ENGAGING YOUTH IN ICT FOR ENHANCED AGRICULTURAL KNOWLEDGE

RATIH NAWANGWULAN

WAGENINGEN UR
For quality of life

lpdp
lembaga pengelola dana pendidikan

Engaging youth in ICT for enhanced agricultural knowledge

Student	: Ratih Nawangwulan
Registration no.	: 921013596100
Study Program	: MSc Food Technology, Food Innovation and Management
Course code	: MST-80436
Supervisor	: Prof. Jacques H. Trienekens
Co-reader	: Dr. Emiel Wubben

Abstract

The rapid population growth requires the agrifood sector to increase production, putting the agrifood sector into a much more important role to feed the planet. However, the agrifood sector is facing numerous challenges, including the aging population of people working in the agrifood and limited access to knowledge. To bridge these gaps, this study aims to understand and address the specific needs of potential youth to enhance knowledge sharing using ICT and to support better understanding among the actors of agrifood supply chain (AFSC). To this end, the research question is as follows: *What are the possibilities to enhance and to extend the reach of agricultural knowledge using ICT and support better understanding among the actors of agrifood supply chain from the standpoint of young professionals?* Subsequent to these, we investigated the current knowledge sharing practice, the roles of ICT, and young professionals engagement in AFSC through literature research, questionnaires, and interviews with current young professionals and experts in agrifood sector.

A cross-sectional study of members of Young Professionals in Agricultural Development (YPARD) in Indonesia, Nepal, and the Philippines was conducted to explore the involvement of young professionals and utilization of ICT in AFSC. Findings suggest that young people have the capability and potential to incorporate ICT in the AFSC, as demonstrated by the high awareness of ICT benefits. Furthermore, the studied young professionals were found to be highly skilled in using different ICT devices (mobile phone, computer, internet, and advanced ICT devices). However, several constraints were identified in relation to cost, skill, and support from the government. More importantly, the presence of digital divide between younger and older professionals or between supply chain partner was found to be challenging in fully incorporating ICT in AFSC.

Nevertheless, applications of ICT can provide wider opportunities if the goals are specific and well-defined, meaning that the development of ICT devices should meet the requirement of current and future professionals. Further research could be undertaken to identify the interaction of individual motivation to share knowledge and support from organization to foster the ICT adoption in AFSC from the standpoint of young professionals.

Contents

List of tables

List of figures

Abbreviations

AFSC : Agrifood supply chain

FAO : Food and Agriculture Organization

FSCN : Food supply chain network

GPS : Global positioning system

ICT : Information and communication technology

ITU : International Telecommunication Union

KS : Knowledge sharing

PC : Personal computer

SaaS : Software as a service

SC : Supply chain

UN : United Nations

1. Introduction

1.1 Research Background

World population is constantly growing and therefore the rapid population growth would require a 70 percent increase in global food production by 2050, putting agrifood sector into a much more important role to feed the planet (Carmody et al., 2015). However, agrifood sector is facing numerous challenges such as climate change, lack of policy, low technology support for smallholder farmers, and sustainability (Sumberg & Anyidoho, 2012).

Furthermore, millions of people have left agriculture since the automation of jobs back in the 19th century and thus the age of people working in the agrifood sector is weathering. The United Nations (UN) defines 'youth' as the age of cohort of 15-24 (UN, 2016). A number of factors shaped the opinion of young people over this sector such as having relatively limited career options due to the lack of support from the government and discriminatory policies that prioritize urban development, not to mention the perception and profile of agrifood sector as 'dirty laboring work' and low-income career (Lohento & Ajilore, 2016). On the contrary, unemployment and underemployment among young people are also a severe problem in most countries as the investment in technologies is highly likely to close the labor markets rather than creating jobs. Furthermore, young people are often not equipped with the specific skills required by the employers (Breen, 2005; White, 2012).

White (2012) suggests that the agrifood sector can be the source of employment and enhance the livelihoods for many more if given necessary support and thus, is able to attract more youth. The support can come from infrastructure enhancement, access to financing, adoption of technology, and ultimately access to knowledge where information and communication technologies (ICT) can play a role.

The importance of ICT in the development process has been long recognized and even stated in one of the targets of the Millennium Development Goal No. 8 that was laid down in September 2000 by 189 UN member states. It highlights the advantages of new technologies, in particular, the role of ICT to fight against poverty. The advancement of ICT for the last 25 years began after the successful installation of computers, followed by the internet connection in the 1990s which led to new forms of collaboration in social media and growing usage of mobile phones (Michaels, Natraj, & Van Reenen, 2014). It is also supported by the growth of ICT tools utilization and the supporting infrastructure from 2000 to 2015, as shown in Figure 1. Globally, the proportion of households equipped with internet access increased from 18% in 2005 to 46% in 2015. The mobile broadband subscription has also seen an increase of 97% from 738 million to 7 billion subscribers in 2015 (ITU, 2017b).

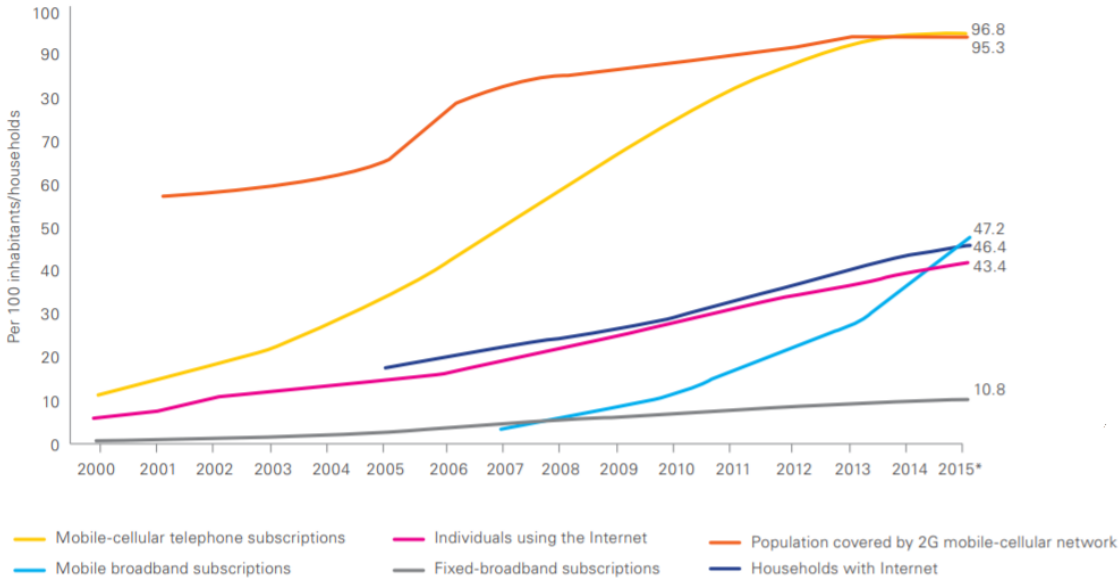

Figure 1 ICT growth from 2000-2015 (ITU, 2017b)

The global agrifood supply chain has fundamentally changed as a result of the vast development of ICT. ICT usage in agrifood sector is essential to enhance practice and to improve the current knowledge service relative to providing the user's knowledge needs (Lesaona-Tshabalala, 2009). ICT, for example, can increase accessibility to the knowledge that would allow farmers to solve some essential problems such as how to increase yields, gaining access to markets, or adapting to changing weather conditions (Feder, Just, & Zilberman, 1985; Lohento & Ajilore, 2016). These are some examples of how modern ICT can transform the agriculture industries, hence presenting opportunities for young people to get involved in the supply chain by making agriculture professions an ICT-based and knowledge-intensive sector for a better knowledge-sharing experience among stakeholders in the agrifood supply chain (Mammo, 2015).

