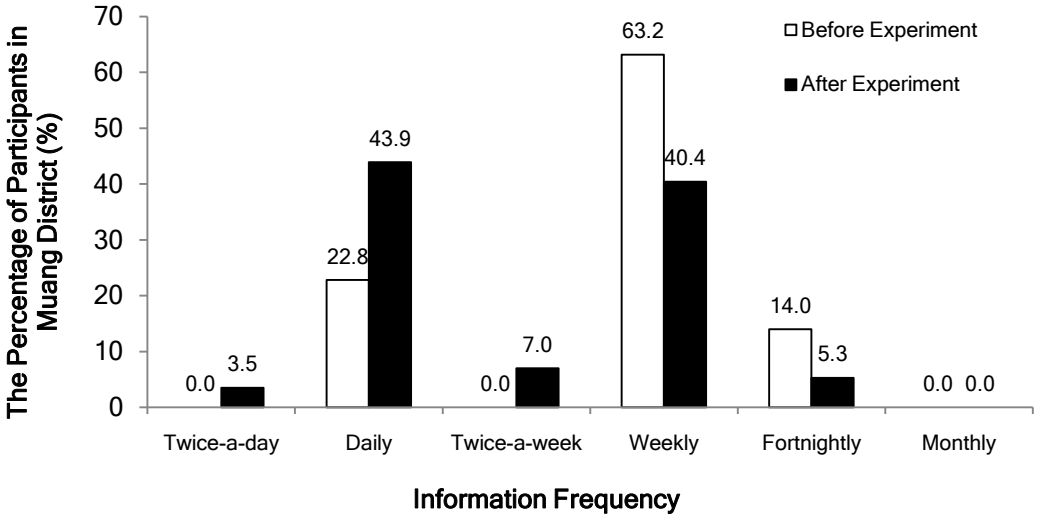

Figure 20. The comparison of information frequency between before and after the experimental service among participants in the Muang District.

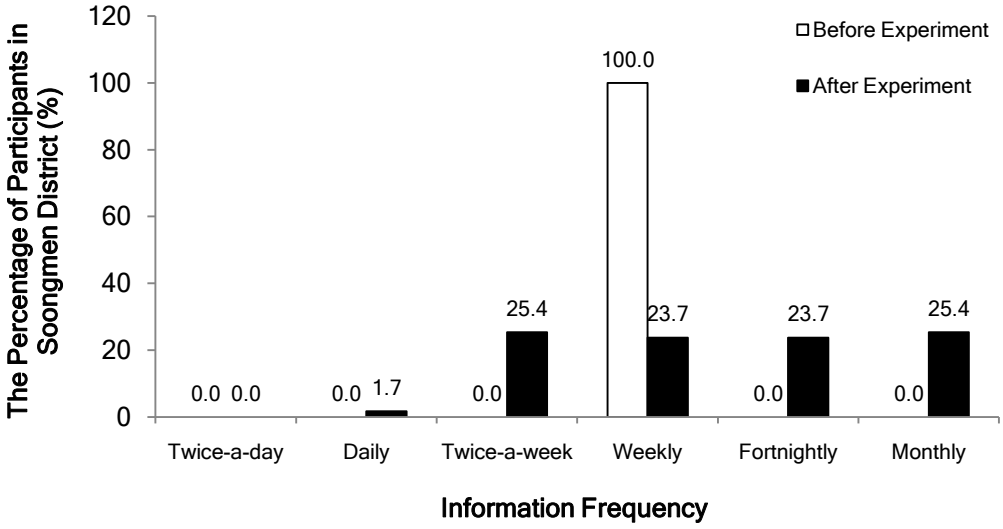

Figure 21. The comparison of information frequency between before and after the experimental service among participants in the Soongmen District.

6.4.3 Opinions of the information dissemination in the experiment

In terms of participants‟ opinions of the information delivery service, participants from the two villages revealed differences on some aspects; namely convenience, ease of use, a free-of-charge service, knowledge enhancement, a technology practice, information timeliness and an information format. The average score and standard deviation value in each category of opinions toward the service is shown for each in Table 16 below.

Table 16

Opinions Toward the Experimental SMS Service Between Two Villages

	Muang District		Soongmen District	
Opinions	Average	SD	Average	SD
Convenience	4.86	0.35	4.56	0.57
Ease of use	4.82	0.38	4.64	0.58
Free of charge	4.95	0.23	4.53	0.57
Knowledge enhancement	4.88	0.38	4.54	0.57
Technology practice	4.77	0.44	4.39	0.62
Information timeliness	4.86	0.35	4.40	0.64
Information format	4.84	0.37	4.42	0.62

Note. Values are mean scores on a 5-point scale which the lowest score is 1 and the highest score is 5.

It can be seen from Table 16 that on average participants in the Muang District had more positive opinions toward the service in every aspect than those from the Soongmen District. Moreover, the standard deviation in each category also showed that the opinions among participants in the Muang District alone were less variable than those from the Soongmen District.

Furthermore, in terms of opinion ranking from Table 16 it showed that participants from the Muang District were more interested in the benefit of free services and the knowledge they gained, while participants from the Soongmen District perceived advantages in the convenience of the service followed by the ease of use.

Compared to the survey results obtained from research activity Stage 1, this survey revealed that the Soongmen participants used ICT tools for receiving information more than Muang participants did for every sample tool except landline phones. In addition, the percentage of mobile phone users among the Soongmen farmers (68.3%) was much higher than those from the Muang District (38.8%). Also the preference toward the use of ICT tools among the Soongmen farmers was higher than, or at least equal to, those from the Muang District for every tool, including the preference for the use of mobile phone as an information source. Consequently, it may be assumed that familiarity with using ICT tools positively affected opinions toward the use of these technologies for agricultural purposes.

Furthermore, in regard to the knowledge enhancement from the information received, the Muang participants scored this issue at the second rank. Percentages of the Muang participants‟ educational backgrounds were higher than those from the Soongmen participants at all levels except the primary school level. In other words, the Muang participants had higher educational qualifications than the Soongmen participants. This factor may have affected the understanding and learning effectiveness of information obtained by the participants.

6.4.4 Further requested agricultural information

All participants were also asked, in case they would like to continue this information dissemination service, what kind of agricultural information they would require. Information related to market price was the most requested topic (44.8%) followed by pest management (40.5%), financial management (22.4%), the use of insecticide (15.5%) and weather forecast (5.2%).

The requirement for pest control information among these participants was different from participants in Ekoja‟s (2004) Nigerian study where information regarding pest control was in high demand at 93.1% of all participants. This different requirement for pest control information highlights the fact that pest control is very specific to particular locations.

Similarly, information concerning financial management seemed to be unwanted among the participants in this study whereas information on the investment of agricultural profits was requested by 91.1% of participants in Ekoja‟s (2004) study. These different results may be because in Thailand a commercial bank running under the government support, named the Bank for Agriculture and Agricultural Co-operatives (BAAC), was set up for directly supporting farmers and agricultural activities spread throughout the country. In 2009, this bank allowed 298,000-million-baht credit for 4,668,799 individual farmers and 1,530,000 farming cooperatives (Agricultural Information Center, 2010). Therefore, how to receive financial support may not be a great concern for Thai farmers.

Furthermore, these two villages provided noticeably different results in their need for information on the subject of pest management, insecticides, weather forecasts and market prices, as depicted in Figure 22.

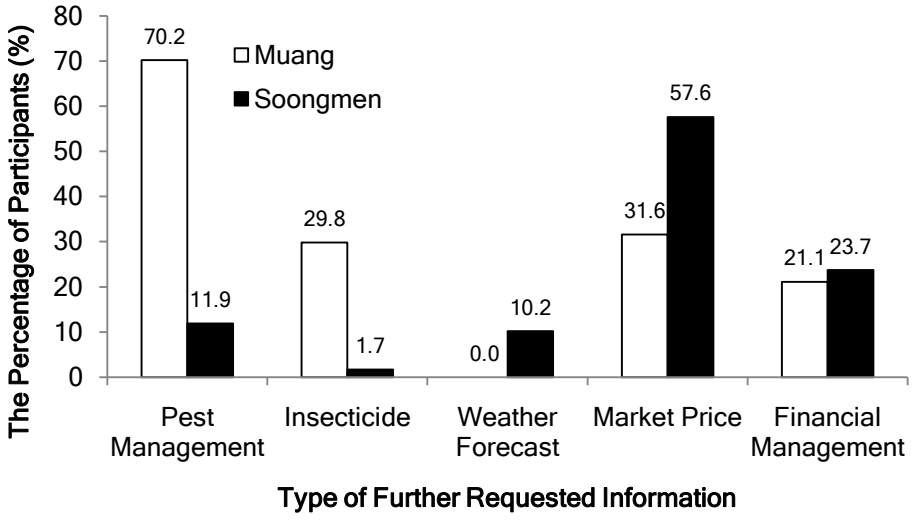

Figure 22. A comparison of the requirement various information topics between the two villages.

Information related to pest management was required by most participants from the Muang District (70.2%). Conversely, this kind of information was needed only by a minority of participants from the Soongmen District (11.9%).

How to use insecticide also was not in demand among participants from either village (Pearson Chi-square, $p < 0.01$). However, nearly all participants from the Soongmen District (98.3%) mentioned they did not require it, while 29.8% of participants from the Muang District indicated that they still needed it.

It seemed that information in relation to weather forecasts was not a priority among these participants (Pearson Chi-square, $p < 0.02$). No participant from the Muang District stated that they needed it while only a small percentage of participants from the Soongmen District (10.2%) requested it.

The need for information concerning product market prices showed diverse results between these two villages (Pearson Chi-square, $p < 0.01$). Only 31.6% of the participants from the Muang District stated that they required this kind of information whereas more than half of the participants from the Soongmen District (57.6%) did. It can be seen that participants from the Soongmen District were nearly twice as interested in receiving market price information as those from the Muang District.

6.4.5 Difficulties from the experiment

In relation to unfamiliarity with the use of technology tools, only 18.6% of participants from the Soongmen District cited as a problem, while this problem was not mentioned among those from the Muang District. The technology familiarity among these farmers reiterated a rural development issue, that implementing ICT tools for enhancing livelihood in rural areas still needed a certain level of technology competence skills (Sindir, 2005).

Additionally, inconvenience from reading text that was too small was pointed out by 12.9% of all participants, which was divided into 8.6% from the Muang District and 4.3% from the Soongmen District. Nevertheless, nobody mentioned that receiving information by SMS was a cause of annoyance was not responded, and only 1.7% thought that some of the information received was impractical.

6.4.6 Crossed analyses among variables

Considering the dissimilarity between genders, it was found that in general male participants always rated higher score in every aspect of opinions of the experimental service. Table 17 illustrates average score and standard deviation in each aspect of their opinions.

Table 17

Opinions Toward the Experimental SMS Service Between Male and Female Participants

	Female		Male	
Opinions	Average	SD	Average	SD
Convenience	4.60	0.50	4.75	0.49
Ease of use	4.70	0.47	4.75	0.51
Free of charge	4.64	0.49	4.77	0.48
Knowledge enhancement	4.55	0.51	4.77	0.50
Technology practice	4.33	0.60	4.65	0.53
Information timeliness	4.42	0.61	4.71	0.53
Information format	4.51	0.50	4.67	0.57

Note. Values are mean scores on a 5-point scale which the lowest score is 1 and the highest score is 5.

The female participants‟ opinions toward the information delivery service were in accordance with Annan (2003 cited in Saghir, Ashfaq & Noreen, 2009) and Saghir, Ashfaq & Noreen (2009). Like females from other countries, the female participants did not enjoy their access information technology tools as much as males did.

The income of most female participants (78.8%) fell into the category of 3,001-10,000 baht while a majority of male participants (73.5%) earned between 5,001 and 20,000 baht. This showed that generally male participants slightly earned more than female participants.

A relationship between income and the type of information received also warranted some attention (Pearson Chi-square, $p < 0.02$). A majority of participants, who requested

information related to the use of fertilizer (76.7%) or organic farming (75.8%), earned between 3,001 and 10,000 baht. However, 70.0% of participants who received the soil improvement information were in the income category of 8,001 to 20,000 baht. In other words, participants, who earned higher incomes, were more likely to require information related to soil improvement.

Also the relationship between educational level of farmers and farmers‟ income showed a trend. All farmers with degrees earned more 20,000 baht a month while only 1.1% of farmers who had a basic primary school education earned the same amount. In the meantime, all farmers who earned less than 3,000 baht finished only to the primary school level. The higher educated farmers were more likely to earn more money than others who had lower educational qualifications.

Moreover, income and the required frequency of the information received showed a relationship. Participants who requested agricultural information daily earned at least 8,001 baht per month; most participants of this group (69.2%) made revenue between 10,001 and 20,000 baht a month. In contrast, 80% of the participants who received information fortnightly earned between 3,001 and 10,000 baht monthly. In other words, richer participants were more likely to request agricultural information more often than the poorer participants. However, all participants who chose to receive the information once a month were equally distributed in four income groups.

Opinions about the convenience of use also showed a relationship to participants in each income group. Participants, who rated the convenience of service use with a score of four out of five (76.7%), were mainly in groups of 3,001 to 10,000 baht income, whereas a majority of participants who gave convenience a score of five out of five (73.7%), earned income between 5,001 and 20,000 baht. In other words, higher income participants were more likely to award higher scores for the convenience of technology tool usage.

In addition to the relationship between the convenience of ICT tool use and income group, a similar relationship also showed in opinions of the free-of-charge service. Most of

participants, who stated they agreed with this issue (77.7%), earned between 3,001 and 10,000 baht while 73.5% of participants, who strongly agreed, were mostly in groups earning 5,001 to 20,000 baht. In other words, the more income the participants earned the more likely they were to rank this aspect highly.

Moreover, a relationship between income groups and opinions toward knowledge enhancement was revealed. Similarly, 54.2% of participants, indicating that they strongly agreed with the agricultural knowledge they gained, were in income groups of 5,001 to 10,000 baht. However, about a half of the participants (53.6%), who earned 5,000 baht or less, rated four out of five score in this topic. Also in this matter, higher income participants were more likely to allocate higher ranking for the knowledge enhancement which they believed they gained from the experiment.

Additionally, a relationship between opinions toward technology practice and income was also in an agreement with previously mentioned relationships. A majority of participants, who had a strong agreement on the technology practice they obtained from the experiment (89.9%), earned between 3,001 and 20,000 baht monthly while 90.7% of participants, who only agreed, had 10,000 baht or less per month. In other words, richer participants were more likely to allocate higher scores to an agreement about the technology practice.

Furthermore, among participants who indicated a strong agreement with the timeliness of the service, the largest group (33.3%) earned about 8,001 to 10,000 baht a month. In contrast, the largest group of participants who indicated just an agreement (33.3%) monthly earned between 3,001 and 5,000 baht. It seems that the richer group was more likely to enjoy the service than the poorer group.

The relationships between income and further information requirements were also present for the topic of pest management as illustrated in Figure 23. In comparison among participants who earned 8,000 baht a month or less, participants who required information related to pest management were less than those who did not. Furthermore, the number of participants in both groups was equal in the group of participants who earned 8,001 to

10,000 baht monthly. The number of participants who required the information was larger than the other group if their income was 10,001 baht or more a month. It seems that the higher the income they earned, the more likely they were to pay attention to obtaining pest management information.

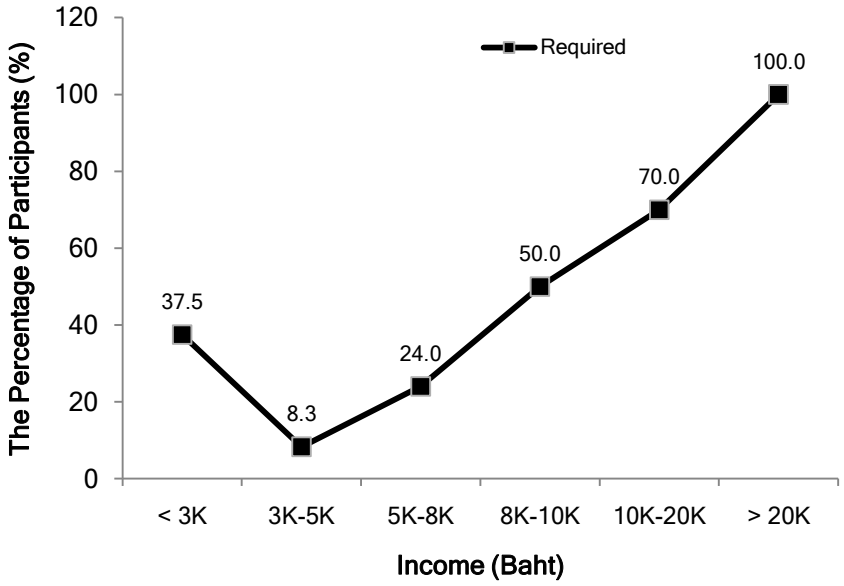

Figure 23. A percentage of participants who required and did not require pest management information in each income group.

Moreover, income related to a shortcoming of the service, like unfamiliarity with use of technology tool, as shown in Figure 24. Comparison of each income group, between participants who had this problem and those who did not, the higher income they earned, the lower the percentage of participants finding it difficult to use ICT tools. Additionally, all participants who found this to be an obstacle earned less than 8,000 baht a month.

The relationship between the types of agricultural information requested by the farmers and frequency for receiving information also showed in the cross tabulation analysis (Pearson Chi-square, $p < 0.01$). Among participants receiving information about the use of fertilizer, 34.9% preferred to obtain the information weekly, and 23.3% wanted to obtain it twice a week. However, nearly a half of participants requesting information related to soil improvement (45.0%) preferred to receive information daily, followed by weekly (37.5%).

Participants, who received information related to organic farming, were happy to receive the information fortnightly (30.3%) whereas receiving the information twice a week, weekly and monthly was requested equally (21.2%), as depicted in Figure 25.