With roughly 80 percent of youth aged 15-24 in 104 countries are active ICT users (ITU, 2017a), they can play roles along the agrifood supply chain such as producers or growers, manufacturers, entrepreneurs, extension officers, scientists, academics, and researchers etc. That being said, young people have the potential to be more involved in the digital revolution of agricultural development, enhance the transfer of local knowledge among communities and support better understanding among the current and future professionals in agrifood sector (Huggins & Izushi, 2002).

Within the framework of this research, the involvement of young professionals and utilization of ICT along the agrifood supply chain will be studied by doing a cross-sectional study of members of Young Professionals in Agricultural Development (YPARD), particularly in Asia-Pacific. Young professionals according to YPARD are those persons between the ages of 18-39 years old who work in agriculture, agricultural research for development, or rural development (YPARD, 2017). Implication of the youth age extension in this research is that finding of this study would not only be applied to youth as defined by the UN, but also 'older' youth within the range of YPARD member's age. Considering the active participation in YPARD network, the young professionals from Indonesia, Nepal, and Philippines were chosen as study subjects. Through their roles as study subjects, this study hopes to find evidence of how agricultural productivity can be enhanced by the involvement of young professionals and ICTs utilization.

1.1.1 About Partner: Young Professionals in Agricultural Development (YPARD)

YPARD is a global youth network that supports the creation of agricultural's next generation leaders, thinkers, and entrepreneurs to address critical development issues. YPARD contributes with its extensive knowledge on youth-relevant issues in agriculture through its network of 15,000 registered members globally. YPARD's global youth outreach is further underpinned by its strong online presence through active social media channels, its position as a network of networks and capacity to reach less connected youth over 60 member countries who develop and implement activities on the ground with rural and urban youth in agriculture.

YPARD is a movement that works to enhance access to and exchange information among youth, linking youths within countries and around the world, contribute to a positive view of agriculture among young people, address issues around employability of young people and seeks to enhance the livelihoods of youth in agriculture (YPARD, 2017).

1.2 Research Objectives

The objectives of the research are stated as follow:

1. To understand and address the specific needs of youth for knowledge sharing using ICT in agrifood supply chain
2. To support better understanding among the actors of agrifood supply chain using ICT as knowledge sharing tool
3. To engage and involve youth in agrifood supply chain using ICT as knowledge sharing tool

1.3 Main Research Question

The following main research question can be derived from the background of this study and the research objectives, which was presented in section 1.1 and 1.2.

What are the possibilities to enhance and to extend the reach of agricultural knowledge using ICT and support better understanding among the actors of agrifood supply chain from the standpoint of young professionals?

To answer this general research question, the following specific research questions (SRQ) need to be answered.

SRQ1: *How do young professionals share knowledge with and without ICT among stakeholders of agrifood supply chain?*
Knowledge sharing among actors involved in the supply chain is essential to enhance the agrifood supply chain by providing relevant knowledge which a firm can benefit. However, little is known about how actors in the supply chain practicing knowledge sharing within the organization and whether ICT is already employed in the agrifood supply chain. The answer of this question will help to fill the knowledge gap on how effective the current knowledge sharing practice as perceived by young professionals in the agrifood supply chain with and without ICT.

SRQ2: *What is the current level of awareness of ICT in agrifood supply chain of young professionals?*
Despite the potential benefit of ICT, many stages in the agrifood supply chain are still not fully embracing and implementing ICT. This research question aims to study the level of awareness towards the adoption of ICT in the agrifood supply chain from the standpoint of young professionals working along the agrifood supply chain.

SRQ3: *How do young professionals apply ICT in the current agrifood supply chain?*

ICT has indeed been an integral part of young people's lifestyle. Nevertheless, little is known about the specific ICTs applicability in the agrifood supply chain. This sub-research question will explore specifically on the current use of ICT in the agrifood supply chain by young professionals.

SRQ4: *What are the challenges faced by young professionals in the application of ICT in agrifood supply chain?*
The application of ICT in the agrifood supply chain often meets challenges. Although ICT has been widely found in almost every sector, its adoption and implementation in the agrifood supply chain is yet to be optimized. This sub-research question is meant to explore the present challenges that may hinder the adoption and implementation of ICT in the agrifood supply chain by young professionals.

SRQ5: *What are the future opportunities in applications of ICT for young professionals in agrifood supply chain?*
After identifying different key areas of ICT utilization in the agrifood supply chain, there is a need to propose a possible future scenario of ICT. Figuring out the opportunities in the applications of ICT will help to direct the young professionals in optimizing ICT usage in the agrifood supply chain to leverage knowledge sharing.

Overall, the study aims to further explore the possibilities to enhance and extend the reach of agricultural knowledge and support better understanding among actors in the agrifood supply chain from the standpoint of young professionals. All sub-research questions will be answered by the data collected from interviews and surveys. This step is taken because the present study is explorative, which means that little is known in this study area and that the final aim is to contribute to the present literature. Reviewing the literature and secondary data will also be used to set the background of the study and facilitate data analysis.

1.4 Research Framework

The research framework illustrates how the research is conducted to achieve the objectives. It is organized into four different sections. A systematical approach of the research framework is depicted in Figure 2.

1. Theoretical Study
   The theoretical study aims to acquire information about young professionals; the application, challenges, and potential of ICT; and the knowledge sharing in the agrifood supply chain.
2. Empirical Study
   The empirical study is obtained via questionnaire and semi-structured interviews (mixed-methods study) with members of YPARD and experts in youth and ICT for agricultural development. A mixed method approach is practical to obtain breadth and depth of understanding and corroboration. This research used quantitative survey procedures and follow up interviews from individuals who completed the survey to help explain the reasons behind and meaning of the quantitative survey results.
3. Analysis
   The results from the empirical study will be collected and analyzed to identify what are the applications, challenges, and future potentials of ICT in the agrifood supply chain and how it gives impact on the knowledge sharing practice. Explorative analysis is used to collect perspectives and practices of ICT utilization by the study population in Indonesia, Nepal, and Philippines based on knowledge sharing practice, awareness of ICT, application of ICT, challenges in ICT, and future opportunities of ICT

4. Conclusions

This chapter will provide recommendations on which gap of ICT utilization that can be minimized in the agrifood supply chain by young professionals and how the analyzed factors can help knowledge sharing using ICT.

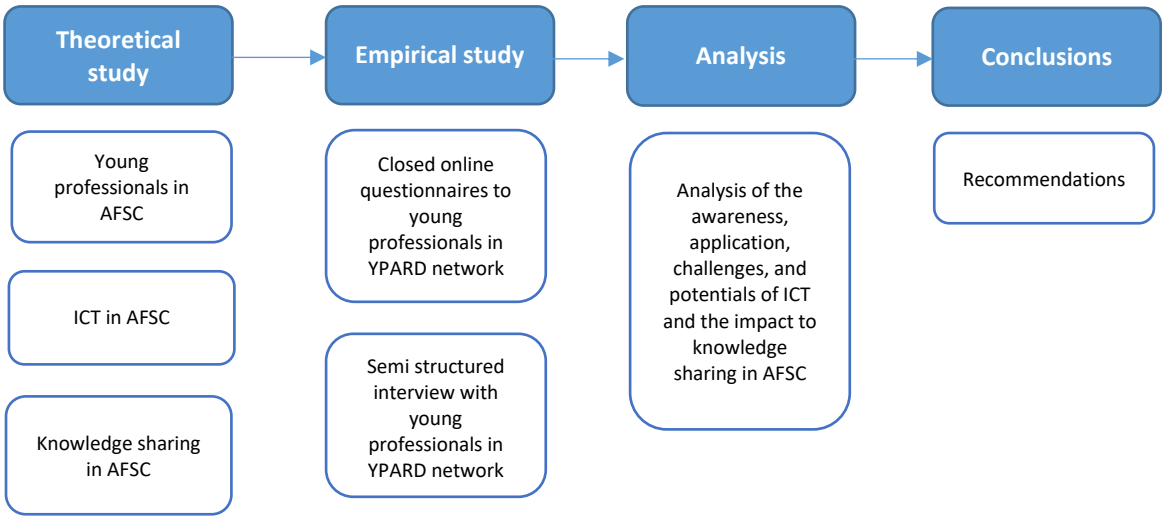

Figure 2 Research framework

2. Literature Review

This section presents the concepts to answer research questions. Introduction to terminology of data, information, and knowledge is shown in section 2.1. Section 2.2 gives an introduction on the terminology of knowledge sharing. In section 2.3, the concept of knowledge sharing process in the agrifood supply chain is presented to answer SRQ 1 "*How do young professionals share knowledge with and without ICT among stakeholders of agrifood supply chain?"*. Section 2.4 aims to answer SRQ2 "*What is the current level of awareness of ICT in agrifood supply chain of young professionals?"*. Section 2.5 is presented to give the idea on the current applications of ICT in the agrifood supply chain and to answer SRQ3: "*How do young professionals apply ICT in the current agrifood supply chain?"*. Furthermore, section 2.6 argues on the challenges of ICT adoption and implementation in the agrifood supply chain to answer SRQ4: "*What are the challenges faced by young professionals in the application of ICT in agrifood supply chain?"*. Finally, section 2.7 will present the opportunities of ICT for young professionals in the agrifood supply chain to answer SRQ 5: "*What are the future opportunities in applications of ICT for young professionals in agrifood supply chain?".* The chapter ends by answering specific research questions logically represented by the conceptual framework.

2.1 Terminology of data, information, and knowledge

In this section, the terminology of data, information, and knowledge will be explained as complementary information for this research. The last paragraph in this section will give four main types of knowledge in the knowledge sharing process.

Shih, Hsu, Zhu, and Balasubramanian (2012) affirm the importance to distinguish between data, information, and knowledge. The difference can be determined by the degree of organization and functionality. *Data* are referred as raw stimuli or facts with little organization or ready utility (Bierly, Kessler, & Christensen, 2000). *Information* is defined by Zins (2007) as a set of signs that represent empirical knowledge. *Knowledge* is "*a high-value form of information that may be useful in making decisions and prompting actions*" (Shih et al., 2012). Many kinds of literature also add the highest stage of knowledge management concept which is wisdom. It is defined as the "*ability to perceive or determine what is good, true or sound*" (Bierly et al., 2000). However, this research will adopt knowledge as "***information processed by individuals including ideas, facts, expertise, and judgments*****" which are relevant to individual, team, and organizational performance** (Wang & Noe, 2010) and limit the study to "knowledge" level to create consistency and common understanding.

According to Shih et al. (2012), knowledge itself is tacit or explicit in its nature:

> *"Tacit knowledge is difficult to codify, transmit, or convey: it contains data that are processed, organized, useful, but the logic of its organization is frequently complex, implicit, and ambiguous. It is rooted in actions within a specific context. It is important for solving problems that are intractable, complex, or variable […]. Explicit knowledge is discrete and digital, and may be easily transmitted via formal and systematic means."*

Since the focus of SRQ1 is the knowledge sharing activity in the agrifood supply chain, it is important to describe what types of knowledge are playing roles. Four main types of knowledge are defined based on the relationship between the product and process innovation and organizational and strategic knowledge (Crone & Roper, 1999). These four types of knowledge are defined in Table 1.

Table 1 Types of knowledge (Crone & Ropper, 1999)

Knowledge type	Explanation
Product-related knowledge	Knowledge related to technical issues, performance, product development in production
Process-related knowledge	Knowledge related to process equipment/technologies and how to improve the process.
Organizational knowledge	Knowledge related to managerial/organizational techniques
Strategic knowledge	Knowledge related to strategic issues, planning and forecasting of production, opportunities seeking, guidance on a strategic/financial aspect of the organization

2.2 Terminology of knowledge sharing

This study will discuss the role of ICT in the knowledge sharing practice between stakeholders in the agrifood supply chain.

Knowledge sharing is defined as **an interactive process to diffuse a set of shared understandings to provide members access to relevant knowledge** (Garbach, Lubell, & DeClerck, 2012; Hoegl, Parboteeah, & Munson, 2003; Li & Lin, 2006; Van Baalen, Bloemhof-Ruwaard, & Van Heck, 2005). The current research will focus on the knowledge sharing practice in the agrifood supply chain by young professionals in the supply chain with and without ICT.

2.3 Knowledge sharing in the agrifood supply chain

This section explains the knowledge sharing process in the agrifood supply chain to answer the first sub-research question: "*How do young professionals share knowledge with and without ICT among stakeholders of agrifood supply chain?*". Section 2.3.1 will explain the first factor of knowledge sharing, which is individual factor. Section 2.3.2, organizational factors will be defined, and section 2.3.3 will briefly introduce how technology factors may affect the knowledge sharing process.