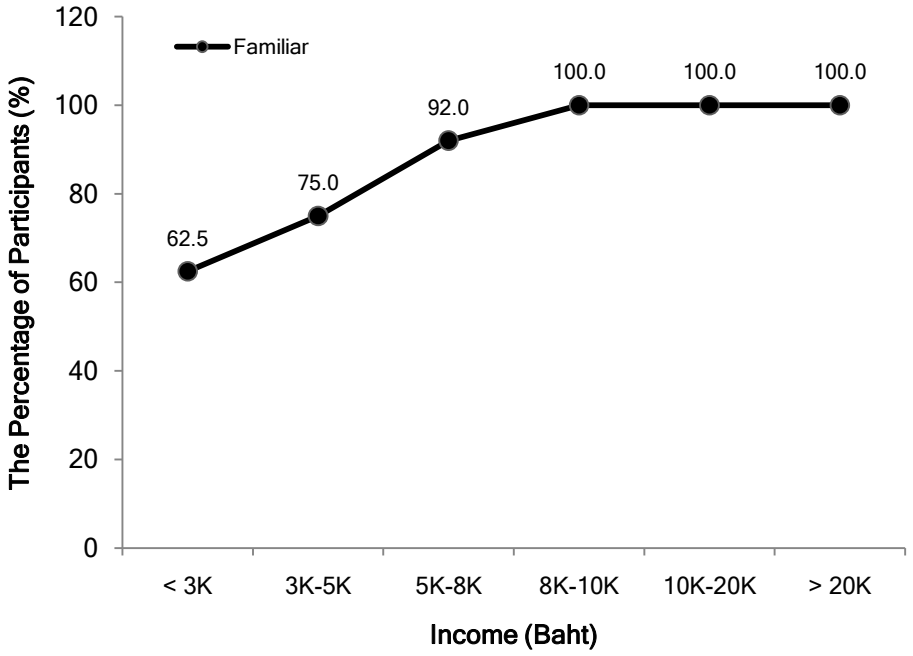

Figure 24. Comparison between participants who found unfamiliar ICT tools to be a problem and those who did not.

Furthermore, more than 90% of participants receiving information regarding soil improvement allocated the highest score for the benefit of convenience from the experimental service. Nevertheless, other participant groups, who received information, either about the use of fertilizer or organic farming, allocated the same score at 60.5% and 63.6%, respectively.

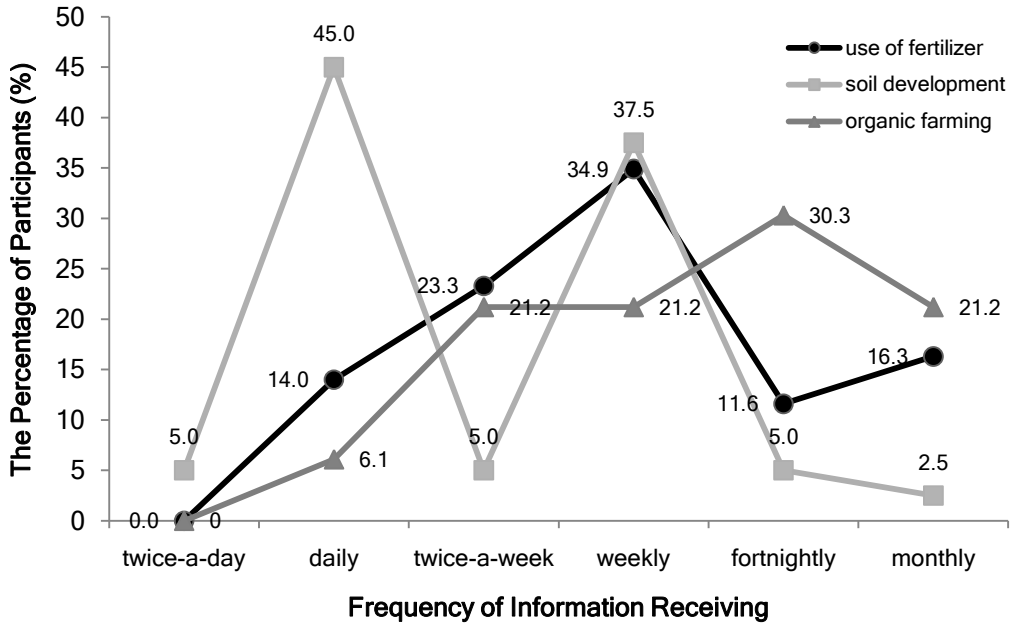

Figure 25. The percentage of participant preference to receive further information categorised by information type they previously obtained.

In addition to the topic of convenience, the ease of use was also highly mentioned by the participants receiving information concerning soil improvement. 90% of these participants allocated the five-out-of-five score for ease of use while only 60.5% and 78.8% of participants receiving information regarding the use of fertilizer and organic farming, respectively, allocated the same score.

Similarly, a majority of participants receiving the soil improvement information (92.5%) allocated the highest score for the benefit of free service, whereas participants who received information about the use of fertilizer or organic farming topics, allocated the same score at 67.4% and 63.6%, respectively.

The previous pattern also showed in the topic of the knowledge enhancement the participants gained from the experiment. Most participants who received information about soil improvement (92.5%) strongly agreed on this benefit; however a smaller number of participants from the other two groups strongly agreed at that they had benefited. In detail,

62.8% from the use of fertilizer group and 63.6% from their organic farming group mentioned the strong agreement that their knowledge had been enhanced.

The benefit of technology practice was strongly supported by most participants who received information related to soil improvement (80.0%). Additionally, about a half of the participants receiving information about fertilizers (53.5%) used strongly agreed when questioned about this issue. Furthermore, less than a half of farmers gaining information concerning organic information (42.4%) allocated the same level of agreement.

Information timeliness and information format were other two aspects that a majority of farmers, who received information in relation to soil improvement (87.5%), rated the highest score for both aspects. In accordance with results from other aspects, the percentage of participants obtaining information about the use of fertilizer and organic farming who strongly agreed on these two aspects (58.1%) were much fewer than the soil improvement group.

From the pattern of results, it may be assumed that farmers receiving the soil improvement information were more satisfied with the experimental service than the other two groups. However, it was previously found that the higher income participants were more likely to allocate higher score in each aspect than the lower income groups. In addition, the participants earning higher income were more likely to request soil improvement information. It may be assumed that the results from participants receiving the soil improvement information were similar to the rich participants because a majority were in the higher income groups.

A relationship between each information group and a further information request for pest management was also found in this survey (Pearson Chi-square, $p < 0.01$). Only one third of farmers receiving the use of fertilizer information (32.6%) indicated that they might need the pest management information while a majority of farmers in the soil improvement group (67.5%) mentioned that they might need it. However, most participants who received information about organic farming (81.8%) declined the offer of the pest management information when a further experiment was discussed. It may be assumed that farmers in

the organic farming group believed they had already learned enough about pest management in their own field; therefore, they would not need this kind of information to any extent.

Moreover, information related to the use of insecticide was not greatly needed by any of the farmer groups (Pearson Chi-square, $p < 0.01$). Even though one third of the participants receiving information about soil improvement (32.5%) stated that they might need information in relation to the use of insecticides, farmers obtaining information about the use of fertilizer and organic farming hardly felt they needed the insecticide information, at 9.3% and 3.0%, respectively.

However, among participants who might cancel the information service because of unfamiliarity with the technology, about two thirds of them (63.6%) were in the use of fertilizer group and the rest (36.4%) were in the organic farming group. No one in the soil improvement group mentioned that possibility. Additionally, it cannot be forgotten that a majority of participants receiving the soil improvement information were in the high income groups and these groups did not report any unfamiliarity with the tools used in the experimental service.

Changes in the frequency of information delivery requested by participants also related to the benefits of the experimental service. All participants who requested further information twice a day rated the service at the highest score in every aspect; namely, convenience, ease of use, free-of-charge service, knowledge enhancement, technology practice, information timeliness and information format. Additionally, among farmers who indicated they preferred to receive information daily, twice a week, weekly or fortnightly, a majority of each group also rated the service highly with a score five out of five. However, the majority of farmers who requested information monthly allocated the score four out of five for every aspect. This result may reflect their satisfaction toward the service. This group of participants preferred to receive information monthly which was the least often frequency offered. Although they were not extremely satisfied with the service, they were not dissatisfied.

Moreover, most participants in each information frequency group did not mention that unfamiliarity with the technology was their problem, except the participants who requested further information monthly. This group stated that they found or did not find this an inconvenience at similar percentages, 53.5% and 46.7%, respectively. It may be assumed that unfamiliarity with the technology was the reason why they preferred to utilise the technology as infrequently as possible.

6.5 Evaluation of the Framework

The user satisfaction survey revealed in total that participants had strongly positive attitudes toward the mobile phone based service that they received as shown in Table 18.

Table 18

The Average Score and Standard Deviation in Each Aspect of the Service

Opinions	Average	SD	Evaluation
Convenience	4.71	0.49	Strongly Agree
Ease of use	4.73	0.50	Strongly Agree
Free of charge	4.73	0.48	Strongly Agree
Knowledge enhancement	4.70	0.51	Strongly Agree
Technology practice	4.56	0.56	Strongly Agree
Information timeliness	4.63	0.57	Strongly Agree
Information format	4.63	0.55	Strongly Agree

Note. Values are mean scores on a 5-point scale which the lowest score is 1 and the highest score is 5.

From Table 18, it can be seen that average score in each aspect was closer to the level of Strongly Agree opinion; therefore, it may assume that generally participants realized the benefits of the experimental service in using mobile phones to receive agricultural information.

In addition, after the experiment the participants were asked how often they preferred to receive information in the next experiment. It was found that a majority of them (65.5%) required the information delivery more often or as often as the current frequency they got in the recently finished experiment. This may be another indicator that participants were satisfied by the information dissemination service through SMS on mobile phones.

However, in terms of displeasure against the service only a small percentage of participants expressed that they did not appreciate some issues of the service as shown in Table 19.

Table 19

The Total Percentage of Participants Against the Service Shortcomings

Shortcomings	Mentioned	Not mentioned
Unfamiliarity of the ICT tool used	9.5%	90.5%
Too small text size shown on mobile phone	12.9%	87.1%
Cause of annoyance	0.0%	100%
Unrelated or unpractical information	1.7%	98.3%

It can be seen from Table 19 that a majority of total participants did not encounter any hindrance in using mobile phones to receive agricultural information; especially no participants felt this service annoying.

The lack of experience in using SMS feature may be a cause of feeling unfamiliarity in using this provided service. This experiment was the first time that these farmers directly obtained agricultural information via their own mobile phones. Although the SMS is a common kind of available feature on mobile phones, it is understandable that most farmers only used mobile phones for calling service.

Particularly, all farmers who mentioned the information irrelevance were in the group of fertilizer-related information receiver. Therefore, the dissatisfaction might depend on the content itself, not on the service provided.

In summary, it can claim that generally the targeting participants were satisfied with this experiment. Also in regard to agricultural knowledge enhancement, these participants rated 4.7 out of 5 which was very high. Therefore, it may conclude that this kind of service was effective in the target participants‟ view.

6.6 Summary of the Implementation

During the experiment three types of agricultural information namely use of fertilizer, organic farming and soil improvement were provided to the participants. Then after the experiment these participants were asked in future if they would like to continue on this service, what kinds of information they preferred. It appeared that information regarding the produce market price (44.8%) was at the top rank closely followed by pest management topic (40.5%). However, other alternatives such as financial management (22.4%), the use of insecticide (15.5%) and weather forecast (5.2%) were still at the bottom.

In summary, it may conclude that use of fertilizer, organic farming and soil improvement agricultural information topics were in the highest demand among Thai farmers in the study areas. Beside these topics, market price and pest management information was also desirable. However, the importance of information related to financial management, the use of insecticide and weather forecast was not essentially perceived in the participants‟ point of view.

However, the user satisfaction survey after the experiment in Section 6.4.6 revealed relationships among variables as illustrated in Figure 26. It was found that income and information topics affected many variables such as gender, further information request, preferred frequency of information and opinions toward the service. In addition to the preliminary results in Section 5.3.7, it is confirmed that participants‟ income related to their education and technology familiarity.

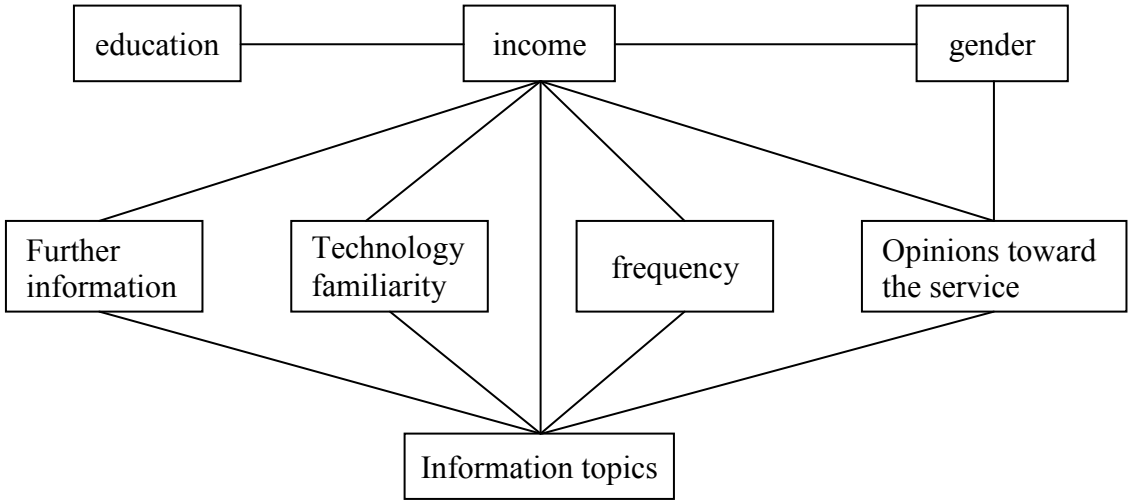

Figure 26. Relationship diagram between variables in the user satisfaction survey.

However, due to the fact that a majority of some variables were also a majority of another variable, some unreasonable relationships may be unable to be neglected. A relationship between types of information received and technology familiarity was an example. It may be illogical if this relationship was tried to get a reason to support why participants who received a particular type of information were more familiar with the ICT tools used than participants who received other types of information.

According to the user satisfaction results, a majority of high income participants chose the option of the soil improvement information. Also, a majority of high income participants had fewer difficulties in using the ICT tools to receive the agricultural information provided. It may be concluded that in fact the relationship between the information topics and the technology familiarity was a derivative outcome. In regard to the relationships among income, information received and further information request, the relationship between information received and further information request were more reasonable than one between income and further information request. Accordingly, if these presumed relationships are removed from the relationship diagram in Figure 26, the outcome will be the diagram depicted in Figure 27.

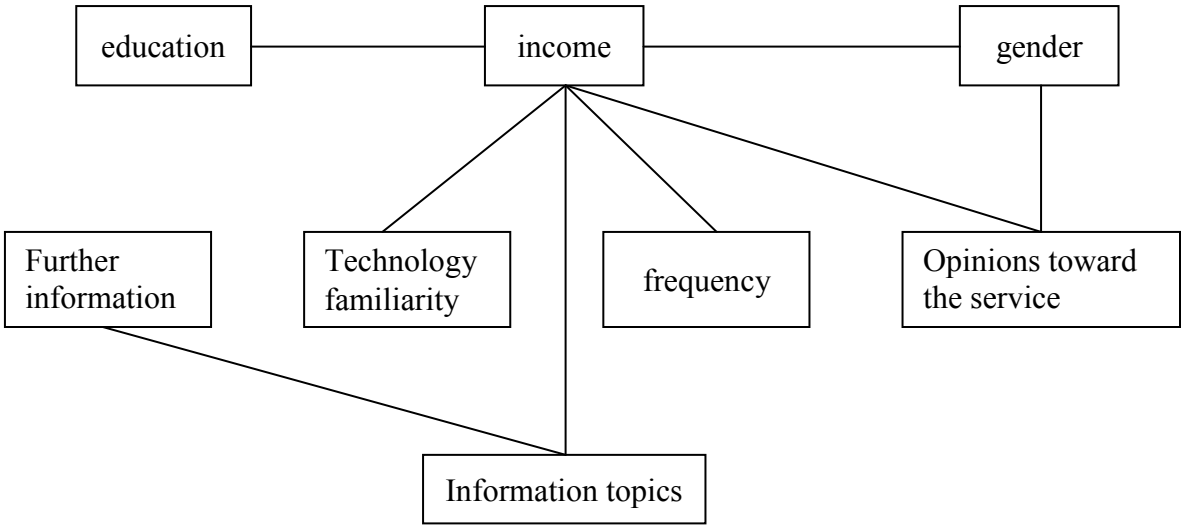

Figure 27. Presumed relationship diagram between variables in the user satisfaction survey.

6.7 Results of Group Interview

After the experimental information delivery service concluded, a user satisfaction survey was conducted for all the participants. Then group interviews were separately held in both villages in order to find out their further needs for ICT services to support their agricultural practices. Their satisfaction with the finished information dissemination service was evaluated and a few examples of ICT services in which they might be interested were proposed and discussed.

Participants from the Muang District were asked to engage in a group interview at their agricultural learning centre at an assigned time and date. However, only eight of them, together with their village chairperson and an agricultural extension worker responsible for their area, came to the centre and joined the interview; as a result ten interviewees took part in this group interview. The interview took approximately one hour, and continued until there were no new ideas or comments emerging.

Then, a group interview with participants from the Soongmen District was arranged at their village chairperson‟s place at an assigned time and date. Seven of these participants, including the village chairperson himself, attended this group interview. The interview went through a similar process to the previous interview with participants from the Muang District. The interview took about one hour to accomplish, although there were fewer interviewees than the previous interview. Comments critical of their extension worker were added to the interview freely without any prompting from the interviewer. This was perhaps another reason why interviews in both villages took a similar period of time, although fewer Soongmen district residents attended.

In these interviews, four projects involving the use of mobile phones and the Internet were proposed to the participants to obtain their opinions. Those four ICT projects were:

1) Using camera-built-in mobile phones to take pictures of plant diseases and insects that damage their crops then send them to extension workers to find solutions
2) Making free phone calls to a particular number to listen to recorded agricultural information related to their interest
3) Registering their phone number in order to receive scheduled alerts via SMS to do activities in their fields, such as spreading a specific fertilizer at a particular time, spraying organic insecticide in a particular week and harvesting at different times to avoid over-supplying the market
4) Using free internet access to search for additional agricultural information or to find solutions for cropping problems

The interviews with participants from these two villages revealed similarities and differences of farmers‟ opinions in many aspects.

6.7.1 Similar opinions between Muang and Soongmen district

Responses from participants in the Muang district were similar to those from the Soongmen district in the projects related to free calls for information, and SMS alert service. In

addition, they agreed on the use of SMS for information delivery, the assistance from their descendants, and the concern of using mobile phones as an expensive product.

Among mobile phone services, phone calls and SMS were the methods with which they were the most familiar and most confident. Some participants agreed that sometimes they might ask their children to help them to use mobile phone services, such as reading SMS contents. Some participants were worried about losing their mobile phones or damaging the phones when they went into their fields, therefore they would leave the phone at home; then check missed calls after work. They were not worried about losing a connection during the day because they usually used the land line phone to make a contact with their friends and family. Additionally, there were not many calls they might get during the day. Moreover, some households used mobile phones as landline phones. The phones belonged to everyone in the house; therefore the housewife or any people at home were willing to answer the phone. As a result, the participants felt comfortable leaving mobile phones at home during field work.