A supply chain is a network of actors that directly involved in the upstream and downstream flow of products, services, finances, and information from the source to the end-user (Bowersox, Closs, & Cooper, 2007; Dath, Rajendran, & Narashiman, 2009). Some functions may occur within a single firm, while others cross-firm boundaries. The agrifood supply chain encompasses firms in each level of the farm-to-table market channel. Multi-level chains characterize many agricultural product handling systems. Another feature of agrifood supply chain is that some products are transformed from commodity to differentiated branded foods, while others undergo packaging but remain essentially homogeneous (Salin, 1998). Figure 3 depicts the conceptual configuration of agrifood supply chain.

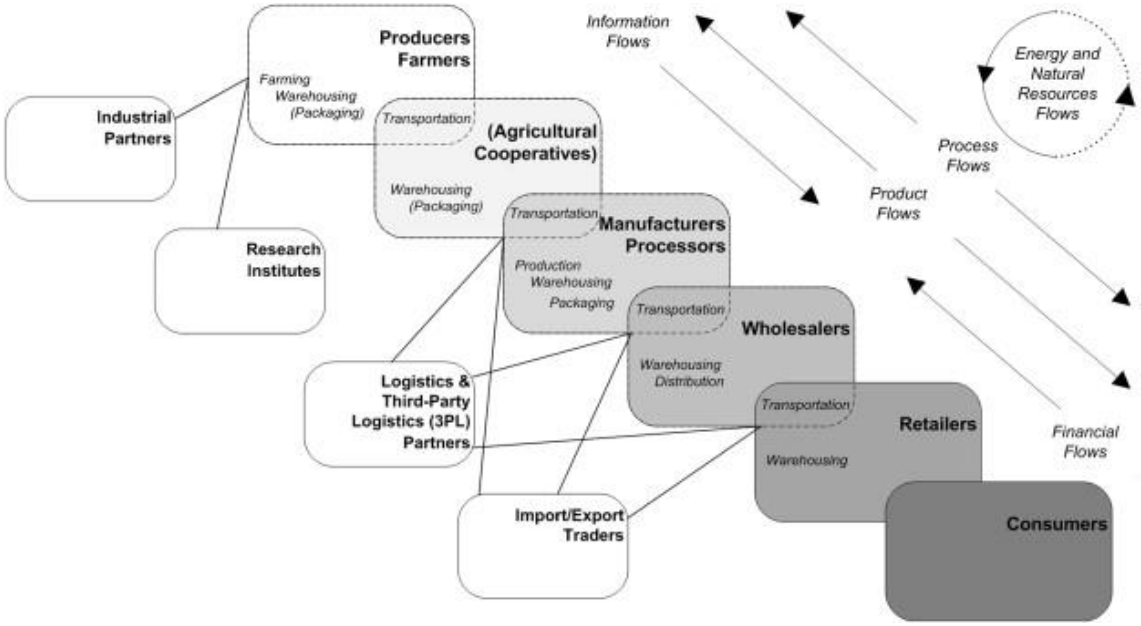

Figure 3 Conceptual system of agrifood supply chain (Tsolakis, Keramydas, Toka, Aidonis, & Iakovou, 2013)

Delivering relevant knowledge to parties involved in the agrifood supply chain has been long identified as one of the keys to enhance the supply chain. Knowledge sharing is essential to improve the efficiency and competitiveness of an organization and therefore the supply chain management can be intensified (Li & Lin, 2006). Shih Hsu, Zhu, and Balasubramanian (2012) argue that the goal of knowledge sharing practice must not be limited to the transfer of knowledge to target receivers, but better aligned with the organization's culture.

The process of incorporating knowledge to predict or create a scenario consists of four phases as reported by Bergman, Jantunen, & Saksa (2004). The first phase is when the individuals are forming a network and work on a specific task to create and share knowledge. This includes identifying the knowledge gap among members and collecting tacit knowledge for a certain goal. In traditional knowledge sharing, this phase usually involves person-to-person discussions, group meetings, or spontaneous conversations. The second phase is the articulation of tacit knowledge to find out the most valuable knowledge that best-suited for an organization. The third phase of knowledge incorporation scenario is the integration of new knowledge gathered in the previous phase throughout the knowledge network. The last phase is the implementation of the created knowledge where the created knowledge is continuously diffused within the organization during a project (Bergman et al., 2004).

According to Lin (2007), three main factors are involved in enabling the learning process and also facilitate knowledge sharing processes within or across teams of work. These three main factors are individual factors, organizational factors, and technology factors (see Figure 4).

All of which affect the knowledge sharing processes where knowledge donation and knowledge collection take place.

> *"The "knowledge sharing processes" dimension refers to how organization's employees share their work-related experience, expertise, know-how, and contextual information with other colleagues. Knowledge sharing processes consist of both employee willingness to actively communicate with colleagues (i.e., knowledge donating) and actively consult with colleagues to learn from them (i.e., knowledge collecting)* (Lin, 2007)"

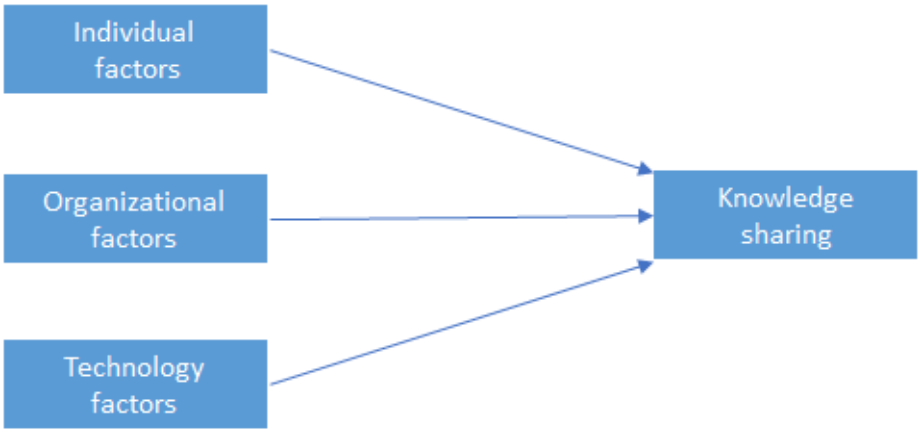

Figure 4 Factors influencing knowledge sharing (Lin, 2007)

2.3.1 Individual factors

Lin (2007) indicated that individual factors might promote or inhibit organizational knowledge sharing activities. The motivation of an individual to share knowledge is an important touchstone for promoting knowledge sharing. A study by Wasko and Faraj (2005) shows that employees are motivated to have a contribution of knowledge because being engaged in intellectual pursuits and solving problems is both challenging and satisfying, and because they enjoy helping each other. Organization members who believe that they can give a contribution to organizational performance through the sharing of knowledge tend to develop a greater positive willingness to both contribute and receive knowledge.