Receiving agricultural activity alerts via SMS was not fully accepted by participants from either village. Although they all agreed that this service might be a good method to assist them to get higher and better yields; they were not sure that this service would be successful. During rice production there might be many factors affecting their procedures, such as drought, plant diseases and insects. Furthermore, they asked about insurance in case their experimental yields were lower than the usual amount or less than their friend‟s products which were grown according to a typical traditional procedure.

With one aspect of making free phone calls to obtain new knowledge, participants from both villages expressed their agreement. They were not sure whether such a service would always be free of charge. Their income was not high enough to afford something they did not think was really necessary. One participant claimed that if their phone credit ran out quickly, no matter what the cause, this service would be the first cause they thought about. It would be safer for them not to use this service in the first place. Moreover, a few participants added that this service was not an activity they were used to in their daily lives.

Therefore, it would be easy to neglect it after they made a few phone calls in the early stages of the experiment.

However, participants in each village differently expressed their views in some aspects such as the project of sending pictures of their problems via mobile phones to acquire the advice from experts, and the project of free ICT tools practice.

6.7.2 Different opinions between Muang and Soongmen districts

In relation to taking pictures then sending them to extension workers to solve the problem, the Muang district residents mentioned that this service would be of no use for them, because their extension worker lived in the same area and they had a great relationship with her. It would be much more convenient and quicker to call the extension worker to the field or take samples of plant disease to her office to find the solution.

Conversely, the Soongmen district residents agreed that this concept was an interesting idea, because their extension worker lived in another area and they did not have a good relationship with her. A Soongmen district resident mentioned that he had not met the current extension worker and he did not know that person. With this type of service, they did not have to wait for the extension worker to visit their fields and they would not have to care who the current extension worker was.

The interview results also reflected the preliminary survey findings that the Muang farmers rated extension workers as agricultural information providers at the top rank which was comparable to the findings in Opara (2008) and Ekoja (2004). In contrast, extension workers occupied the third rank (46.2%) in the point of view of the Soongmen participants. Additionally, this circumstance among the Soongmen farmers was in conformity with Elizabeth and Zira‟s (2009) results in which their participants were aware of the existence and usefulness of the extension worker but, due to the infrequent visits of extension

workers, the participants turned to rely on their neighbours for agricultural information instead.

This contradiction may show that the relationship between farmers and extension workers may affect aspiration to learn new technology tools and practice in some way. However, in terms of the benefit farmers gained, strong relationships between farmers and extension workers will establish more advantages in the long term.

Different opinions about training and using computers and the Internet to obtain new agricultural knowledge were revealed by participants in each village. Muang participants were glad if they might have access to the Internet because many agricultural support projects, run by the government, were also announced on the Internet. If they could access the Internet, they would be up to date with agricultural news and announcements. Additionally, in some projects the farmers needed to register online. At present, they had to visit a local government office to do this. This wasted a lot of time and if they did not register in time, it meant they missed valuable opportunities. Having access to the Internet would be a good chance for them to step up their agricultural business. As far as training was concerned, they felt comfortable in encouraging their extension worker to undertake an official training. Then, the extension worker would work everything out for them. It seemed that their actual requirement was to have access to the Internet, so that it could be used among them and their extension worker, as long as proper training for their extension worker was included.

On the contrary, even though free Internet training was offered to prepare Soongmen farmers for using the Internet for their own agricultural advantages, they were reluctant to accept such an offer. Some participants gave reasons that they were too old to learn new technology tools; computers and the Internet in their concept were complicated and sophisticated. Some of them mentioned that even if they were given the training, they might not use it in daily life.

In terms of enthusiasm about knowledge enhancement, the Muang district residents seemed to be happier to obtain more information in other topics or continually receive the same service. Nevertheless, the Soongmen district residents stated that it would be good to have this service but they would not feel lost if they could not have it.

6.7.3 Recommendations from farmers

Additionally, the famers in Muang district provided comments on the project of SMS alert service and a way to improve the effectiveness of the use of ICT tools for agricultural practices. The farmers preferred their extension worker to get technical and information support then relay the communications to them face-to-face. They thought that this way would be more effective than directly teaching them to use technology tools. This suggestion was based on the fact that Muang farmers had a strong relationship with their extension worker.

In relation to the scheduled alert service, they recommended that at first there would be an experimental field to show that following the service recommendations would be more successful. Then it would be more reliable for them to follow the service.

It can be seen from the interviews with the farmers in both villages that even they were impoverished and low-educated; they were enthusiastic to learn new ICT practices to improve their livelihood and agricultural practices. The farmers did not fully accept all technologies offered even though they realized the advantages of the ICT tools and practice. They considered the feasibility and the appropriateness of the technologies in actual practices. Therefore, their requirements were necessary to be regularly fed into the system to maintain the effectiveness. However, it was found that relationships between agricultural extension workers and the farmers may affect the ways they learned new technologies.

CHAPTER 7 NEW PROPOSED FRAMEWORK

7.1 A New Framework for a Wider Scale

According to the action research model, which is a continuous and iterative process in conjunction with the system framework in the experiment, it is necessary for all the feedback from end users, the farmers targeted in this case, should be incorporated in the system in order to improve its effectiveness. Also feedback from participants, discussed in section 6.4 and 6.7, revealed that the majority of participants would like this service to continue. However, other types of information, including up-to-date agricultural news and technology practice, should be provided to these farmers. The high competitiveness in mobile phone markets, which will lead to better features but lower prices for mobile phones, should be considered. The new information topics would usually be delivered frequently during every cultivation period, while the period of technology change would be more flexible and depend on users‟ requests and readiness. The consideration toward the separate module between information update and application modification was made. Figure 28 on page 118 shows how the previously implemented, could be adapted for a longer-run system.

It can be seen that the proposed framework is a circulated flow, starting from the information dissemination system containing an agricultural information repository which delivers information in the user-requested formats, such as a typical SMS or short video clips. Then user satisfaction should be periodically evaluated to improve the system. User requests for information should be passed to the information administrator who is responsible for managing all the content in the agricultural information repository, including the dissemination schedules and lists. In the meantime, other farmer feedback related to technical manipulation of the system should be forwarded to the applications developer who deals with all system modifications. After all related components within the system were updated, the changed system will continue to and a new phase begins.

Although mobile technology may change, this framework concept will remain valid as long as the technology is based on mobile phone services.

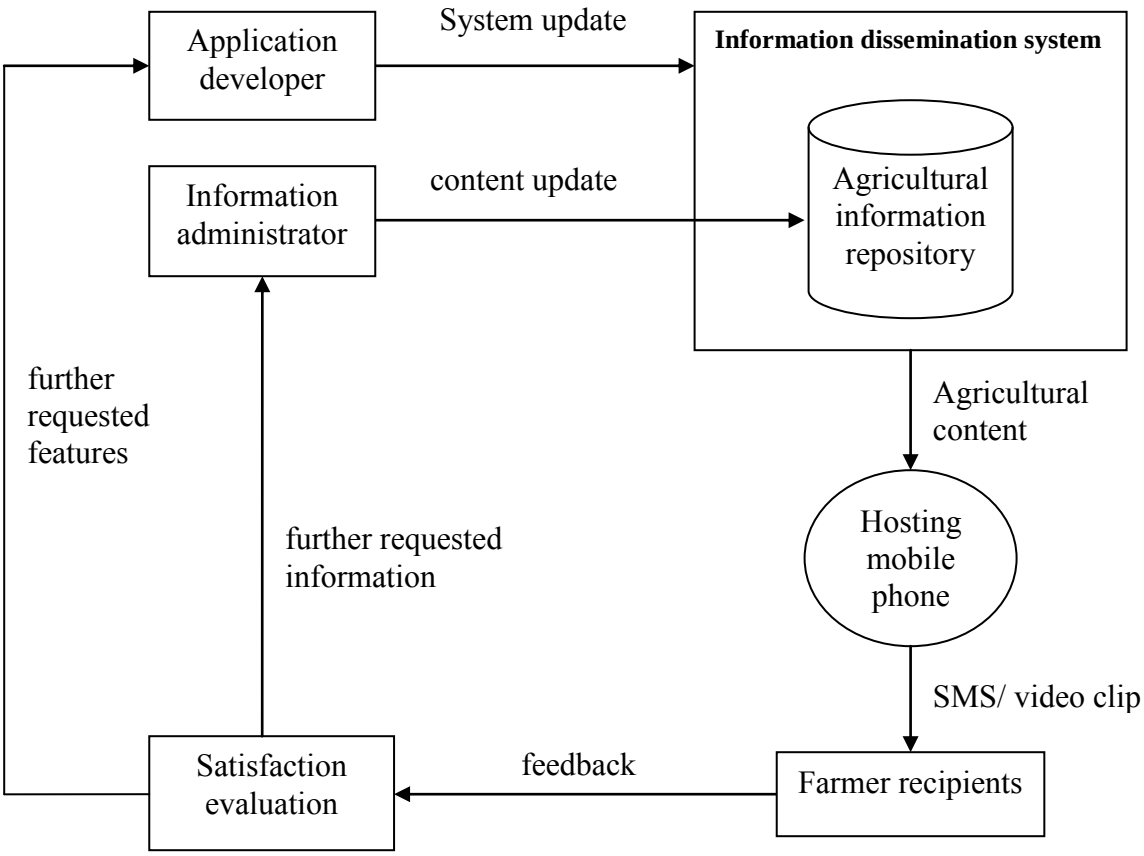

Figure 28. A framework of information dissemination via mobile phone, proposed for wider scale operation.

This framework could be implemented and maintained under the supervision of government agricultural bodies, such as the Department of Agricultural Extension or the Ministry of Agriculture, or run by academic institutes, such as agricultural colleges or departments of agriculture in universities, which are sources of accurate and credible agricultural information.

However, in practice due to limited memory in low-end mobile phones, farmers may not receive new incoming messages if their inbox is full. This difficulty could be avoided by

providing the farmers a session of usage training. Also, in case the farmers accidentally delete received messages, they may ask their extension workers for re-sending those messages. This option is readily available due to the program and database design.

7.2 Comparisons with Other Frameworks

When compared to other agricultural information dissemination frameworks, this framework shows both similarities and differences.

A well-known agricultural information dissemination system, AgrIDS, developed by Krishna Reddy and Ankaiah (2005) mainly focused on bringing field situations to the experts in order to solve problems more effectively. With help from the coordinators, current field issues were sent through ICT tools and networks to agricultural experts, then, with support from an agricultural information system, the expert sent suggestions back to the farmers. It reduced both travelling costs and time for agricultural experts to visit each farm to solve a variety of problems. This framework can be used to advise farmers with direct answers suited to each circumstance; however, it is needed to resolve problems on a case-by-case basis.

The proposed framework aims at providing agricultural information to farmers on a large scale, which would lead to knowledge enhancement in the longer term. Also Thai farming participants are familiar with the use of mobile phones, as can be seen from the high percentage of mobile phone owners. As a result, coordinators to assist in sending and receiving information would be unnecessary in this proposed framework.

In addition, another agricultural SMS system (Zhang et.al, 2007) essentially emphasized techniques to deliver SMS effectively and efficiently by employing a real-time controller polling module to handle requests and message traffic. However, this framework was not designed to support the entire knowledge enhancement process. No provision for continuous development was mentioned in this framework.

However, this study‟s proposed framework has been designed for further development by taking feedback from real users to improve the quality of system to meet farmers‟ requirements. This improvement process will be able to operate continuously.

The Armstrong, Diepeveen and Tantisantisom‟s (2010) Farmer Knowledge Decision Support Framework (FKDSF) described procedures which farmers actually used when they required relevant information to solve their problems or to improve their products. This framework drew a whole picture of problem solving methods used by farmers. It included other ICT tools and techniques to provide farmers with information to further make decisions.

Nevertheless, this newly proposed framework aimed at offering the necessary information to aggregate farmers‟ agricultural knowledge, rather than solving all the problems farmers might have encountered. Furthermore, the FKDSF was designed for an Australian farming context. It can be assumed that farmers in a developed country had more opportunities and were able to use computers and the Internet more often and more successfully than farmers in developing countries such as Thailand. Therefore, employing other ICT methods such as online searching, decision support systems and data mining may not be suitable for Thai farmers at present.

An attempt to provide current market prices directly from various local markets to farmers was employed in Kenya (Mukhebi et. al, 2007). The farm produce prices were collected then disseminated to registered farmers. This project was successful; the success determined from higher produce selling prices than traditional selling procedures. Nonetheless, besides higher income which farmers earned and the ICT skills they gained from the use of mobile phones to receive market information, other agricultural knowledge was not included in this project.

On the other hand, the framework proposed in this study emphasizes improving farmers‟ agricultural knowledge, which will consequently upgrade farming products‟ quality and

quantity. This concept will not only benefit the whole agricultural system in the long term but also support life-long learning activities.

An agricultural decision support system is another concept implemented to deliver agricultural information and advice to farmers (Ahmad & Sarwar, 2008). Farmers‟ queries through mobile phones were passed to the decision support system to create suggestions based on an agricultural information system, then the suggestions were returned to the farmers via the same channel. Nevertheless, according to Gandhi, Mittal and Tripathi (2009), farmers in their study necessarily needed back-and-forth conversations in person regarding personalized solutions.

Although the framework proposed in this study is not designed for personal interactions between farmers and extension workers, farmers‟ opinions and requests including feedbacks are gathered at the end of each system cycle. This concept is able to improve the framework continuously to meet farmers‟ requirements.

CHAPTER 8 ASSESSMENT OF THE NEW FRAMEWORK

The new framework developed in the previous chapter also needed to be evaluated for validity before it could be implemented in practice. Authorities working in real situations, such as the agricultural extension workers responsible for the areas studied obviously were the appropriate framework critics. Farmers, as end users, were not included in this interview because they had formerly provided feedback in the user satisfaction survey, which reported that most participants were strongly satisfied with the experiment. This improved framework was a further development of the previous framework. It may be assumed that the farmers would not offer immensely different opinions of the new framework. Additionally, this evaluation emphasized the continuous implementation in a wider scale, in actual circumstances.

The adjusted framework was proposed and explained to the agricultural extension workers responsible for each village. Both agricultural extension workers also had been observers in the SMS experiment mentioned in Chapter 6. Then they provided feedback and comments toward the framework. The interviews were conducted separately and took approximately 30 minutes, for explaining the framework concept and receiving their feedback. The two agricultural extension workers also expressed their opinions and concerns including recommendations related to the practical implementation.

The interview results which were gathered from the two agricultural extension workers revealed that some commonality occurred in their opinions of the proposed new framework. Similarities and differences of interview results from both agricultural extension workers were addressed as presented in Table 20 on page 123.

Table 20

Similarities and Differences Between Agricultural Extension Workers' Opinions

Similarities	Differences
Feasibility	Role as the information administrator
Instant delivery channel	Additional requests during the cycle
Multitude receivers	
Repeated review	
Separate task responsibilities	
Outsourcing for the application program	
Financial supports	
Collaboration with mobile service providers	
Collaboration with local councils	
Mobile phone coverage	
ICT adaptation due to poverty and illiteracy	

In addition to similarities and differences of the agricultural extension workers, their agreements on benefits and concerns were summarised in Table 21.

Table 21

Agreements on Benefits and Concerns Between Agricultural Extension Workers

Benefits	Concerns
Instant delivery channel	Financial supports
Multitude receivers	Mobile phone coverage
Repeated review	ICT adaptation due to poverty and illiteracy

In terms of feasibility, viability and appropriateness, both agricultural extension workers agreed on workflow and information flow of the framework. For example, both believed that this framework would be workable in a field situation. The Soongmen agricultural extension worker affirmed the proposed framework would be a tool to deliver news and agricultural information to farmers without the need for the extension worker to travel to the village. Also, they suggested that it could be an alternative communication channel

which could deliver information to farmers who may need multiple reassurances about novel agricultural technology information and practices. In addition, they suggested that it would assure that every registered farmer will receive news and emergency announcements, such locust outbreaks. Furthermore, this framework would be able to disseminate a number of messages at the same time; therefore, there will not be a problem of delayed information dissemination which may cause loss of opportunity those farmers. The Muang agricultural extension worker also gave an example:

> Once a farmer registration project launched by the government was announced, she had only a few weeks left to make sure that all farmers registered because she had to wait for all other information from the Ministry. In that case, it would be more effective and less stressful for her if she could immediately send information to farmers then confirmed with them afterward. At least, she would know that all farmers got the news. (The Muang agricultural extension worker, personal communication, December 16, 2010)

Additionally, with this proposed model farmers may have the chance to review the text messages, or even video clips, several times to reinforce their understanding. Memory of workshops or demonstrations by agricultural extension workers may fade out in the future. The Soongmen agricultural extension worker said that:

> This is a good approach because I do not have to repeatedly explain the same knowledge or information. Particularly, if information or announcements contain numbers, date and time, it can be sure that all farmers have the same information and can recheck the information by themselves. No need to keep asking the agricultural extension workers the same question. (The Soongmen agricultural extension worker, personal communication, December 20, 2010)

Moreover, the Muang agricultural extension worker also supported the concept that information update and technological update were separated. Different job descriptions and personnel were needed because, in her point of view, the agricultural extension workers are experts in agricultural information but may be less able in technological matters. Consequently, it is more acceptable that the agricultural extension workers play a role as information administrators only and the technological matters are passed to an information and technology, or computer department in the office. On the other hand, the agricultural extension worker from Soongmen District stated that, in practice, at least two recruits

should be added to the current office to maintain the service system. One would be needed for updating information and the other one for updating or resolving technological issues. She disagreed with the idea of assigning the information administrator‟s tasks to current agricultural extension workers, due to the fact that they are already overburdened.

However, both agricultural extension workers accepted that an option of outsourcing for updating and modifying the technological implementation could be considered if this model was actually implemented by the agricultural extension bodies.

One of the main concerns toward the actual implementation of the proposed framework is related to the size of budget they receive from the government. The Muang agricultural extension worker was concerned to learn if SMS would be the main channel used to disseminate agricultural information, including news, to farmers. To employ this service, not only the cost of computer servers would be required, but also the cost of SMS delivery would have to be taken into account. It would cost a large amount of money to pay for this service, especially if the messages were needed to be disseminated daily. In detail, as there are 84,449 farmers living in Phrae and approximately 56.8% of Thai residents owned a mobile phone, it may be calculated that 47,967 messages should be delivered to Phrae farmers daily (ICG, Provincial Office, 2010; NSO, 2010a). Working in a government agency, she could not be sure that the budget would be readily approved.

Moreover, this concern echoed by an issue regarding financial support from the government body which was raised by the Soongmen agricultural extension worker. During the conduct of the experiment, there was a special promotion for text messaging with 199 baht for 500 messages. The cost was approximately 3 Australian cents for a message, as at the 6th of April, 2010. She pointed out that, if this promotion had finished and no equal or better promotion was launched, the expense would be uncontrollable. The Soongmen agricultural extension worker further explained that:

> Each financial year, she had to propose projects and budget to work or continue on the next financial year. If the budget was underestimated, she would not have enough money to run the project throughout the year. On the other hand, if the budget was

> overestimated, the project might not be approved or it would be her fault for miscalculation. (The Soongmen agricultural extension worker, personal communication, December 20, 2010)

Nevertheless, as employees of a government body, both agricultural extension workers agreed that it might be possible to obtain collaboration with one of many mobile phone service providers to support such a project.