2.3.2 Organizational factors

Ipe (2003) mentioned that organizations could benefit from the competitive advantage given by knowledge sharing for its ability to provide long-term sustainability and success of organizations. In the knowledge sharing process, an organization can leverage the knowledge creation and diffuse a set of understanding within the network. The support of management has been known as one of the important factors to enhance organizational knowledge (Connelly and Kelloway, 2003). Encouragement of the management team to maintain the positive knowledge sharing culture is necessary by creating a conducive to share knowledge atmosphere and providing sufficient resources (Lin, 2007).

2.3.3 Technology factors

The third important factor of knowledge sharing is the technology factors where the use of ICT and knowledge sharing are closely related. Shih et al. (2012) highlight the importance of incorporating ICT to knowledge sharing at each level of the supply chain as it can reduce the number of echelons and streamline business processes of each supply chain partner and therefore speed up the decision-making process. Faucett et al. (2007) add that advances in ICT have changed modern business practice and making collaborative supply chain possible through the facilitation of new methods and applications (such as groupware, online databases, intranet, virtual communities, etc.). ICT in the knowledge sharing has three major roles, i.e. obtaining knowledge; defining, storing, categorizing, indexing, and linking knowledge-related digital items; and seeking and identifying related content (Zack, 1999).

ICT as technology factor is fast becoming a key instrument in a knowledge-based economy (Roberts, 2000). ICT enhances the efficiency for knowledge communication to other group members, regardless of time and geographic location. Moreover, the benefits that ICTs can bring to young

people have been widely acknowledged. In general, improvements in education and access to information were seen from ICT utilization (United Nations, 2011). The agrifood sector has also seen the potential of young peoples' involvement in operating ICT (Harkin, 2005; Stricker, Emmel, & Pape, 2003). For example, Harkin (2005) reported that the agribusiness market run by Short Messaging Service (SMS) in Europe and Asia was dominated by young people as a result of higher participation of youth in ICT development. More on the applications of ICT in the agrifood supply chain by young professionals will be discussed in section 2.5 on the applications of ICT.

This section concluded that there are three main factors play important role in the knowledge sharing process, namely individual factors, organizational factors, and technology factors. This study will focus on the implications of ICT usage in the agrifood supply chain as the technology factors to improve the sharing of knowledge, which will be discussed in the next sections.

2.4 Young Professionals' Awareness of ICT in the Agrifood Supply Chain

In this section, the level of awareness of ICT in the agrifood supply chain will be discussed in order to answer sub-research question 2: "*What is the current level of awareness of ICT in agrifood supply chain of young professionals?"*. Sections 2.4.1 and 2.4.2 define two major factors that can affect the level of awareness of ICT in the agrifood supply chain, namely *the experience of using ICT* and *perceived benefits of ICT*, respectively.

ICT program implementation in a developing country relies on various facets such as infrastructure, government policy, cultural factors, organizational and human resources. Human resources are one of the crucial factors to help to diffuse ICT-related program (Purnama & Lee, 2010). Lack of awareness of the benefits of ICT is a major hindrance to the deployment and implementation of ICT in the agrifood supply chain (Hare, 2007). In different studies, awareness had an effect on the perceived usefulness and perceived ease of use of technologies (Wabwoba, Wanyembi, & Mutua, 2013). The decision to invest in, adopt, and implement ICT in the agrifood supply chain is difficult when organizations are unaware of the potential benefits they can derive from such undertaking.

The level of awareness of the ICT can be linked to how users having knowledge on the ICT usage (respective experiences) and the perceive benefits of ICT as an innovation (Mohlameane & Ruxwana, 2014). The following sub-sections give the idea of how the experience of using ICT and the perceived benefits of ICT may affect the level of awareness of ICT in the agrifood supply chain.

2.4.1 The experience of using ICT

Studies have shown that awareness of an innovation is affected by the experience of using the innovation (Arts, Frambach, & Bijmolt, 2011; Liao & Lu, 2008). An individual can see how innovation works by trying and observing it. Observability increases the motivation to receive the innovation's rewards. Trialability enhances the readiness that helps to understand the role of ICT and thus future users will have the confidence to use the innovation (Arts et al., 2011). As such, experience to use ICT as innovation may affect the young professionals' awareness of the benefits of ICT in the agrifood supply chain.

2.4.2 Perceived benefits of ICT

Prior research has shown that perception of the benefits of innovation is highly related to the level of awareness of innovation (Wabwoba et al., 2013). People are highly likely to adopt and implement innovation when they believe that the innovation is of value to them and their organization. However, the impact of perceived benefits of ICT in the agrifood supply chain by young professionals is still not clear. In a study by Mohlameane and Ruxwana (2014), the most significant factor that influences the perception of benefits in ICT is the quick and easy implementation. As such, how

young professionals perceive the practicality of ICT usage in the agrifood supply chain may influence the level of awareness of ICT in the agrifood supply chain.

Concluding, this section aims to answer SRQ2 by defining factors that may affect the level of awareness of young people towards the benefits of ICT. Those factors are the experience of using ICT and the perceived benefits after using ICT. In the next section, the common applications of ICT in the agrifood supply chain will be discussed.

2.5 Applications of ICT in the agrifood supply chain

This section will discuss the applications of ICT in the agrifood supply chain to answer sub-research question 3: "*How do young professionals apply ICT in the current agrifood supply chain?".* First, the product and process characteristics in the supply chain stage and the impact on ICT are identified by referring to the study of Vorst and Beulens (2005). Later, investigate which ICT tools that may play roles in the supply chain activities.

The potential of ICT to connect farmers with the knowledge they need has received increasing attention in the past decade. ICT has successfully helped to expand the capacity of people to communicate and improve access to knowledge (Lohento & Ajilore, 2015). ICT enables reliable and rapid access to knowledge support from experts which is important to foster the adaptation of strategies and knowledge on a large scale. For example, Ali and Kumar (2011) have encountered the improvement of decision-making capabilities of Indian farmers along the supply chain due to better delivery of knowledge and service. Table 2 gives the overview of how ICT can play a role in the product and process characteristics of the food supply chain network and what are the common ICT devices utilized in each supply chain stage.