In addition, the need to work in collaboration with village chairpersons or local councils to acquire further requirements and feedback from farmers at the end of each cultivation cycle was accepted by both agricultural extension workers. However, another issue that concerned the Muang agricultural extension worker related to the cycle completion. Due to her close relationship with the farmers, they might ask her for other types of agricultural information or technology advice they needed at the middle of the cycle. A cultivation period took approximately three months until harvesting. A month after the beginning of the cultivation, the farmers might request agricultural information related to fertilizers or pest management, as they currently faced those problems. She would supply the information but she could not tell them to wait until the end of cycle to provide feedback afterward. This possible disruption of the cycle was not mentioned by the Soongmen agricultural extension worker.

Furthermore, mobile phone coverage was another concern from the extension workers. In the experiment areas there was no problem regarding mobile phone signals, but Phrae Province includes numerous hills and mountains. Therefore, farmers living in those areas may not receive these messages at the time they were sent because of signal blind spots. Additionally, the Soongmen agricultural extension worker suggested that the system should report any transmission failure to the administrators to decide which action should be taken or whether to keep sending failure messages until the transmission was completed.

Another issue was related to technology adoption among farmers. Both extension workers noticed that a majority of farmers were elderly and lacked ICT skills and confidence in. An

attempt to apply this technology framework may take a significant period of time and effort to achieve practical outcomes. The Muang agricultural extension worker stated that:

> Most farmers are poor and afraid of damaging technology tools because they have a limitation in affordability. Therefore, encouraging them to use these tools will take a while. When they get used to the tools or see a benefit from using them from other people, it will be easier to encourage followers to do the same thing. (The Muang agricultural extension worker, personal communication, December 16, 2010)

Also they realized that most farmers were illiterate, consequently reading short messages may not help them fully understand all the content. Although video clips may compensate for this hindrance, it takes much effort, time and expense to create them. Additionally, disseminating video clips may be possible only for the limited group whose mobile phones support this feature.

In addition, the agricultural extension worker from the Soongmen District recommended that in the future it would be a great benefit if the system was able to gather all delivered messages and then convert them for conclusion in a knowledge repository which was ready to be used for multiple purposes.

In summary, findings from the interviews with the agricultural extension workers from Muang and Soongmen District revealed that they agreed on the possibility and usefulness of this framework. In practice, however, it may need some contributions from third parties in the form of time, knowledge and funds. These supports may come from village chairpersons, local councils, mobile service providers, universities or academic sectors, and the Department of Agricultural Extension itself.

CHAPTER 9 DISCUSSION

9.1 Introduction

Results from the initial requirements survey in Section 5.3, from the user satisfaction survey in Section 6.4, together with results from farmer group interviews in Section 6.7 and extension worker interviews in Chapter 8 were analysed to extract findings.

9.2 General Discussion

Overall results from previous chapters were compared in many aspects such as a relationship between involvement and gender, age groups and income groups.

9.2.1 Participation between gender groups

The gender of participants was one determining factor of willingness to participate in the experiment. There were proportional representations of males and females who participated in the requirement survey in both villages. In Section 5.3.1, the Muang District group consisted of 54.8% of males and 45.2% of females; together with 57% of males and 43% of females in the Soongmen District. A contrast was found in the user satisfaction results in Section 6.4.1; participants from the Muang District who joined the experiment were composed of 84.2% males and 15.8% females. 59.3% males and 40.7% females from the Soongmen District joined the experiment. The results from the Muang District may support a finding that females enjoyed less access ICT tools than males as reported by Saghir, Ashfaq & Noreen (2009). On the other hand, the percentages of male and female participants in the Soongmen District did not show significant differences. The reason for this difference between the two villages should be further investigated.

Although gender may be a factor affecting the adaptation of ICT usage among these Thai farmers, the proportion of males and females participating in the experiment was still

considered reasonable. The situations may be much more difficult in some countries where females are not allowed to join community activities (IICD, 2006; Sheriff, 2009 for example).

9.2.2 Participation among age groups

Also initial age was taken into account for the volunteers‟ involvement in the experiment. The initial requirements survey, taking both villages together, revealed that participants aged 41 years or above accounted for 85.9%, as indicated in Section 5.3.1. It additionally showed that younger generations were more likely to use ICT tools as channels to receive agricultural information than older generations. Results from the user satisfaction survey showed a contrary outcome, that 98.3% of participants joining the experiment in using mobile phones as a tool for receiving information were at least 41 years old, as mentioned in Section 6.4.1. This finding regarding older participants indicated that they were more likely to be self information providers for the family. It may be assumed that a number of the older participants took part in this experiment because they saw another opportunity to provide agricultural information to their own family, as they usually did.

9.2.3 Participation among levels of education

Educational levels of participants joining the experiment on the SMS service also contradicted the results from the requirement survey in Section 5.3.1 that participants with higher educational levels were more likely to use ICT tools. From the requirement survey, 67.6% of the participants finished primary school, together with another 22% who finished secondary school. Compared to the results from the user satisfaction survey in Section 6.4.1, 76.7% of the participants had a primary school educational background, while another 19.8% finished secondary school. It can be seen that in typical situations more highly educated farmers were more likely to employ ICT tools to obtain agricultural information than less educated farmers. This result was in accordance with Warren‟s (2004) finding that levels of education among farmers were another factor relating to the adoption

of ICT tools. Contrary to set-up circumstances which freely provide opportunities to learn ICT tools, it may be assumed that educational backgrounds of participants may not hinder their willingness to learn how to use new technology tools for agricultural improvement among Thai farmers.

9.2.4 Time preference to receive agricultural information

According to the time preference for receiving the information from the requirement results in Section 5.3.4, it was found that most participants preferred to receive information through mobile phones either in the early morning from 6 to 9 o"clock (46.8%) or in the evening from six to 10 o"clock (22.7%). This result was in accordance with farmer group interviews in Section 6.7 that they might leave the mobile phones at home when they were working on fields. Even though they possessed mobile phones; some of them might use the mobile phones as portable landline phones. Although the reasons were not directly expressed, it may be assumed from their low income levels that they might have to share mobile phones with the other family members and that lost or damaged mobile phones may cause inconvenience for the whole family.

9.2.5 Satisfaction with the experiment between two districts

Also results from the experimental survey in Section 6.4.3 may conclude that the Muang participants were more satisfied with the experimental service than the Soongmen participants. It can be seen from the opinions of the service that on average the Muang participants gave higher scores than the Soongmen participants for every aspect; namely, convenience, ease of use, free of charge, knowledge enhancement, technology practice, information timeliness and information format. In addition, about 80.8% of the Muang participants requested information from the service more often than, or at least as much as was delivered by the experiment, whereas only 50.8% of Soongmen participants did.

These results were in line with the farmer group interviews in Section 6.7; the Muang interviewees seemed more enthusiastic about receiving agricultural information via technology tools than the Soongmen interviewees did. In detail, the Muang participants were pleased to continue with the service while the Soongmen interviewees did not feel that they would lose benefits if it ceased. It can be assumed from these results that the Muang participants were on average richer than the Soongmen participants, and the higher income participants were more likely to be more satisfied with the experiment than those with lower incomes.

9.2.6 Agricultural information requirements between two districts

In terms of further information requirements in Section 6.4.4, both villages showed diverse requests for further agricultural information. Approximately 70.2% of participants from the Muang District requested information related to pest management and 29.8% of the Muang participants requested information on how to use insecticide. These two types of information were significantly rarely requested by Soongmen participants. Only 11.9% of the Soongmen participants requested for pest management information and 1.7% mentioned the need for information regarding the use of insecticide. These dissimilarities on the information requirements may indicate that agricultural fields in the Muang District encountered more pest-related problems than in the Soongmen District.

In addition to few requests for pest-related information by the Soongmen district residents, results from the user satisfaction survey in Section 6.4.4 indicated that nearly half of the Soongmen participants (44%) received information for organic farming from the experimental service. It may be assumed that the Soongmen participants already have a broad range of information related to pest control, due to their own interests in organic farming. This may be a reason why a majority of them did not request this kind of information.

9.2.7 Participation among income groups

Participants‟ income also plays a role in the use of ICT tools, shown in both the requirements survey in Section 5.3.1 and the user satisfaction survey in Section 6.4.1. A majority of all the participants in the requirement survey (73.5%) earned less than 5,000 baht a month whereas 71.6% of participants who joined the experimental service earned between 3,000 and 10,000 baht monthly. Particularly, the largest group in the requirements survey (39.7%) fell into the 3,000 to 5,000 baht category, while the largest group in the experiment survey (29.3%) earned between 8,000 and 10,000 baht. Thus it can be seen that the participants who joined the experiment on using mobile phones for receiving information did not represent the farmer participants in general. The participants engaging in the experiment were predominantly in the high income groups. Also the requirements survey indicated a relationship that the richer groups were more likely to utilize more ICT tools for receiving agricultural information than the poorer groups. These results supported the conclusion that richer farmers were more likely to adopt new ICT tools or services for agricultural purposes.

Analysis of the relationships between variables in both surveys revealed that participants‟ income levels related to many variables such as technology familiarity, education level, the variety of ICT tools used for receiving information, types of information sources and positive opinions about the service. These findings may help to establish a strategy to introduce ICT tools or services to farming groups in the future. Project leaders should firstly aim at higher income groups in rural areas in order to achieve the objectives of the first stage. Other groups are more likely to be involved in later steps, especially if the success is verbally confirmed the first group. Nevertheless, income and social status based on money are sensitive issues; therefore, to operate this strategy every relevant aspect should be considered to avoid any social discriminations, which might cause negative feelings among participants and lead to failure of the project.

9.2.8 Limitations in the experiment

Some limitations regarding to current technologies were encountered during the research implementation. Firstly, a prototype implementation depending on 3G technology could not be applied to this study due to uncertainty about concession contracts in Thailand (Chantanusornsiri, 2011). During the first phase of 3G technology in Thailand, it will be available mainly in the capital city, Bangkok and in significant provinces in other areas, such as Phuket, Khon Kaen, Chiang Mai and Pattaya in Chonburi (Public Relations Department, 2010). This plan may not include rural areas across the country for sometimes, especially the fields studied.

Due to Thai character decoding of the SMS contents delivered, the length of a message is limited to only 70 characters. This may restrict the understanding of farmers, who mostly had an educational qualification at the primary school level and were considered as an illiterate group. Additionally, the Thai writing script contains up to four levels of characters in one line; therefore, a message in a local language needed more space on the mobile phone screen than English characters. This was an obstacle to understanding the message, but the text size problem was unavoidable. This was confirmed by the results of the after-experiment survey; 12.9% of all the participants mentioned this problem as presented in Section 6.4.5.

9.3 A comparison of the interviews of farmers and agricultural extension workers

According to the proposed framework, farmers were placed as end users of the system while agricultural extension workers were able to play a role as either an end user or an information administrator. Agreements and disagreements between participants in both villages, and between farmers and agricultural extension workers were revealed.

Both sets of villagers agreed on their satisfaction with the use of mobile phones as an agricultural information channel; some needing assistance from their children with reading the SMS, and most being aware of problems of mobile phone loss or damage. They tended

to avoid any risks affecting their expenses or yields, such as the free call service or the technology adoption according to the suggestions provided. They were more likely to use the technology they were familiar with than adopt any other unfamiliar tools.

In contrast, the idea of taking pictures of plant disease then sending them to the agricultural extension workers, caused very different reactions. The Muang participants stressed that they found it easier to call the agricultural extension worker out to the fields, whereas the Soongmen participants accepted this idea due to the distant relationship between agricultural extension workers and themselves. Provision of the free use and training on the computers and the Internet also saw the two sets of villagers in disagreement. The Muang participants enjoyed having these services, even though they relied on the use of agricultural extension workers. Conversely, the Soongmen participants showed negative responses on these services at the first place because they felt the services were too sophisticated and too complicated for themselves.

However, the interviews revealed that farmers and agricultural extension workers‟ opinions were in agreements in terms of the purposes of using mobile phones as an information channel and as a remedy for illiteracy levels coupled with low ICT skills among participants in this study.

The Soongmen agricultural extension worker emphasized a benefit of the proposed model that it could help the officers save travelling time if the officers did not have to meet every single farmer to deliver news and information. Comparatively, neighbours appeared to be the main source of information, although the Soongmen participants gave the highest credibility to the agricultural extension worker according to Table 6. It may be concluded that the Soongmen participants had a weak relationship with their extension worker. This resulted in a willingness to adopt some kind of technology services which were simple and suitable for the Soongmen farmers to solve their own agricultural difficulties. This echoes a finding that weak relationships between information users and extension workers were reported as a factor causing low agricultural yields in Kenya (Ministry of Agriculture, Republic of Kenya, 1997 cited in Kiplang‟at & Ocholla, 2005).

Additionally, the Soongmen agricultural extension worker observed that most farmers were old, illiterate and short of technology skills. This remark was in agreement with the Soongmen farmers‟ interview comments that they might not attend the free computer and Internet training because they were too old to learn these technologies. Furthermore, participants from the Muang District supported their agricultural extension worker to learn and practice these technologies on their behalf rather than doing it themselves. This may show farmers‟ attitudes toward technology tools and that they still lack confidence in using these unfamiliar tools. It was in line with Karnka‟s (2006) study that farmers had a belief that the Internet was too complicated for them. This leads to another conclusion that adopting technology tools or services through already familiar technology tools makes farmers feel more confident and more acceptable toward the tools or services.

Also in the user satisfaction survey, it revealed that a majority of participants in this study strongly satisfied with the use of mobile phones as an information channel. The cancellation due to unfamiliarity with the use of SMS service on mobile phones was reported at 12.9% of entire participants which can be considered as a small number of overall. This outcome agreed with Elsey and Sirichoti (2003) that farmers may change their attitudes or behaviours toward the use of ICT tool if they realized the advantages derived from the usage.

As it was previously mentioned that most farmers were illiterate, only reading short messages may not make them fully understand the contents. This may link to farmers‟ interview that many of farming participants still needed some help from their descendants to read the received message. This behaviour may be caused from many reasons such as age, illiteracy and technology unfamiliarity. This finding was in agreement with Warren (2004) that farming family members who were more fluent in the ICT tools had a role in passing information to other family members.

In comparison, the Muang agricultural extension worker showed more commitments on her works than the other extension worker. This can be seen in the Muang agricultural extension worker‟s interview that she willingly determined another responsibility to be an

information administrator to deliver information and news to farmers. Contrary to the Soongmen agricultural extension worker, she required another two recruits to work on this project as an information administrator and a program developer. Although she gave a reason that agricultural extension worker‟s responsibility was now overloaded, it seemed that she did not put an effort on this project. As a result, it is reasonable that the Soongmen farmers were more likely to rely on themselves and neighbours. In accordance, the Muang participants seemed to heavily rely on their agricultural extension worker in problem solving and technology learning. These interview results also support the first survey results regarding agricultural information providers that the Soongmen participants rated their neighbours as the top information provider at 68.5% whereas 65.6% of the Muang participants obtained agricultural information from agricultural extension worker.

In the long run, another concern may be considered that the Muang participants may face a struggling situation if their current agricultural extension worker is assigned to work on other areas and they do not get this kind of supports as they used to in the past.

In summary, the results found in this study revealed that the ICT adoption among farmers may be affected from other variables such as gender, age, education, time preference and income. Also, agricultural problems that farmers previously or currently encountered may affect the requirements of particular types of information. In addition, the relationships between farmers and agricultural extension workers responsible in the area also affected the willingness and behaviours to adopt technology tools for the purpose of the information dissemination.

CHAPTER 10 CONCLUSION AND FURTHER STUDIES

This chapter will summarise the results from previous chapters to answer the research questions then further studies will be proposed for future development on the framework proposed in Section 7.2.

10.1 Answers to research questions

This section will summarise all results to answer the research questions stated in Section 1.4. Five sub-questions will be answered in order then the main research question will be answered at last.

10.1.1 Types of necessary agricultural information required by Thai famers

Providing the information that farmers did not truly demand may cause a failure of the ICT services. Two surveys, which were the requirement survey and the user satisfaction survey, were conducted to find out the information topics in needs for farmers. It was found that information related to the use of fertilizers, organic farming and soil improvement was on the highest demand. Information regarding pest management and produce market price was requested by the majority of farmers. However, in both survey the use of insecticide, financial management and weather forecasts were not on a great demand.

Notable is that information related to the use of insecticide and pest management was mostly requested from the village in the Muang District. This may be because the village had encountered pest problems in the past. Therefore it can be assumed that the type of information currently sought has a relationship with previous problems encountered by those farmers. Also, the requests of information at present may be implied to predict the request of similar information types either in next cultivation seasons or at the same period in next year.

10.1.2 Current agricultural information dissemination channels for Thai farmers

Document analysis from relevant government agencies‟ annual reports in conjunction with the needs survey was conducted to answer how these farmers currently received agricultural information. It revealed that the responsible government bodies attempt to deliver agricultural information through community speakers, service call centre, television broadcast, local radio channels, publications and web sites (DAE, 2010; Ministry of Agriculture and Cooperatives, 2009). Furthermore, agricultural documentaries in forms of VCD and e-books were created and available for farmers (DAE, 2010).

Agricultural information provided through the Internet channel seemed unpopular among Thai farmers. Statistical reports and the needs survey indicated that only 1.9% of workforce in the sectors had used ICT (NSO, 2010a). Together with the survey results, computers and the Internet were the least used ICT tools to receive agricultural information among these farmers.

10.1.3 Factors needed to be considered for information delivery to Thai farmers

It is interesting to note that within Thai farming families, each member had differently impacting roles in conveying agricultural information. The participants themselves (62.9%) provided agricultural information to other family members, followed by their spouse (24.3%) and their children (6.4%). Although the results were different between these two villages, both obtained agricultural information from local councils (57.2%), neighbours (56.9%) and extension workers (56.5%). Other government officers and sales agents were mentioned as a source among some villagers whereas web sites and private company showed insignificant roles as information providers which were account for less than 10%.

The survey results and interviews with farmers and agricultural extension workers, some factors needed to be considered in order to improve the agricultural information dissemination.

The needs survey revealed that age, income and educational background of participants related to the ICT tools used to receive agricultural information. Significantly, income level of participants related to technology familiarity and attitudes toward the technology services such as convenience, cost, knowledge enhancement, technology practices and information timeliness. In addition, participants‟ educational level was also linked to the knowledge enhancement perceived by the participants.