Table 2 Overview of main characteristics of FSCNs and their impact on logistics and ICT (Vorst & Beulens, 2005)

SC stage	Product and process characteristics	Impact on ICT	ICT devices	Source
Overall	• Shelf life constraints for raw materials, intermediates and finished products and changes in product quality level while progressing the SC (decay) • Recycling of materials required	• Timing constraints • Information requirements • Return flows	Computer, internet, mobile phone, GPS, electronic identification software, GIS, remote sensing	Opara, 2003
Growers cq. Producers	• Long production throughput times (producing new or additional products takes a lot of time) • Seasonality in production • Variability of quality and quantity of supply	• Responsiveness • Flexibility in process and planning	Computer, mobile phone, smartphone, Internet of Things (IoT), cloud hosting, software as a service (SaaS), GPS, drone	Kaloxylos, 2003; Lohento & Ajilore, 2016
Food industry	• High volume, low variety (although the variety is increasing) production system • Highly sophisticated capital-intensive machinery focusing on capacity utilization • Variable process yield in quantity and quality due to biological variations, seasonality, random	• Importance of production planning and scheduling focusing on high capacity utilization • Flexibility of recipes	Internet, intranet, CAD software, electronic data interchange (EDI), email, cloud database	Luccheti & Sterlacchini, 2002; Falk, 2004

	factors connected with weather, pests, other biological hazards • A possible necessity to wait for the results of quality tests (quarantine) • Alternative installations, alternative recipes, product-dependent cleaning and processing times, carry over raw materials between successive products lots, etc. • Storage buffer capacity is restricted, when materials, intermediates or finished products can only be kept in special tanks or containers • Necessity to value all parts because of complementarity of agricultural inputs (for example, beef cannot be produced without the co-product hides) • Necessity for lot traceability of work in process due to quality and environmental requirements and product and responsibility	• Timing constraints, ICT-possibility to confine products • Flexible production planning that can handle this complexity • Need for a configuration that facilitates tracking and tracing		
Auctions/ Wholesalers/ Retailers	• Variability of quality and quantity of supply of farm-based inputs • Seasonal supply of products requires global (year-round) sourcing • Requirements for conditioned transportation and storage means	• Pricing issues • Timing constraints • Need for conditioning • Pre-information on quality status of products	Mobile phone, internet, social media, computer, online marketing	Rahman, 2017; Faruq et al, 2013; Patidar, 2015 ; Egeberg, 2015, Tehrani, 2010

From the study on the applicability of ICT in the agrifood supply chain above, common ICT tools that are mainly used in the supply chain by young professionals were extracted (Table 3). Table 3 contains definitions of different common ICT devices and categorizes the specific ICT tools/function and through which device it usually operated. Traditional communication technologies like radio, television, written press, and video (Irungu, Mbugua, & Muia, 2015) are no longer discussed in this study and specifically focusing on ICT tools that are common among professionals in the agrifood supply chain recently.

Table 3 Categorization of main ICT devices

Category of ICT devices	Definition	Specific ICT tools
Mobile phone	Instrument to mediate communication between people-people, people-institutions, and people-inanimate objects, wirelessly (Laoris & Eteokleus, 2005)	Smart phone, email, internet, social media

Computer	"Device to provide a platform for the operating system and software applications to support network data transmission and user applications" (Ling & Pedersen, 2005)	Electronic identification software, Internet of Things, SaaS, intranet, CAD software, EDI, email
Internet	"Tools to use for information retrieval and communication in individual, group, and mass contexts" (Ling & Pedersen, 2005)	Cloud hosting, IoT, email, cloud database, online marketing, social media
Advance ICT devices	-*	GPS, GIS, remote sensing, electronic identification software, Internet of Things, cloud hosting, SaaS, drone, CAD software, EDI, cloud database

**no definitions can be found*

From Table 3, it is clear that four main ICT tools are widely used along the agrifood supply chain. These devices are based on basic ICT devices, which are mobile phone, computer, and internet (Irungu, Mbugua, & Muia, 2015) and advance ICT devices. No relevant studies were found to describe advance ICT devices explicitly. However, in the study's framework, advance ICT devices are ICT devices that require special training (non self-taught) or such basic education is not provided at school. These advance ICT devices are in the form of application software, e.g. Software as a Service (SaaS), cloud computing, etc. and hardware e.g. global positioning system (GPS), geographic information system (GIS) , remote sensing, drone, etc. (Lohento & Ajilore, 2015; Irungu, Mbugua, & Muia, 2015).

It can be concluded in this section that different ICT tools are needed for every supply chain stage. However, four main ICT devices can help to determine how ICT can be utilized in the agrifood supply chain at different stages by young professionals i.e. mobile phone, computer, internet, and advance ICT devices.

2.6 Perceived challenges of ICT in the Agrifood Supply Chain

In this section, the perceived challenges of ICT in the agrifood supply chain will be discussed in order to answer sub-research question 4: "*What are the challenges faced by young professionals in the application of ICT in agrifood supply chain?".* This section is divided into four sub-sections explaining major challenges found in the utilization of ICT in the agrifood supply chain.

The incorporation of ICT in the agrifood supply chain to attract more young people is facing challenges as a consequence of technology transformation. Even with the discussed benefits of ICT to modernize agriculture activities, there is still some challenges hold up the adoption of ICT particularly in emerging countries. These challenges come from the technical adoption of ICT and some specific constraints (Lohento & Ajilore, 2015).

The low willingness of the government to invest in ICT has some negative impacts on the agriculture productivity. For most young professionals or other stakeholders, the ultimate challenge of ICT adoption is associated with costs. Furthermore, poor connectivity and unreliable internet and mobile network services often hinder young people to optimize the use of ICT for agriculture activities. Additionally, the low proficiency in digital literacy for most stakeholders in agriculture becomes one of the obstacles for future development. More needs to be done to encourage actors in the agrifood supply chain, especially young people in the rural areas to participate in the new digital society (Várallyai & Herdon, 2013). Despite the increasing infrastructure coverage and cheaper devices, the cost of buying a device and maintain the connection to data service remains a challenge for young

people, especially rural youth (Lohento & Ajilore, 2015). Sub-sections 2.6.1, 2.6.2, 2.6.3, and 2.6.4 will deliver more on the impact of cost, skill, access and infrastructure, and support of the government in the adoption and implementation of ICT in the agrifood supply chain.

2.6.1 Cost

The cost of ICT is highly associated with the low ICT adoption in the agrifood supply chain. The previous study reported that since the costs of buying hardware and software, access to the internet, and of system maintenance are perceived as very high, stakeholders in the agrifood supply chain could not benefit yet from ICT (Hosseini et al., 2009). This condition leads to lower ownership of ICT devices and thus there is a knowledge gap occurs in the agrifood supply chain (Kameswari, 2011).

2.6.2 Skill

Previous studies have reported that human resources capacity plays an important role in the adoption and implementation of ICT (Sanga et al., 2013; Barba-Sanchez et al., 2007; Hossein et al., 2009). Without the proper knowledge and skills of ICT in the supply chain, the integration of ICT will meet difficulties and therefore limit the knowledge sharing processes through ICT. Most problems come from the lack of awareness of the benefits of ICT to enhance knowledge sharing. Barba-Sanchez et al (2007) suggest that continuous training of basic and advanced ICT enables organization members to acquire a learning culture, getting used to ICT integration in their work activities, and in-depth understanding in the potentialities of ICT.

2.6.3 Access and infrastructure

To achieve the goal of ICT implementation, access and infrastructure should be considered carefully. Developing an ICT system means that some requirements are needed to be fulfilled. Some studies have found that the electricity supply, the provision of internet, the speed of internet access (bandwidth), and other infrastructures are important to build a whole working system of ICT (Hosseini et al, 2009; Farrell, 2007). The lacking of these infrastructures will decrease the access to ICT and therefore hold up the full implementation of ICT in the agrifood supply chain.