Furthermore, age of respondents also reflect the use of the Internet to receive agricultural information. This finding corresponded to the fact that the Internet in Thailand became commercialized in less than two decades. Therefore, it may be concluded that the technology emergence also affected the tendency of technology usage for agricultural purposes.

From the interview results it may be assumed that relationship between farmers and agricultural extension workers responsible in that area affected how the information was delivered to farmers. A good relationship between farmers and the agricultural extension workers in the Muang District led to the reliance on the agricultural extension worker for required information while the loose relationship in the Soongmen District may urge farmers to make use of other available approaches including ICT tools and services.

10.1.4 Effectiveness of the implementation developed in this study

Then, a user satisfaction survey was conducted to evaluate the effectiveness of the service after the experimental SMS service. It revealed that these farmers had strong agreements on every measured aspect of the service; namely convenience, ease of use, free of charge, knowledge enhancement, technology practice, information timeliness and information format. Additionally, more than half of all participants requested more frequent information deliver in the next phase. It may be assumed that these farmers realized the importance and usefulness of information directly delivered on hand. Therefore, it may conclude that farmers were strongly satisfied with the agricultural information dissemination in forms of short messages on available mobile phones.

In addition, interviews with agricultural extension workers showed that they agreed on the practical use of the proposed model even though financial supports and collaboration with third parties may need to be taken into account if the model is actually implemented.

10.1.5 Framework improvement for a wider scale

Results from the experiment, surveys and interviews were used to create a framework for implementing SMS service on a wider scale which was proposed as shown in Figure 28 in Section 7.1.

In order to use this framework in a wider scale, such as an entire province, information contents may be voluminous; consequently, information administrators should be separately responsible for content update and maintenance. Other technological adjustment or improvement for more efficient performance should be under application developers‟ responsibility.

In order to disseminate a large amount of information on a regular basis, collaboration between related government bodies and academic sectors can be performed to ensure the accuracy of the up-to-date information.

Additionally, targeting farmers‟ requirements and feedback should be periodically gathered to improve and amend either content aspect or technology aspects. In this study, the framework was conducted in particular areas; therefore, to obtain requirements and feedback can be done by a few staffs. If this framework was applied for an entire province or larger, a number of assistants should be employed. These assistants may work under the supervision of either agricultural extension departments or local councils. Even chair village people can be asked for collaboration.

Furthermore, sending SMS to a number of farmers in a wide scale required a large amount of financial support from the government. Public-private participation may be an option to

extend the scope of SMS receivers and reduce the financial dependence. In terms of private sector‟s benefit, they will gain not only long-term customers but also positive marketing image and advertisement.

10.1.6 How ICT can be used to enhance agricultural information dissemination to selected groups of Thai farmers

A preliminary survey was planned and conducted to obtain requirements from selected Thai farmers as shown in Section 5.3. In addition, documentary and statistical analyses were employed to assess the current ICT situation in Thailand and the area studied as illustrated in Section 5.1 and Section 5.2. It revealed that mobile phones were considered to be a proper channel to deliver agricultural information to Thai farmers in this study. Accordingly, a framework for agricultural information dissemination through SMS on mobile phones was created followed by the prototype implementation as described in Section 6.2 and Section 6.3.

The analysis of the implementation of the proposed framework in Section 6.4 showed that using the SMS via mobile phones is an effective communication channel to disseminate timely agricultural information directly to Thai farmers. Due to the growth rate of mobile phone users in Thailand and the number of mobile phone possessions among Thai farmers, information delivery through mobile phones will be continuously developed for a long period of time. The analysis of the survey after the experiment in Section 6.4 revealed that the majority of selected farmer groups were satisfied with the SMS and would like to continue to receive agricultural information on other topics. An overall evaluation of the framework in Section 6.6 found that this framework is successful at a competent level and can be developed further to expand the service areas and other formats of agricultural information to Thai farmers.

Additionally, the interviews with farmers in Section 6.7.2 showed that the use of ICT tool for agricultural information dissemination is another option for solving the gap between farmers and agricultural extension workers. Consequently, a number of farmers can receive

agricultural information without waiting for the agricultural extension worker visits. This benefit will be more obviously seen in remote areas, where are very far from the agricultural extension offices.

Comments from the agricultural extension worker working in Muang District supported the advantages of using the ICT tool to provide the farmers instant announcements to a multitude of farmers in broad areas. This will help farmers stay up-to-date with agricultural news, outbreak warnings and supporting projects from governments. As mentioned by the agricultural extension worker in Chapter 8 that the farmers can recheck the information details at anytime they would like to because the provided messages remain in their phones. Compared to TV or radio, if the farmers did not watch or listen to the programs at that time, they would miss the information. In case they had a chance to do that, they might miss some information such as date, time and conditions. Even publications or brochures free provided to farmers included specific information details and could be rechecked several times, the farmers might simply lose these materials. As mentioned in Section 6.7.1, the situation will be different with contents in mobile phones because the farmers regarded the mobile phones as valuable belongings; therefore, they will not carelessly neglect their phones. Although the Internet contains a number of agricultural information, this study found, in Section 5.3.2 and Section 6.7.2, that a majority of rural Thai farmers were not ready to adopt this type of technology.

Current industry trends indicate that mobile phones tend to have more features while their prices have decreased, as commonly expected in other technology tools. This offers a chance for poor Thai farmers to possess a better mobile phone with acceptable affordability. This study has shown that when Thai farmers are more familiar with other features on mobile phones, other mobile phone services may be alternatives for Thai farmers to receive or request agricultural information as needed.

In addition, it was found in the survey results in Section 5.4 and Section 6.6 that many factors, such as income, education and gender, may affect the preference of using ICT tools for agricultural purposes. Consequently, in order to actually employ this framework in

farming field these factors should be taken into account for selecting the primary target groups then extending to other groups of farmers to ensure the achievement of the project.

10.2 Further Studies

In this study, a simple SMS was applied in order to directly disseminate required agricultural information to farmers. However, in terms of further implementations to improve the efficiency of agricultural information delivery, other techniques may be utilised. This section will explain further research issues to be considered if the framework will be adapted to other parts of Thailand or other countries as well as technology advancements that can be employed to achieve higher outcomes.

10.2.1 Adaptation to other parts of Thailand or other countries

This study was conducted in a northern province of Thailand; in order to adapt this framework to other areas some issues should be considered. For instance, in some southern provinces of Thailand, not only Thai language but also other local languages are used in daily life. In order to deliver text information through mobile phones, the most used language in that area should be taken into account. It may affect the script coding in the application and features for supporting language in the mobile phones. Another example, many ethnic tribes living on high mountain areas do not have writing scripts in their own language. Therefore, encouraging them to read information in an alien language may not succeed.

Even the 3G network in Thailand does not presently cover all over the country; it will be achieved in the near future. In accordance with the continuously reducing phone prices and better features on mobile phones, short video clips presenting new agricultural practices or technologies can be a possible option for rural Thai farmers. It will be able to compensate for illiteracy among farmers.

10.2.2 Possible technology advancements employed

Instead of employing a stand-alone application and a particular registered mobile phone linked through a Bluetooth connection, for example, the service may be applied to the use of an SMS web service. A limitation in using the stand-alone application may occur in case the content administrator is not in the country for a short period of time. The administrator needs to manage all contents and schedule them in advance. However, the SMS web service provides an Internet-based application which their subscribers are able to log into the system from anywhere around the world via the Internet connection and then manage the content delivery to receivers. Utilising this technique broadens working areas for the sender.

Alternatively, rather than employing the push technology by disseminating information straight to users, the pull technology which provides the information only on request may be another practice to be considered as shown in Jensen and Thysen‟s (2003) study. With this technique, farmers will receive the agricultural information only in the topic that they would like to know and at the time they are convenient to consume. However, to properly use this technique, having a certain level of SMS use skills are necessary to the farming users. Consequently, a requirement on application training for farmers themselves or responsible extension workers is essential. However, according to Islam and Gronlund‟s (2010) study, it also encountered the situation that farmers did not send information requests to the system in a significant amount as it was expected due to their lack of confidence concerning the SMS expense issue. Therefore, to apply this technique comprehensible communication is very necessary. In this case, the system framework is to be adjusted as shown in Figure 29.

The added dashed arrows illustrate information request directions starting from SMS requests on required agricultural information from farmers to the pre-defined mobile phone number then these requests are forwarded to trigger the information disseminating system.

Nevertheless, in case the farming users are familiar with using their mobile phones to request information in their interest or report field problems, all incoming messages are able to be mapped in the geographic information system (GIS) for further analysis, implementations and prediction. For example, after a certain number of requested information related to a plant disease or a certain pest management in a particular area, it may be assumed that the farming areas infected from the outspread disease or pests. Then all connected farming areas should be given a warning. Another example, high requests for a specific type of agricultural information from the same area may hint the extension workers to educate those farmers with particular information for better understanding.

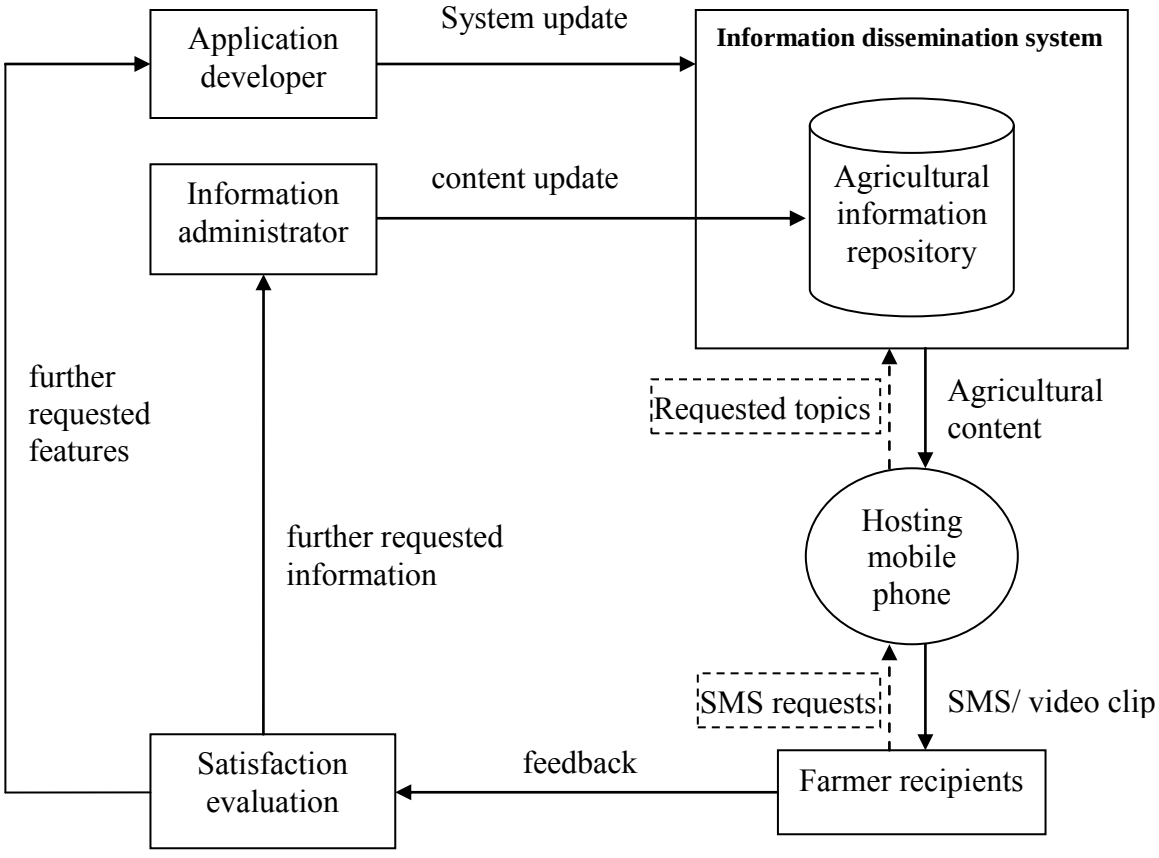

Figure 29. A further framework information dissemination via mobile phone.

Moreover, intelligent database, whose answers could be directly mined from, may be implemented to handle the information requests from farmers. In case the farmers feel that they are able to easily obtain the answers they really need, the system could be more acceptable among farmers.

As another option according to Parikh (2009), pictures are able to alleviate inconvenience regarding illiteracy among poor farmers and too small Thai characters on the mobile phone display. The price of mobile phones has decreased and it also happens to the built-in-camera phones. Farmers may take pictures concerning pest or disease then send them to a particular official phone number. Subsequently, responsible government officers including agricultural extension workers will analyse and make a suggestion to the sender. Nevertheless, at the first place the camera-built-in mobile phones have to be provided though its price is not as expensive as it was in conjunction with proper training for farming users.

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Appendix A: The questionnaire for the needs analysis

QUESTIONNAIRE

Please mark × in the □ in front of the choice you have made

Part A Demographic Data

1. Gender □ male □ female

2. Age range (excluding months)
   □ below 15 years old □ 16 – 20 years old □ 21 – 25 years old
   □ 26 – 30 years old □ 31 – 35 years old □ 36 – 40 years old
   □ 41 – 45 years old □ 46 – 50 years old □ 51 – 55 years old
   □ 56 – 60 years old □ over 61 years old

3. Highest education level
   □ primary school □ junior high school □ high school
   □ certificate □ undergraduate diploma □ bachelor degree
   □ master degree or higher

4. Marital status
   □ single □ married □ divorced
   □ separated

5. The number of family members
   □ 1 person □ 2 people □ 3 people
   □ 4 people □ 5 people □ more than 5 people

6. Average income (per month)
   □ less than 3000 baht □ 3001 – 5000 baht □ 5001 – 8000 baht □ 8001 – 10000 baht □ 10001 – 15000 baht □ 15001 – 25000 baht □ more than 25000 baht

7. Type of agricultural activities (you can make more than 1 choice)
   □ crop grower
      □ rice □ sugar cane □ cassava
      □ corn □ mung bean □ soy bean
      □ others (please specify)……....

   □ livestock
      □ poultry □ pig □ cow/cattle
      □ others (please specify)……....

8. Agricultural areas
   □ 4 acres or less □ 5 – 10 acres □ 11 – 20 acres
   □ 21 – 20 acres □ 21 – 30 acres □ 31 acres or more

9. Do you own the land you farm?
   □ yes □ no (rent) □ both own and rent

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

10. What kind of ICT tools do you currently use in daily life? (can make more than 1 choice)
    □ TV □ radio □ CD/DVD player
    □ home phone □ mobile phone □ computer
    □ Internet □ community loud speakers

11. 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 tools	strongly agree	agree	neutral	disagree	strongly disagree
TV					
Radio					
CD/DVD player					
home phone					
mobile phone					
Computer					
Internet					
community loud speakers					

12. In your family, who plays the main role in conveying new agricultural information to you?
    □ yourself □ your children □ your spouse
    □ brother(s) □ sister(s) □ father
    □ mother □ others (please specify)……....

13. Other than your family, who or what are your main agricultural information providers? (can make more than 1 choice)
    □ neighbours □ local council □ extension workers
    □ private company □ sales agents □ government officers
    □ related web sites
    □ others (please specify)……....

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

information sources	strongly believe	believe	neutral	disbelieve	strongly disbelieve
Neighbours					
local council					
extension workers					
private company					
sales agents					
government officers					
related web sites					

15. What type of information would you like to acquire in order to improve your productivity? (can make more than 1 choice)

□ pest management □ use of fertilizer □ soil improvement
□ market price □ use of insecticide □ weather forecast
□ financial management □ organic farming
□ others (please specify)……....

16. How often and how much time would like to spend acquiring new information? Please tick one box

Frequency	5 min	15 min	30 min	45 min	1 hour
Daily					
Weekly					
Fortnightly					
Monthly					

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

□ 6.00 – 10.00 □ 10.01 – 13.00 □ 13.01 – 16.00
□ 16.01 – 18.00 □ 18.01 – 21.00 □ 21.01 – 24.00

18. Which positive outcomes have you resulted from the information you have received from these providers? (Please tick any that apply.)

□ increasing amount of productivity
□ higher quality of productivity
□ lower cost
□ higher selling price
□ others (please specify)……....

19. Which negative outcomes have you resulted from the information you have received from these providers? (Please tick any that apply.)
    □ failure of productivity
    □ higher cost but lower productivity
    □ low selling price
    □ complicated processes
    □ no follow-up process to stimulate the success
    □ others (please specify)……....

20. What kinds of current agricultural support have you used or heard about? (can make more than 1 choice)
    □ market prices via mobile phone services
    □ CD/DVD about agricultural productivity improvement
    □ agricultural forums/web board on the website of Department of Agriculture
    □ weather forecast for agricultural purpose on the website of The Thai Meteorological Department

21. What are your expectations towards agricultural information dissemination via ICT tools?

……
……
……
……
……

Appendix B: Consent Form

Information Letter to Participants (Thai farmers)

Information Dissemination in Multiple Formats to Thai Farmers in Rural Area

Dear Research Participants,

As a candidate for a Doctor of Information Technology degree at Edith Cowan University (ECU), Perth, Western Australia, I invite you to become a research participant to provide data in order to improve information dissemination techniques for your occupational developments.

The aim of this study is to improve agricultural processes and support agriculture-related decision making in Thailand by introducing information and communication technology tools in order to disseminate value information to Thai farmers in the forms of easily understandable formats. As a result, Thai farmers will be aware of the usefulness of information and communication technology and then adapt themselves to long-life learning through information and communication technology tools. In the long term, it will be a good opportunity to enhance the quality of livelihood for needy farmers.

To ensure confidentiality and anonymity, this research project has been approved by the ECU Human Research Ethics Committee. In details, all provided data and information will be used only in this research without identification of any person, organisation, time or place. The original questionnaires will be held in a secure place at my home for at least five years, as are all the data and information gathered. Any third parties outside of the immediate university staff directly concerned with my research will not be able to access any data or information sourced from these questionnaires.

You, as a participant, have the right to withdraw from this research process at any time. Moreover, in case you would like to remove all contents that you have provided, this requirement can be done under you own consideration.

If you require any further information concerning the research project, please contact:

Miss Khumphicha Tantisantisom

Email: ktantisa@our.ecu.edu.au

Tel: +61 414 963 662

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer

Edith Cowan University

100 Joondalup Drive

JOONDALUP WA 6027

Phone: (08) 6304 2170

Email: research.ethics@ecu.edu.au

Or the following person if you prefer a contact in Thailand

Associate Professor Pornpen Chochai

Dean of Faculty of Science and Technology

Kamphaengphet Rajabhat University

Kamphaengphet, Thailand 62000

Informed Consent Document

Information Dissemination in Multiple Formats to Thai Farmers in Rural Area

I (the participant) have read the information above and clearly understand the contents provided. I also am informed that I have a full right to withdraw from this study at any time.

I willingly agree to participate in this study.

……

Participant Date

……

Investigator Date

(The information letter, the informed consent document and the interview document will be translated into Thai for clearly understanding between participants and the investigator. Additionally, the translation will be approved by a lecturer from the Department of Foreign Language, Faculty of Humanities, Kamphaengphet Rajabhat University, Kamphaengphet, Thailand.)

Appendix C: Data from the needs survey

Table C1
Valid Percentages of Male and Female Participants in Each Village

Gender	Muang	Soongmen
Male	54.8	57.0
Female	45.2	43.0
Total	100	100

Table C2
Valid Percentages of Participants in Each Age Group in Each Village

Age	Muang	Soongmen
Below 15 years old	0.6	0
16 – 20 years old	0	1.3
21 – 25 years old	0	1.4
26 – 30 years old	0	2.7
31 – 35 years old	5.0	4.0
36 – 40 years old	6.7	6.7
41 – 45 years old	10.6	14.8
46 – 50 years old	21.2	22.1
51 – 55 years old	15.6	23.5
56 – 60 years old	16.8	12.1
Over 61 years old	23.5	11.4
Total	100	100

Table C3
Valid Percentages of Participants in Each Educational Level in Each Village

Education	Muang	Soongmen
Primary school	71.5	62.8
Junior high school	10.1	16.9
High school	8.9	8.8
Certificate	3.9	2.0
Undergraduate diploma	2.8	2.0
Bachelor degree	2.8	6.1
Master degree or higher	0	1.4
Total	100	100

Table C4
Valid Percentages of Participants in Each Type of Marital Status in Each Village

Marital Status	Muang	Soongmen
Single	12.3	12.8
Married	81.9	86.5
Divorced	5.2	0.7
Separated	0.6	0
Total	100	100

Table C5

Valid Percentages of Participants in Each Family Size in Each Village

Family members	Muang	Soongmen
1 person	1.7	4.0
2 people	5.5	8.7
3 people	21.1	29.3
4 people	30.6	32.7
5 people	22.8	14.6
More than 5 people	18.3	10.7
Total	100	100

Table C6

Valid Percentages of Participants in Each Income Group in Each Village

Income	Muang	Soongmen
Less than 3000 baht	37.5	29.5
3001 – 5000 baht	40.9	38.3
5001 – 8000 baht	11.9	14.8
8001 – 10000 baht	5.2	6.0
10001 – 15000 baht	1.1	6.0
15001 – 25000 baht	2.3	4.1
More than 25000 baht	1.1	1.3
Total	100	100

Table C7

Valid Percentages of Participants Who Have Grown Rice in Each Village

Rice growing	Muang	Soongmen
Yes	80.0	92.0
No	20.0	8.0
Total	100	100

Table C8

Valid Percentages of Participants Who Have Grown Sugar Cane in Each Village

Sugar cane growing	Muang	Soongmen
Yes	0	0.7
No	100	99.3
Total	100	100

Table C9

Valid Percentages of Participants Who Have Grown Casava in Each Village

Casava growing	Muang	Soongmen
Yes	0	0.7
No	100	99.3
Total	100	100

Table C10

Valid Percentages of Participants Who Have Grown Corn in Each Village

Corn growing	Muang	Soongmen
Yes	0	28.0
No	100	72.0
Total	100	100

Table C11

Valid Percentages of Participants Who Have Grown Mung Bean in Each Village

Mung bean growing	Muang	Soongmen
Yes	0	2.0
No	100	98.0
Total	100	100

Table C12

Valid Percentages of Participants Who Have Grown Soy Bean in Each Village

Soy bean growing	Muang	Soongmen
Yes	15.9	73.3
No	84.1	26.7
Total	100	100

Table C13

Valid Percentages of Participants Who Have Grown Sesame in Each Village

Sesame growing	Muang	Soongmen
Yes	0	0
No	100	100
Total	100	100

Table C14

Valid Percentages of Participants Who Have Grown Other Plants in Each Village

Other plant growing	Muang	Soongmen
Yes	23.5	4.7
No	76.5	95.3
Total	100	100

Table C15

Valid Percentages of Participants Who Have Fed Poultry in Each Village

Poultry feeding	Muang	Soongmen
Yes	51.2	57.3
No	48.8	42.7
Total	100	100

Table C16

Valid Percentages of Participants Who Have Fed Pigs in Each Village

Pig feeding	Muang	Soongmen
Yes	10.6	3.3
No	89.4	96.7
Total	100	100

Table C17

Valid Percentages of Participants Who Have Fed Cattles in Each Village

Cattle feeding	Muang	Soongmen
Yes	22.4	8.7
No	77.6	91.3
Total	100	100

Table C18

Valid Percentages of Participants Who Have Fed Other Animals in Each Village

Other animal feeding	Muang	Soongmen
Yes	5.9	4.7
No	94.1	95.3
Total	100	100

Table C19

Valid Percentages of Participants in Each the Agricultural Land Size in Each Village

Agricultural area	Muang	Soongmen
4 acres or less	59.9	49.0
5 – 10 acres	33.1	39.3
11 – 20 acres	6.4	5.5
21 – 20 acres	0.6	2.8
21 – 30 acres	0	1.3
31 acres or more	0	2.1
Total	100	100

Table C20

Valid Percentages of Participants in Each Types of Land Use in Each Village

Land own	Muang	Soongmen
Own	42.5	41.4
Rent	41.1	41.5
Both own and rent	16.4	17.1
Total	100	100

Table C21
Valid Percentages of Participants Who Used Television for Receiving Agricultural Information in Each Village

Use of television	Muang	Soongmen
Yes	68.5	79.6
No	31.5	20.4
Total	100	100

Table C22
Valid Percentages of Participants Who Used Radio for Receiving Agricultural Information in Each Village

Use of radio	Muang	Soongmen
Yes	44.2	52.8
No	55.8	47.2
Total	100	100

Table C23
Valid Percentages of Participants Who Used VCD for Receiving Agricultural Information in Each Village

Use of VCD	Muang	Soongmen
Yes	13.9	33.8
No	86.1	66.2
Total	100	100

Table C24
Valid Percentages of Participants Who Used Landline Phones for Receiving Agricultural Information in Each Village

Use of landline phone	Muang	Soongmen
Yes	16.4	16.2
No	83.6	83.8
Total	100	100

Table C25
Valid Percentages of Participants Who Used Mobile Phones for Receiving Agricultural Information in Each Village

Use of mobile phone	Muang	Soongmen
Yes	38.8	68.3
No	61.2	31.7
Total	100	100

Table C26

Valid Percentages of Participants Who Used Computers for Receiving Agricultural Information in Each Village

Use of computer	Muang	Soongmen
Yes	7.3	14.8
No	92.7	85.2
Total	100	100

Table C27

Valid Percentages of Participants Who Used the Internet for Receiving Agricultural Information in Each Village

Use of the Internet	Muang	Soongmen
Yes	6.1	13.4
No	93.9	86.6
Total	100	100

Table C28

Valid Percentages of Participants Who Used Community Speakers for Receiving Agricultural Information in Each Village

Use of community speaker	Muang	Soongmen
Yes	32.1	36.6
No	67.9	63.4
Total	100	100

Table C29

Valid Percentages of Participant Preference on Using Television for Receiving Agricultural Information in Each Village

Preference on using television	Muang	Soongmen
Strongly disagree	0	0
Disagree	0.7	0
Neutral	3.0	1.5
Agree	41.8	43.3
Strongly agree	54.5	55.2
Total	100	100

Table C30

Valid Percentages of Participant Preference on Using Radio for Receiving Agricultural Information in Each Village

Preference on using radio	Muang	Soongmen
Strongly disagree	0	0
Disagree	4.1	0.8
Neutral	3.3	10.1
Agree	59.5	44.1
Strongly agree	33.1	45.0
Total	100	100

Table C31

Valid Percentages of Participant Preference on Using VCD for Receiving Agricultural Information in Each Village

Preference on using VCD	Muang	Soongmen
Strongly disagree	3.0	0
Disagree	9.0	6.2
Neutral	33.0	23.0
Agree	34.0	48.7
Strongly agree	21.0	22.1
Total	100	100

Table C32

Valid Percentages of Participant Preference on Using Landline Phones for Receiving Agricultural Information in Each Village

Preference on using landline phone	Muang	Soongmen
Strongly disagree	0	0
Disagree	11.8	6.8
Neutral	43.0	28.2
Agree	35.5	37.6
Strongly agree	9.7	27.4
Total	100	100

Table C33

Valid Percentages of Participant Preference on Using Mobile Phones for Receiving Agricultural Information in Each Village

Preference on using mobile phone	Muang	Soongmen
Strongly disagree	1.0	0
Disagree	10.7	0
Neutral	31.0	14.0
Agree	36.9	44.9
Strongly agree	20.4	41.1
Total	100	100

Table C34

Valid Percentages of Participant Preference on Using Computers for Receiving Agricultural Information in Each Village

Preference on using computer	Muang	Soongmen
Strongly disagree	1.1	3.5
Disagree	7.6	6.1
Neutral	30.4	31.6
Agree	40.2	32.5
Strongly agree	20.7	26.3
Total	100	100

Table C35

Valid Percentages of Participant Preference on Using the Internet for Receiving Agricultural Information in Each Village

Preference on using the Internet	Muang	Soongmen
Strongly disagree	1.1	1.8
Disagree	8.0	6.2
Neutral	27.3	27.7
Agree	30.6	29.5
Strongly agree	33.0	34.8
Total	100	100

Table C36

Valid Percentages of Participant Preference on Using Community Speaker for Receiving Agricultural Information in Each Village

Preference on using community speaker	Muang	Soongmen
Strongly disagree	0.8	0.8
Disagree	2.5	1.7
Neutral	4.1	14.0
Agree	45.9	37.2
Strongly agree	46.7	46.3
Total	100	100

Table C37

Valid Percentages of Participants as a Role of an Information Provider for the Family in Each Village

Information provider in family	Muang	Soongmen
Yourself	63.3	62.6
Your children	8.4	4.1
Your spouse	24.1	24.5
Brother(s)	0	1.3
Sister(s)	1.2	0
Father	1.2	4.1
Mother	1.8	2.7
Others	0	0.7
Total	100	100

Table C38

Valid Percentages of Participants Who Received Agricultural Information from Neighbours

Neighbours as an information source	Muang	Soongmen
Yes	46.6	68.5
No	53.4	31.5
Total	100	100

Table C39
Valid Percentages of Participants Who Received Agricultural Information from Local Councils

Local councils as an information source	Muang	Soongmen
Yes	57.1	57.3
No	42.9	42.7
Total	100	100

Table C40
Valid Percentages of Participants Who Received Agricultural Information from Agricultural Extension Workers

Extension workers as an information source	Muang	Soongmen
Yes	65.6	46.2
No	34.4	53.8
Total	100	100

Table C41
Valid Percentages of Participants Who Received Agricultural Information from Private Companies

Private companies as an information source	Muang	Soongmen
Yes	0.6	6.3
No	99.4	93.7
Total	100	100

Table C42
Valid Percentages of Participants Who Received Agricultural Information from Suppliers

Suppliers as an information source	Muang	Soongmen
Yes	12.3	20.3
No	87.7	79.7
Total	100	100

Table C43
Valid Percentages of Participants Who Received Agricultural Information from Government Officers

Government officers as an information source	Muang	Soongmen
Yes	28.8	31.5
No	71.2	68.5
Total	100	100

Table C44
Valid Percentages of Participants Who Received Agricultural Information from Web Sites

Web sites as an information source	Muang	Soongmen
Yes	5.5	8.4
No	94.5	91.6
Total	100	100

Table C45
Valid Percentages of Participants Who Received Agricultural Information from Other Sources

Other sources as an information source	Muang	Soongmen
Yes	2.5	1.4
No	97.5	98.6
Total	100	100

Table C46
Valid Percentages of Participant Preference on Receiving Agricultural Information from Neighbours

Preference on neighbours	Muang	Soongmen
Strongly disagree	0	0.7
Disagree	0.8	0.7
Neutral	22.1	8.5
Agree	58.2	75.9
Strongly agree	18.9	14.2
Total	100	100

Table C47
Valid Percentages of Participant Preference on Receiving Agricultural Information from Local Councils

Preference on local councils	Muang	Soongmen
Strongly disagree	0	0
Disagree	1.6	2.9
Neutral	7.7	15.7
Agree	55.8	45.7
Strongly agree	34.9	35.7
Total	100	100

Table C48
Valid Percentages of Participant Preference on Receiving Agricultural Information from Agricultural Extension Workers

Preference on extension workers	Muang	Soongmen
Strongly disagree	0	0
Disagree	1.4	2.1
Neutral	7.9	7.1
Agree	46.4	55.6
Strongly agree	44.3	35.2
Total	100	100

Table C49

Valid Percentages of Participant Preference on Receiving Agricultural Information from Private Companies

Preference on private companies	Muang	Soongmen
Strongly disagree	0	2.4
Disagree	14.8	7.8
Neutral	67.9	44.9
Agree	16.1	29.9
Strongly agree	1.2	15.0
Total	100	100

Table C50

Valid Percentages of Participant Preference on Receiving Agricultural Information from Suppliers

Preference on suppliers	Muang	Soongmen
Strongly disagree	1.1	1.6
Disagree	11.5	8.5
Neutral	46.0	38.7
Agree	38.0	38.0
Strongly agree	3.4	13.2
Total	100	100

Table C51

Valid Percentages of Participant Preference on Receiving Agricultural Information from Government Officers

Preference on government officers	Muang	Soongmen
Strongly disagree	0.9	0
Disagree	0.9	3.1
Neutral	14.7	16.6
Agree	53.2	50.4
Strongly agree	30.3	29.9
Total	100	100

Table C52

Valid Percentages of Participant Preference on Receiving Agricultural Information from Web Sites

Preference on web sites	Muang	Soongmen
Strongly disagree	1.2	3.2
Disagree	3.6	9.5
Neutral	42.2	27.0
Agree	44.6	40.5
Strongly agree	8.4	19.8
Total	100	100

Table C53

Valid Percentages of Participants Who Requested Pest Management Information

Pest management information	Muang	Soongmen
Required	56.6	65.3
Not required	43.4	34.7
Total	100	100

Table C54

Valid Percentages of Participants Who Requested Use of Fertilizer Information

Use of fertilizer information	Muang	Soongmen
Required	68.7	64.6
Not required	31.3	35.4
Total	100	100

Table C55

Valid Percentages of Participants Who Requested Soil Improvement Information

Soil improvement information	Muang	Soongmen
Required	62.0	59.7
Not required	38.0	40.3
Total	100	100

Table C56

Valid Percentages of Participants Who Requested Market Price Information

Market price information	Muang	Soongmen
Required	56.6	59.0
Not required	43.4	41.0
Total	100	100

Table C57

Valid Percentages of Participants Who Requested Use of Insecticide Information

Use of insecticide information	Muang	Soongmen
Required	32.5	36.1
Not required	67.5	63.9
Total	100	100

Table C58

Valid Percentages of Participants Who Requested Weather Forecast Information

Weather forecast information	Muang	Soongmen
Required	16.9	11.1
Not required	83.1	88.9
Total	100	100

Table C59

Valid Percentages of Participants Who Requested Financial Management Information

Financial management information	Muang	Soongmen
Required	28.9	34.7
Not required	71.1	65.3
Total	100	100

Table C60

Valid Percentages of Participants Who Requested Organic Farming Information

Organic farming information	Muang	Soongmen
Required	62.7	41.0
Not required	37.3	59.0
Total	100	100

Table C61

Valid Percentages of Participants Who Requested Other Information

Other information	Muang	Soongmen
Required	1.2	1.4
Not required	98.8	98.6
Total	100	100

Table C62

Valid Percentages of Participant Preference on Receiving Information Daily in Each Length of Information in Each Village

Daily information delivery	Muang	Soongmen
5 minutes	42.1	49.2
15 minutes	31.6	32.8
30 minutes	15.8	16.4
45 minutes	0	1.6
1 hour	10.5	0
Total	100	100

Table C63

Valid Percentages of Participant Preference on Receiving Information Weekly in Each Length of Information in Each Village

Weekly information delivery	Muang	Soongmen
5 minutes	8.7	12.5
15 minutes	42.0	45.3
30 minutes	26.1	32.8
45 minutes	7.3	4.7
1 hour	15.9	4.7
Total	100	100

Table C64

Valid Percentages of Participant Preference on Receiving Information Fortnightly in Each Length of Information in Each Village

Fortnightly information delivery	Muang	Soongmen
5 minutes	8.0	2.4
15 minutes	28.0	36.6
30 minutes	28.0	46.3
45 minutes	24.0	4.9
1 hour	12.0	9.8
Total	100	100

Table C65

Valid Percentages of Participant Preference on Receiving Information Monthly in Each Length of Information in Each Village

Monthly information delivery	Muang	Soongmen
5 minutes	4.9	3.0
15 minutes	16.5	7.6
30 minutes	21.3	40.9
45 minutes	5.8	16.7
1 hour	51.5	31.8
Total	100	100

Table C66

Valid Percentages of Participant Preference on the Time to Receive Agricultural Information

Time to receive information	Muang	Soongmen
6.00 – 10.00	30.6	14.2
10.01 – 13.00	14.4	18.2
13.01 – 16.00	3.1	6.8
16.01 – 18.00	6.3	6.8
18.01 – 21.00	43.1	50.6
21.01 – 24.00	2.5	3.4
Total	100	100

Table C67

Valid Percentages of Participants Who Experienced from Increasing Amount of Productivity after Applying the Information Received

Experience on increasing amount of productivity	Muang	Soongmen
Experienced	64.1	72.1
Not experienced	35.9	27.9
Total	100	100

Table C68

Valid Percentages of Participants Who Experienced from Higher Quality of Productivity after Applying the Information Received

Experience on higher quality of productivity	Muang	Soongmen
Experienced	76.9	61.2
Not experienced	23.1	38.8
Total	100	100

Table C69

Valid Percentages of Participants Who Experienced from Lower Cost after Applying the Information Received

Experience on lower cost	Muang	Soongmen
Experienced	46.2	39.5
Not experienced	53.8	60.5
Total	100	100

Table C70

Valid Percentages of Participants Who Experienced from Higher Selling Price after Applying the Information Received

Experience on higher selling price	Muang	Soongmen
Experienced	59.0	43.5
Not experienced	41.0	56.5
Total	100	100

Table C71

Valid Percentages of Participants Who Experienced from Failure of Productivity after Applying the Information Received

Experience on failure of productivity	Muang	Soongmen
Experienced	23.1	23.4
Not experienced	76.9	76.6
Total	100	100

Table C72

Valid Percentages of Participants Who Experienced from Higher Cost but Lower Productivity after Applying the Information Received

Experience on higher cost but lower productivity	Muang	Soongmen
Experienced	55.1	35.2
Not experienced	44.9	64.8
Total	100	100

Table C73

Valid Percentages of Participants Who Experienced from Low Selling Price after Applying the Information Received

Experience on low selling price	Muang	Soongmen
Experienced	53.8	37.2
Not experienced	46.2	62.8
Total	100	100

Table C74

Valid Percentages of Participants Who Experienced from Complicated Processes after Applying the Information Received

Experience on complicated processes	Muang	Soongmen
Experienced	30.8	44.8
Not experienced	69.2	55.2
Total	100	100

Table C75

Valid Percentages of Participants Who Experienced from No Follow-up Process to Stimulate the Success after Applying the Information Received

Experience on no follow-up process to stimulate the success	Muang	Soongmen
Experienced	41.7	49.0
Not experienced	58.3	51.0
Total	100	100

Table C76

Valid Percentages of Participants Who Ever Received Market prices via mobile phone services

Market prices via mobile phone service	Muang	Soongmen
Ever	22.3	31.6
Never	77.7	68.4
Total	100	100

Table C77

Valid Percentages of Participants Who Ever Watched CD/DVD about Agricultural Productivity Improvement

CD/DVD about agricultural productivity improvement	Muang	Soongmen
Ever	62.8	41.2
Never	37.2	58.8
Total	100	100

Table C78

Valid Percentages of Participants Who Ever Used Agricultural Forums/Web Board on the Website

Agricultural forums/web board on the website	Muang	Soongmen
Ever	11.6	12.5
Never	88.4	87.5
Total	100	100

Table C79

Valid Percentages of Participants Who Ever Received Weather Forecast Information on the Website

Weather forecast on the website	Muang	Soongmen
Ever	10.7	17.6
Never	89.3	82.4
Total	100	100

Appendix D: The prototype user interface

The stand-alone prototype was developed using Visual Basic 6 tools. Bluetooth connection was used to connect a mobile phone to the application gateway. The pre-paid mobile phone registered to an SMS-lover promotion which was able to send out 500 messages within 199 baths (about 6.59 Australian Dollars on the 16th of March, 2011). After connecting the mobile phone to the program, a message can be sent out to either a single or multiple recipient numbers. However, this experiment was conducted in Thailand to send out information in official language which is of Thai. Therefore, text code limited the length of the sent message to 70 characters per a message. After launching the program, the application window shows as in Figure D1.