2.6.4 Government support

Government bodies have essential role in promoting and supporting ICT in the agrifood supply chain. In developed countries such as Australia and New Zealand, small business has benefited from the implementation of ICT which was the positive impact of government policies and initiatives (Alam & Noor, 2009). Some efforts can be made to show the government's commitment for the adoption and implementation of ICT such as providing a legitimate and positive leadership role for the development of ICT infrastructure (Kettinger, 1994; Tan, 1998). In a study by Vinig et al (1998), a successful ICT establishment can also be achieved if the government can open up partnerships and investment opportunities.

Concluding section 2.6 on the perceived challenges of ICT in the agrifood supply chain, four main constraints in the ICT adoption and implementation are identified. Cost is associated with the price of ICT devices and supporting devices provision. The skill factor is the capacity level of human resources to utilize ICT. Also, in order to implement a successful ICT, the access and infrastructure of ICT should be well prepared. Finally, the support of government is needed to ensure a smooth integration of ICT. In the next section, future opportunities in the applications of ICT for young professionals in the agrifood supply chain will be discussed.

2.7 Future Opportunities of ICT for Youth in the Agrifood Supply Chain

In this section, the future opportunities in the applications of ICT in the agrifood supply chain will be discussed in order to answer sub-research question 5: "*What are the future opportunities in applications of ICT for young professionals in agrifood supply chain?".* This section is seeking the possibility of opportunities of ICT usage for young professionals in the future.

Different studies reported that in the future, ICT would become a critical element in the global agrifood supply chain due to its ability to deliver relevant knowledge in the supply chain (Opara, 2003; Oyaid, 2009). For example, with the increasing number of consumers heading towards sustainable food production, ICT can contribute in the implementation of responsible agricultural productions and ensure consistent food supply and safe products (Opara, 2003).

Next comes the major questions; to what extent can youth participate in agriculture development using ICT? What opportunities are on the table for them? Various roles in the agrifood supply chain are available for youth to tap into by optimizing the use of ICT in the supply chain. This makes ICT to play a vital role in generating job opportunities and growing many e-entrepreneurs (Aliu & Halili, 2013). As such, ICT can bring sustainable development and eradicate poverty and socioeconomic inequalities (Várallyai & Herdon, 2013).

A potential gap where youth can play a role in increasing agricultural productivity is the lack of progress in the creation, integration, and utilization of ICT (Várallyai & Herdon, 2013). For instance, farmers usually skeptical about the introduction of new technologies into the conventional farming practices. Young people, on the other hand, are more open to adopting and implementing ICT-facilitated processes into traditional practices. Therefore, they are ideal candidates to be trained as IT facilitators (UNESCO, 2012).

Additionally, young people can also help farmers in creating an ICT application to improve profitability and efficiency, while reducing the costs through a data-driven approach (Jayaraman, Yavari, Georgakopoulos, Morshed, & Zaslavsky, 2016). It is because ICT can boost the economic growth of a nation by providing a space for entrepreneurs to promote and sell their products, as well as transaction with customers in the online marketplace.

ICT also provides room for youth to speak out and bring on the table youth-specific issues. Young people nowadays are vastly under-represented in government, business, political, and social institutions and are having limited capacity and knowledge in civic issues. ICT sector serves as one of the platforms to open to a youth perspective. With ICT, youth can learn and participate in understanding what is it like to take part in a nation's development (Bachen, Raphael, Lynn, McKee, & Philippi, 2008). For example, in YPARD community, members can launch a discussion or contribute to existing debates on a forum or create a blog post to share any knowledge and thoughts regarding agriculture (YPARD, 2017).

More importantly is how these young professional's attitude towards the development of ICT. Xie (2003) and Fesakis and Serafeim (2009) believe that perception towards the development of ICT in the future will affect to which direction ICT will be heading to. Xie (2003) carried out a study about older adults perceptions towards the implementation of technology. In the study, it is clear that perceptions of society will have an impact on technology development.

> *"Technologies are independent of society and their impacts on society are inevitable and irresistible" (Xie, 2003).*

The roles that can be played by young professionals in the development of future ICT are, for example, as a 'consumer advisers' to help designers and manufacturers to understand the needs of

ICT and produce desirable products, or ‘instructors’ to help to diminish the fears or skepticism among members in the supply chain (Xie, 2003).

To sum up, this section gives the idea of the gaps in the agrifood supply chain that can be improved by ICT where young people can serve. Youth can help foster the progress of ICT adoption by facilitating ICT adoption process and share knowledge with like-minded people. Likewise, ICT can generate job opportunities for young people. However, the attitude against the development of ICT affects the direction of future ICT.

2.8 Conceptual Framework

This section discusses the conceptual framework of this research. The conceptual framework portrays a researcher’s synthesis of literature on how to explain a phenomenon (Jabareen, 2009). The conceptual framework is created based on the concepts obtained from the literature review. The goal of presenting the framework is to highlight critical concepts for the base of empirical research. This is the baseline for the construction of the survey and interview questions and further for the analysis and discussion of this research. The conceptual framework is presented in Figure 5.