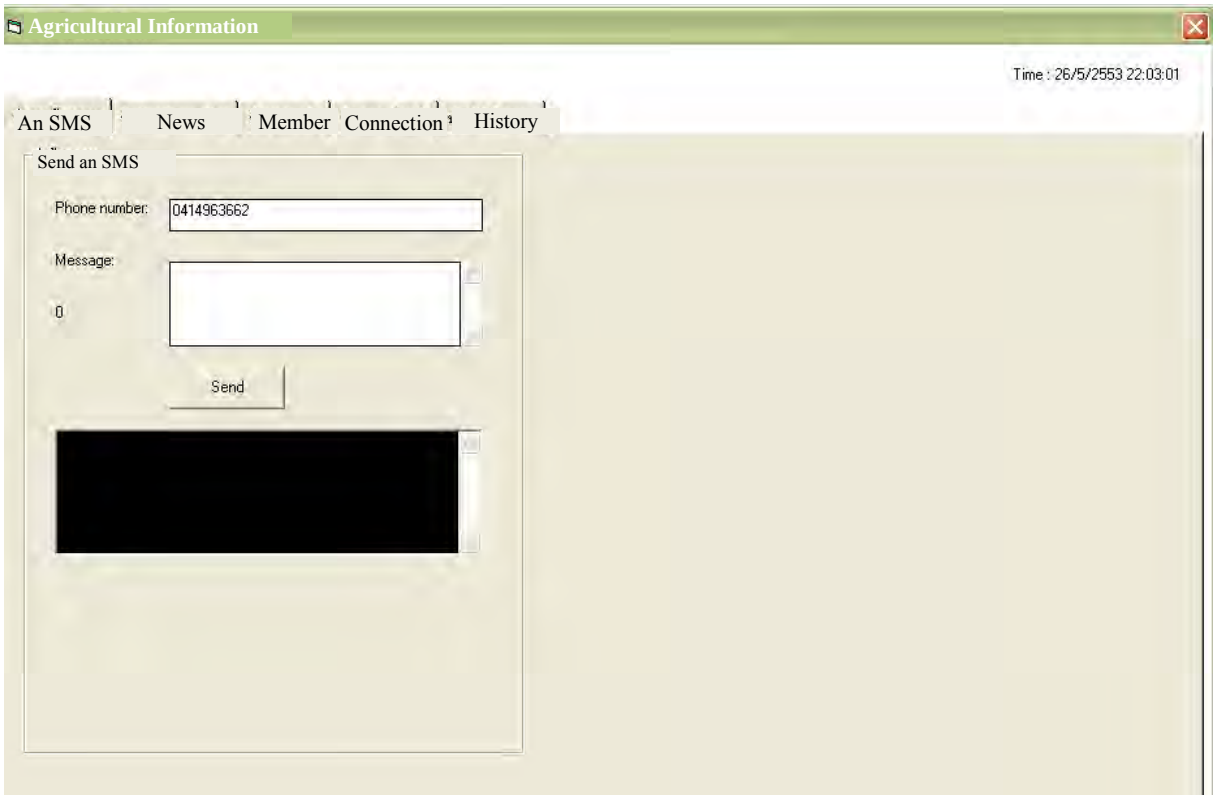

Figure D1. A user interface window to send out a message instantly by filling out all input boxes which are a recipient phone number and a message.

In order to deliver scheduled information to recipients, contents and recipient lists were created. As in Figure D2, clicking the Add button displayed a new interface as shown in Figure D3.

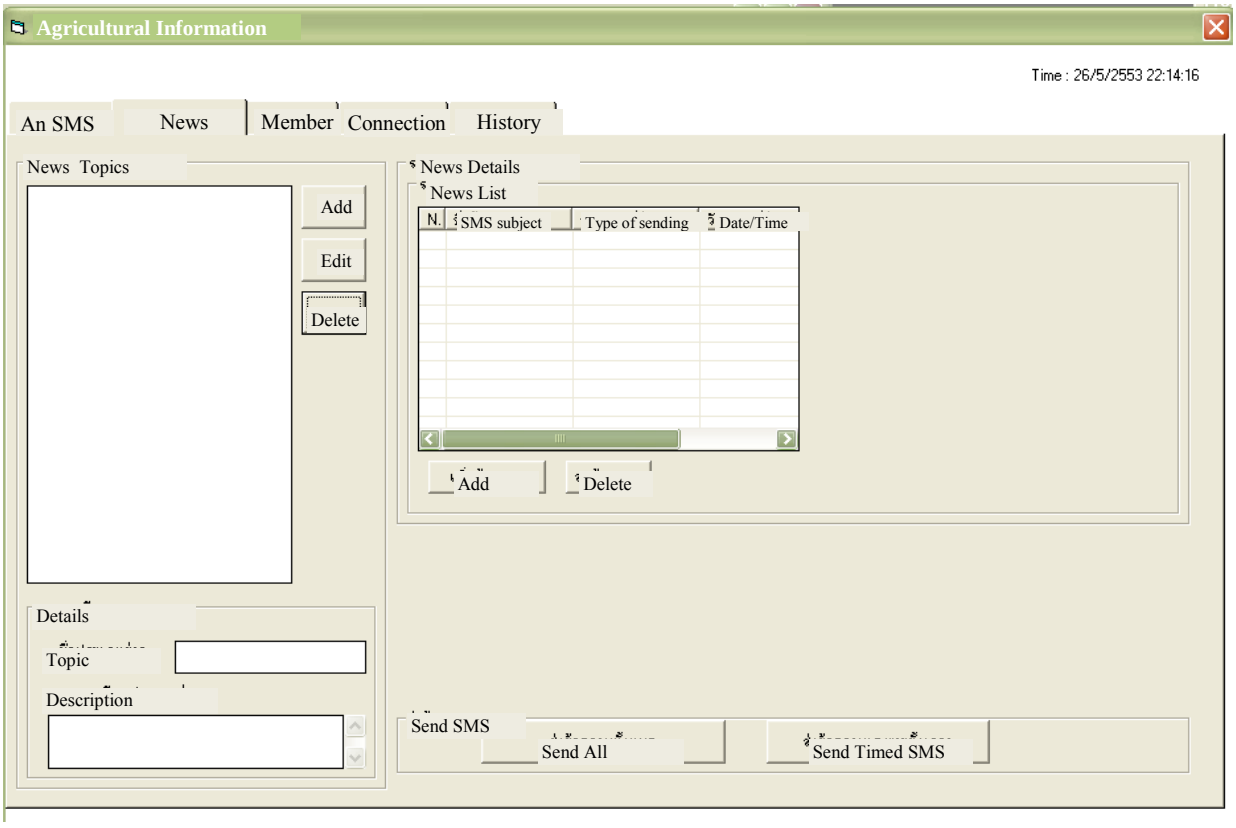

Figure D2. The interface window for managing the news topics.

Additionally, users were able to add, edit or delete news topics in the news topic window.

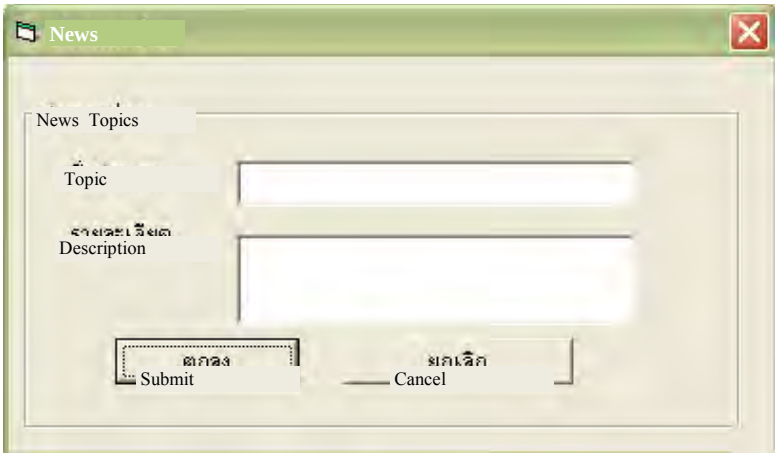

Figure D3. The interface window for completing news topic and its description.

After a new topic was created, clicking a topic in the News Topic box showed the Message box to create a news sub-topic under the selected main topic including its contents as shown in Figure D4.

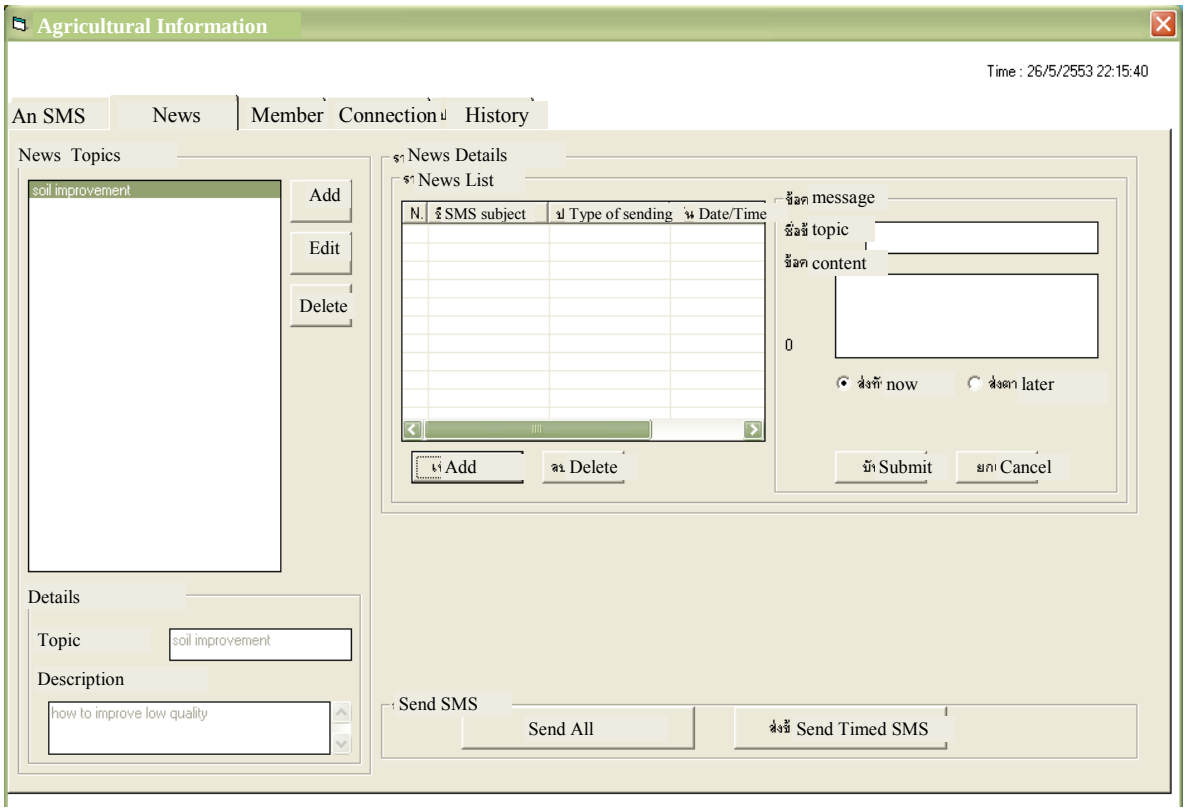

Figure D4. A user interface for creating news contents under each sub-topic.

Before clicking the Submit button, user were able to choose either Now or Later options. By selecting Now option, messages would be disseminated immediately after the Send All button was clicked. On the other hand, selecting the Later option needed the specific time and date to be delivered as shown in Figure D5. Time and date shown at the top right of the window was the time and date of the computer system.

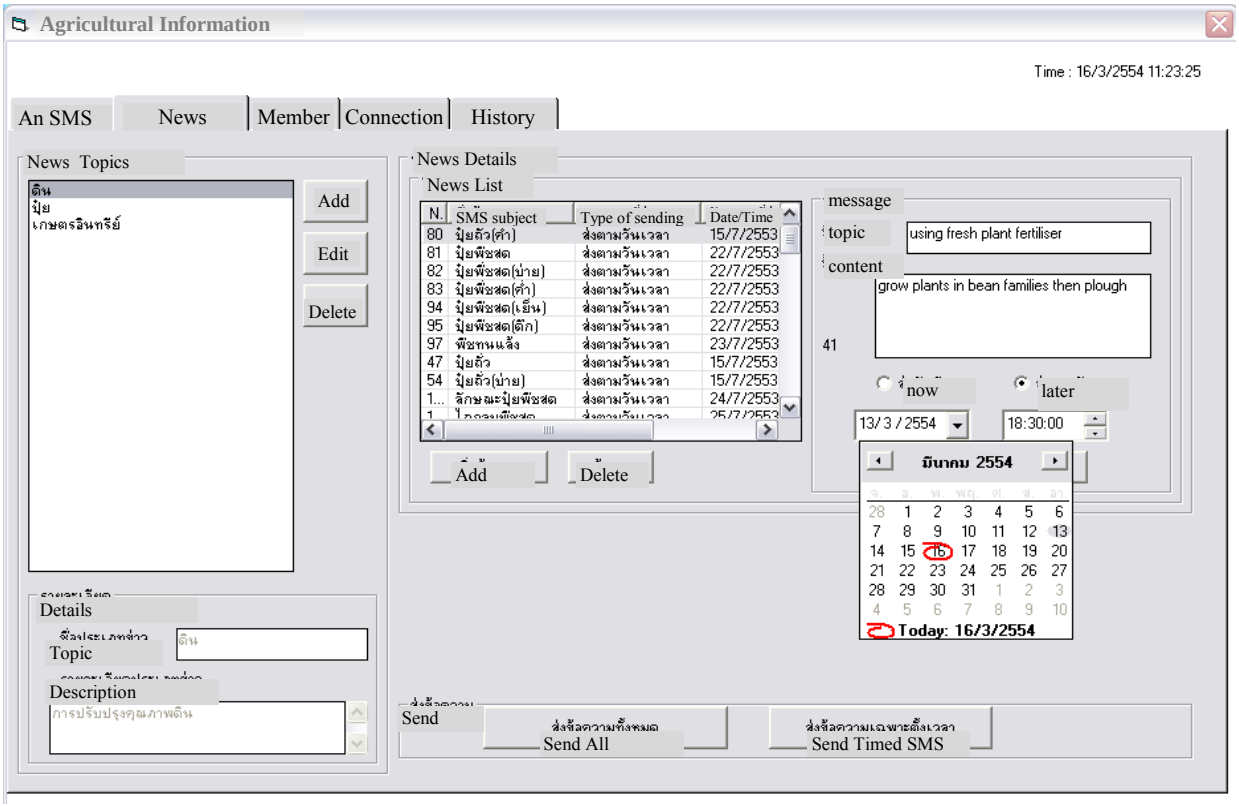

Figure D5. Setting time and date for the message to be disseminated.

Before sending news contents out to recipients, member details needed to be created as shown in Figure D6.

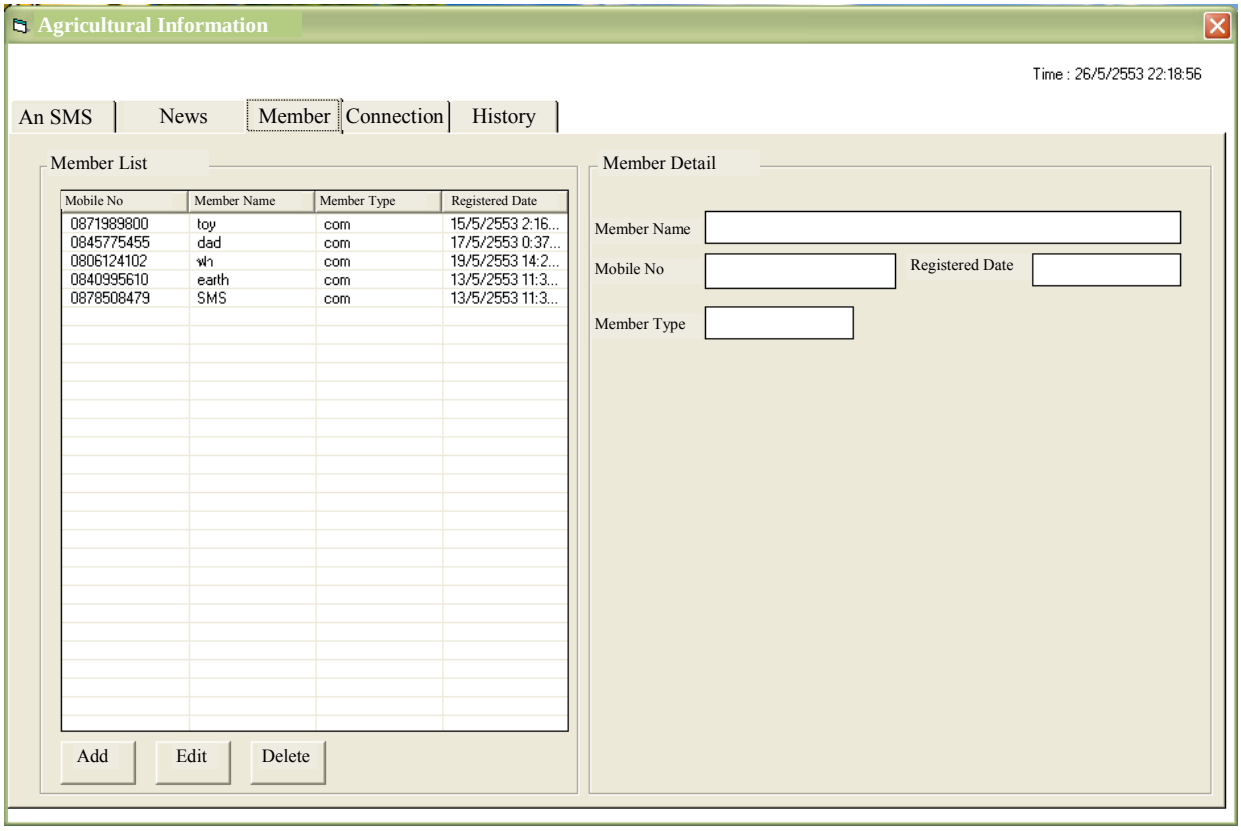

Figure D6. A user interface window for managing member or recipient details.

By clicking the Add button, necessary member details such as name and mobile phone number need to complete as shown in Figure D7. Furtheremore, within this interface, updating and deleting member were able to be accomplished.

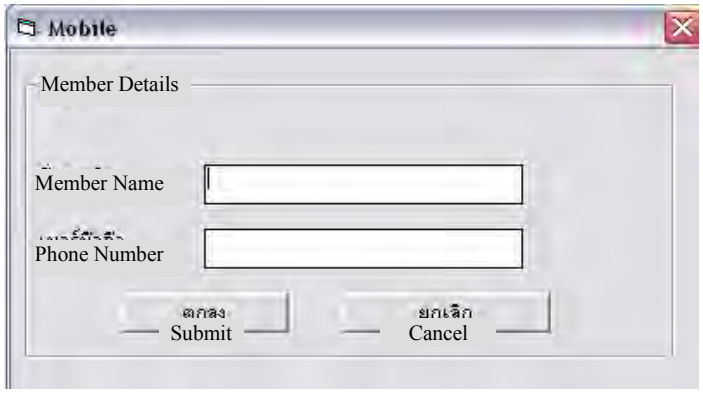

Figure D7. A user interface window to add new member and details.

After having agricultural messages and member details to send to, creating a member list could be done in the News tab as shown in Figure D8.

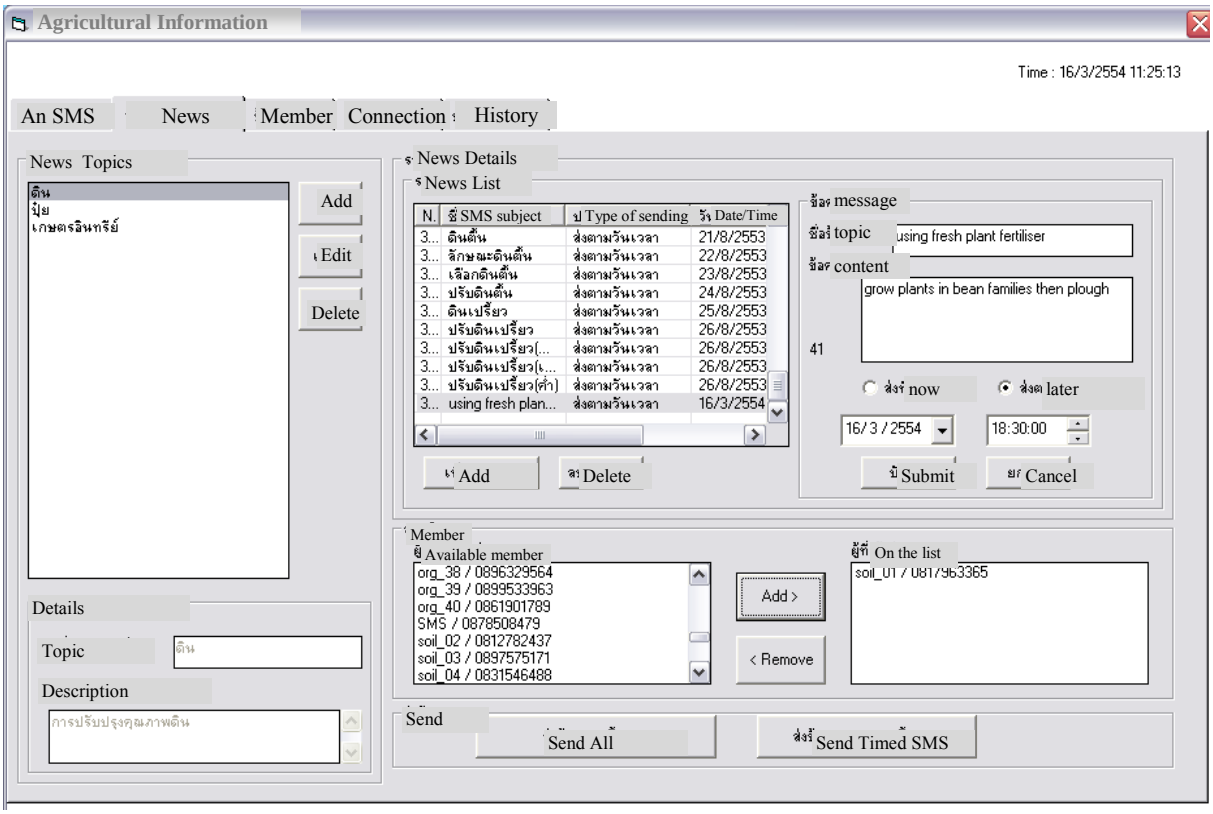

Figure D8. A user interface window to assign recipient list to each message.

However, in order to connect the application to the specific mobile phone via bluetooth connection a computer port needed to be configured as shown in Figure D9. In this experiment, port COM 11 was used.

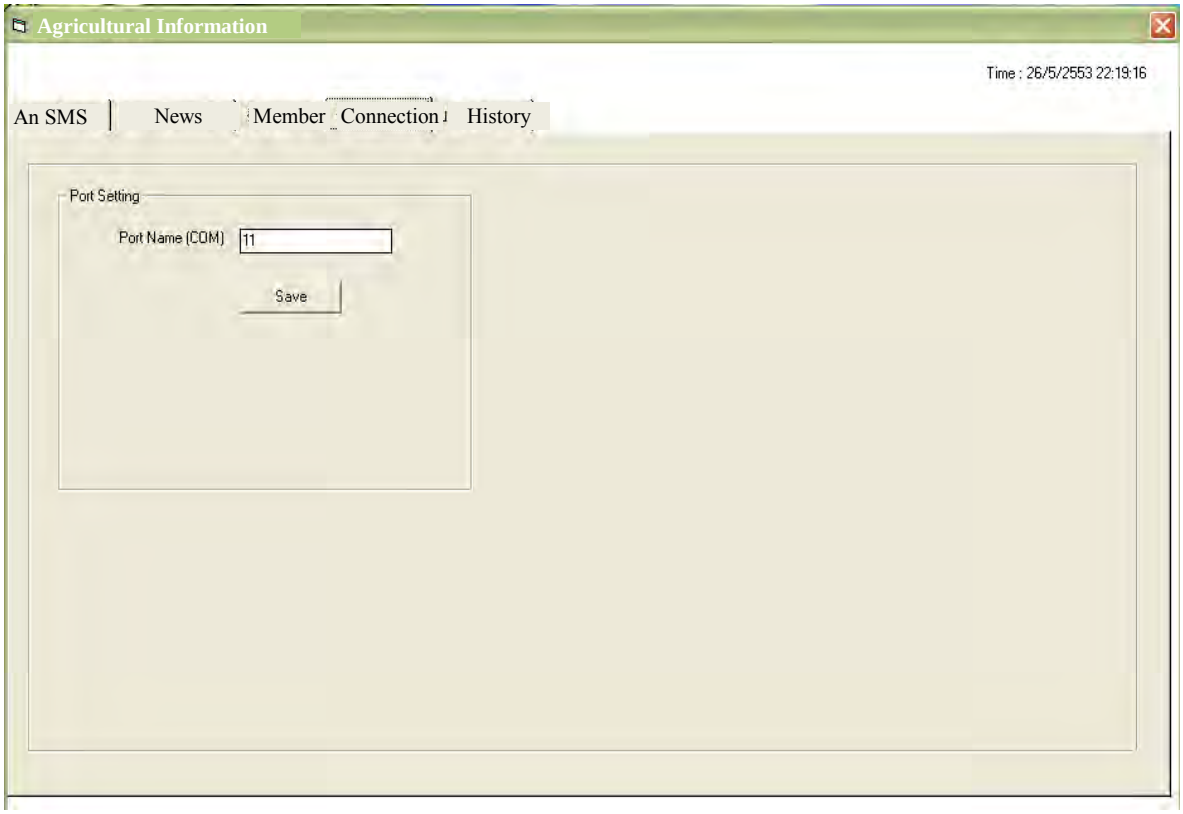

Figure D9. A user interface window for setting the Bluetooth connection port to a specific mobile phone.

Figure D10. The user interface while sending an example message to a receiver.

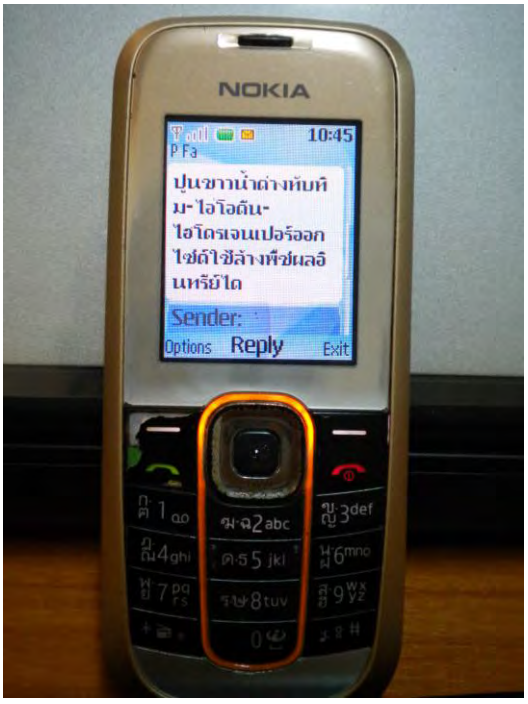

Figure D11. The receiver‟s mobile phone screen showing the message received.

Appendix E: The user satisfaction questionnaire

USER SATISFACTION QUESTIONNAIRE

Please mark × in the □ in front of the choice you have made

Part A Demographic Data

1. Gender □ male □ female

2. Age range (excluding months)
   □ below 20 years old □ 21 – 30 years old □ 31 – 40 years old
   □ 41 – 50 years old □ 51 – 60 years old □ over 61 years old

3. Highest education level
   □ primary school □ junior high school □ high school/certificate
   □ undergraduate diploma □ bachelor degree or higher

4. Marital status
   □ single □ married □ divorced/separated

5. The number of family members
   □ 1 - 2 people □ 3 -4 people □ 5 or more people

6. Average income (per month)
   □ less than 3000 baht □ 3001 – 5000 baht □ 5001 – 8000 baht
   □ 8001 – 10000 baht □ 10001 – 20000 baht □ more than 20000 baht

Part B Data related to the satisfaction toward receiving agricultural information through SMS services on mobile phones

7. What kind of information have you selected?
   □ the use of fertilizer
   □ soil improvement
   □ organic farming

8. How often have you received agricultural information during the experimental service?
   □ daily □ weekly □ fortnightly

9. How often would you like to receive the information?
   □ twice a day □ daily □ twice a week □ weekly
   □ fortnightly □ monthly □ others (please specify)……

10. What are your opinions toward the use of this service? Please fill in the following table for each category.

Category	strongly agree	agree	neutral	disagree	strongly disagree
Convenience					
Ease of use					
Free of charge					
Knowledge enhancement					
Technology practice					
Information timeliness					
Information format					

11. If you would like to continue on receiving agricultural information, what other kind of information would you like to receive?
    □ pest management □ market price □ use of insecticide
    □ weather forecast □ financial management
    □ others (please specify)……....

12. If you would not like to continue on receiving the agricultural information, please give us the reason. (can make more than 1 choice)
    □ technology unfamiliarity
    □ inconvenience in reading including too small character problem
    □ cause of annoyance
    □ information received is not practical or relevant
    □ others (please specify)……....

13. What are your opinions for improving the agricultural information dissemination using mobile phones?

……
……
……
……
……

Appendix F: Data from the user satisfaction survey

Table F1
Valid percentages of male and female participants in each Village

Gender	Muang	Soongmen
Female	15.8	40.7
Male	84.2	59.3
Total	100	100

Table F2
Valid Percentages of Participants in Each Age Group in Each Village

Age	Muang	Soongmen
below 20 years old	0	0
21 – 30 years old	0	0
31 – 40 years old	1.8	1.7
41 – 50 years old	29.8	40.7
51 – 60 years old	54.4	39.0
over 61 years old	14.0	18.6
Total	100	100

Table F3
Valid Percentages of Participants in Each Educational Level in Each Village

Education	Muang	Soongmen
Primary school	66.7	86.4
Junior high school	17.5	8.5
High school/certificate	8.8	5.1
Undergraduate diploma	3.5	0
Bachelor degree or higher	3.5	0
Total	100	100

Table F4
Valid Percentages of Participants in Each Type of Marital Status in Each Village

Marital Status	Muang	Soongmen
Single	5.2	8.5
Married	93.0	89.8
Divorced /Separated	1.8	1.7
Total	100	100

Table F5
Valid Percentages of Participants in Each Family Size in Each Village

Family members	Muang	Soongmen
1 - 2 people	14.0	6.8
3 - 4 people	77.2	71.2
5 or more people	8.8	22.0
Total	100	100

Table F6

Valid Percentages of Participants in Each Income Group in Each Village

Income	Muang	Soongmen
Less than 3000 baht	0	13.5
3001 – 5000 baht	0	40.7
5001 – 8000 baht	14.0	28.8
8001 – 10000 baht	43.9	15.3
10001 – 20000 baht	33.3	1.7
More than 20000 baht	8.8	0
Total	100	100

Table F7

Valid Percentages of Participants Requesting for Each Information Type in Each Village

Information request	Muang	Soongmen
The use of fertilizer	26.3	47.4
Soil improvement	61.4	8.5
Organic farming	12.3	44.1
Total	100	100

Table F8

Valid Percentages of Participant Preference for Information Delivery Frequency in Each Village before the Experiment

Frequency	Muang	Soongmen
Daily	22.8	0
Weekly	63.2	100
Fortnightly	14.0	0
Total	100	100

Table F9

Valid Percentages of Participant Preference for Information Delivery Frequency in Each Village after the Experiment

Frequency	Muang	Soongmen
Twice a day	3.5	0
Daily	43.9	1.8
Twice a week	7.0	25.4
Weekly	40.3	23.7
Fortnightly	5.3	23.7
Monthly	0	25.4
Total	100	100

Table F10

Valid Percentages of Participant Preference on Convenience of the Experimental Service in Each Village

Preference on convenience	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	3.4
Agree	14.0	37.3
Strongly agree	86.0	59.3
Total	100	100

Table F11

Valid Percentages of Participant Preference on Ease of Use of the Experimental Service in Each Village

Preference on ease of use	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	5.1
Agree	17.5	25.4
Strongly agree	82.5	69.5
Total	100	100

Table F12

Valid Percentages of Participant Preference on Free of Charge of the Experimental Service in Each Village

Preference on free of charge	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	3.4
Agree	5.3	40.7
Strongly agree	94.7	55.9
Total	100	100

Table F13

Valid Percentages of Participant Preference on Knowledge Enhancement of the Experimental Service in Each Village

Preference on knowledge enhancement	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	1.7	3.4
Agree	8.8	39.0
Strongly agree	89.5	57.6
Total	100	100

Table F14

Valid Percentages of Participant Preference on Technology Practice of the Experimental Service in Each Village

Preference on technology practice	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	6.8
Agree	26.3	47.4
Strongly agree	73.7	45.8
Total	100	100

Table F15

Valid Percentages of Participant Preference on Information Timeliness of the Experimental Service in Each Village

Preference on information timeliness	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	8.5
Agree	14.0	42.4
Strongly agree	86.0	49.1
Total	100	100

Table F16

Valid Percentages of Participant Preference on Information Format of the Experimental Service in Each Village

Preference on information format	Muang	Soongmen
Strongly disagree	0	0
Disagree	0	0
Neutral	0	6.8
Agree	15.8	44.1
Strongly agree	84.2	49.1
Total	100	100

Table F17

Valid Percentages of Participants Who Further Requested Pest Management Information

Pest management information	Muang	Soongmen
Not required	29.8	88.1
Required	70.2	11.9
Total	100	100

Table F18

Valid Percentages of Participants Who Further Requested Use of Insecticide Information

Use of insecticide information	Muang	Soongmen
Not required	70.2	98.3
Required	29.8	1.7
Total	100	100

Table F19

Valid Percentages of Participants Who Further Requested Weather Forecast Information

Weather forecast information	Muang	Soongmen
Not required	100	89.8
Required	0	10.2
Total	100	100

Table F20

Valid Percentages of Participants Who Further Requested Market Price Information

Market price information	Muang	Soongmen
Not required	68.4	42.4
Required	31.6	57.6
Total	100	100

Table F21

Valid Percentages of Participants Who Further Requested Financial Management Information

Financial management information	Muang	Soongmen
Not required	78.9	76.3
Required	21.1	23.7
Total	100	100

Table F22

Valid Percentages of Participants Who Found Difficulty in Technology Unfamiliarity in Each Village

Technology unfamiliarity	Muang	Soongmen
No	100	81.4
Yes	0	18.6
Total	100	100

Table F23

Valid Percentages of Participants Who Found Difficulty in Too Small Text Size in Each Village

Too small text size	Muang	Soongmen
No	82.5	91.5
Yes	17.5	8.5
Total	100	100

Table F24

Valid Percentages of Participants Who Found Difficulty in Annoyance in Each Village

Annoyance	Muang	Soongmen
No	100	100
Yes	0	0
Total	100	100

Table F25

Valid Percentages of Participants Who Found Difficulty in Unpractical Information in Each Village

Unpractical information	Muang	Soongmen
No	100	96.6
Yes	0	3.4
Total	100	100