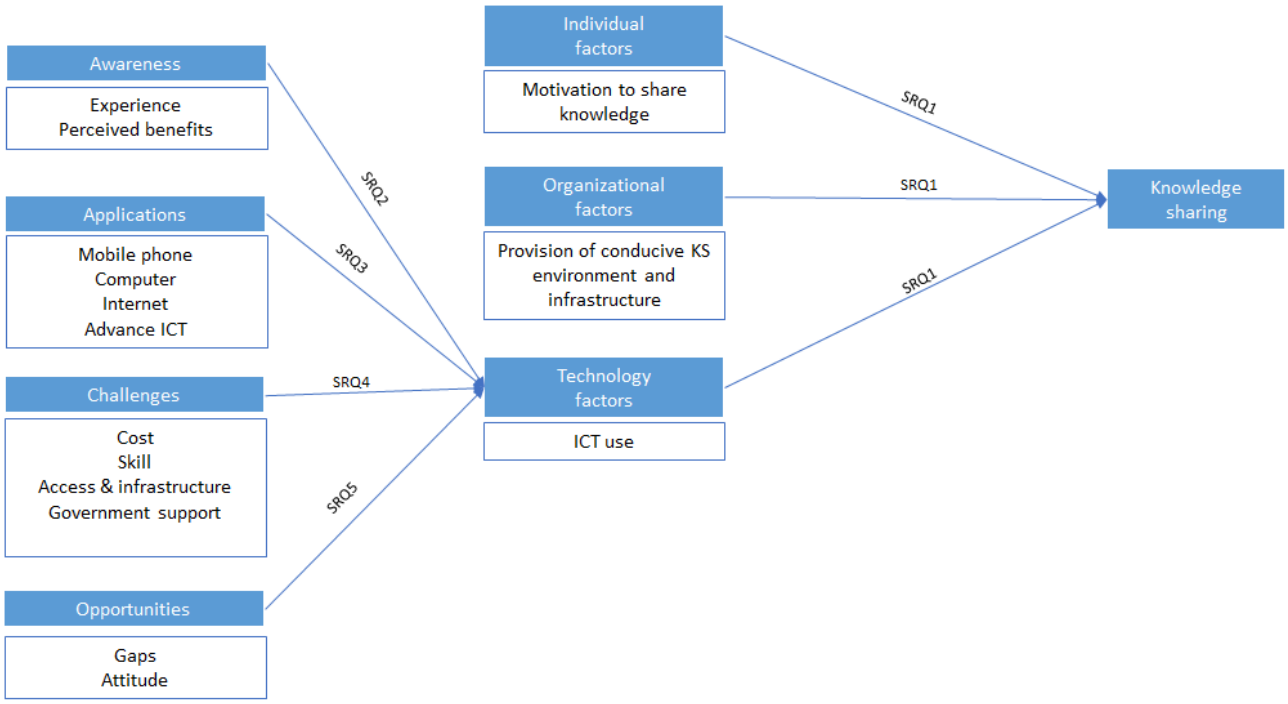

Figure 5 Conceptual framework of the study

In section 2.3, the knowledge sharing process in the agrifood supply chain is influenced by three main factors. The individual factor depicts the motivation of an individual to share knowledge within members of organization and stakeholders in the supply chain. The organizational factor focuses on the creation of optimum knowledge sharing environment and infrastructure. Lastly, the technology factors lately found to have a substantial contribution to the knowledge sharing by the use of ICT to increase the capabilities of the current knowledge-based systems (Neches et al. 1991). These three factors will be studied to answer SRQ 1.

ICT as the technology factor in the knowledge sharing process is a fascinating subject to be studied for its potentials to engage young people in the agrifood supply chain. To explore the possibility of young people to contribute in the knowledge sharing with ICT utilization, four main factors are playing major roles. Section 2.4 explained that the awareness of ICT determines to which degree the use of ICT can influence the decision to fully implement ICT in the agrifood supply chain by young professionals (SRQ 2). In section 2.5, the application of ICT in the agrifood supply chain can be seen by the different ICT devices used (SRQ 3). However, section 2.6 explains that some challenges might hold up the adoption and implementation of ICT in the agrifood supply chain (SRQ 4). Therefore, section 2.5 looked at the future opportunities of ICT application in the agrifood supply chain that young people can engage in (SRQ 5).

3. Research Methodology

This chapter presented the methodology of this research. The first section of this chapter discusses the research design and methods of data collection which include quantitative and qualitative methods. The last section of this chapter presents the method used for analysis of the qualitative and quantitative studies.

3.1 Research Design and Data Collection

Research design serves as a plan that is decided by the researcher and a way to introduce the decision on which study design is proposed to be used, how to collect the information from respondents, how to select respondents, how the collected information will be further analyzed, and how to communicate the findings (Kumar, 2014). A cross-sectional study design was performed in this research with the aim to find out to the prevalence of a phenomenon, situation, problem, attitude or issue, by taking a cross-section of the population (Kumar, 2014), which in this study is YPARD members.

To understand the current knowledge, applications, challenges, future potentials, and knowledge exchange from the standpoint of youth, an inductive approach to young professionals in YPARD network was adopted. The outcome of this study is recommendations to enhance and to extend the reach of agricultural knowledge using ICT along the agrifood supply chain from the standpoint of young professionals.

First, the knowledge sharing practice throughout the agrifood supply chain was analyzed by studying three different factors that affect the knowledge sharing process. Attention is paid to the knowledge sharing because agrifood is a complex and dynamic environment where the stakeholders are expected to continuously work on innovations of products, processes and ways of cooperation to meet increasing demand of consumers (Wolfert, Verdouw, Verloop, & Beulens, 2010).

Next, the awareness of young people towards the benefit of ICT in the agrifood supply chain and how they apply ICT in the supply chain was studied. Next to the application of ICT for agriculture by young professionals, the current challenges of ICT implementation and how it may help attract more young professionals to get involved in the agrifood supply chain were reviewed.

To answer these research questions, a mixed-methods research approach was conducted. This method approach is useful to obtain breadth and depth of understanding and corroboration. This research collected data using quantitative survey procedures and follow up interviews with individuals who completed the survey to help explain the reasons behind and meaning of the quantitative survey results. Furthermore, interviews with several experts in the field of ICT and youth development enriched the research data. The quantitative method was done through a closed online questionnaire for primary data collection with the aim to understand the current knowledge sharing practice and the awareness, utilization, challenges, and opportunities of ICT in the agrifood supply chain. The survey was distributed to YPARD members in Indonesia, Nepal, and Philippines through email and social media.

3.1.1 Quantitative study approach

An online questionnaire is a suitable method for data collection concerning the geographical distribution of study population in Indonesia, Nepal, and Philippines (appendix A). Samples were first reached through the Facebook group of each studied countries (YPARD Philippines, YPARD Nepal, and YPARD Indonesia). 4,712 potential respondents were recorded by looking at the total members

in each Facebook group and notified of an equivalent web-based survey. 20 people were subsequently contacted in a follow-up mailing, which included the link to reach the online questionnaire. The study used incentives and five times notifications through social media (Facebook group) and email. Table 4 shows the number of a potential respondents and the response rate.

Table 4 Potential number of respondents and response rate

No	Country	Total sample size	Response rate
1	YPARD Philippines	283	2.83%
2	YPARD Nepal	3267	0.61%
3	YPARD Indonesia	1162	1.03%

The length of duration to fill in the questionnaire was predicted as the cause of the low response rate (Saleh & Bista, 2017). The survey introduction indicated that it might take up to fifteen minutes to complete and the progress bar was also shown. Some studies revealed that showing progress bar can lower the response rate and it is suggested to keep the survey filling duration lower than thirteen minutes (Saleh & Bista, 2017). The implications of the low response rate may affect the quality of the data obtained. This is because the results obtained is not a proper representative of the whole group of study population and thus the results suffer from both sample error and sample bias.

Of the study population, 40 young professionals in Indonesia, Nepal, and the Philippines completed and returned the questionnaire. Table 5 presents the demographics of respondents and Table 6 summarizes the agrifood supply chain sectors that respondents are working at.

Table 5 Distributions of respondents' background or young professionals in Indonesia, Nepal, and Philippines (n=40)

	No. of respondents	**Percentage**
Gender		
Female	15	37.5%
Male	25	62.5%
Age		
18-21	5	12.5%
22-25	20	50%
26-29	12	30%
30-33	2	5%
34-37	1	2.5%
38-40	0	0%
Nationalities		
Indonesia	12	30%
Nepal	20	50%
Philippines	8	20%

Table 6 Frequency analysis for the working sector of respondents (n=40)

		Responses	**Percent of Cases**
		N	
In which sector(s) are you working at?[a]	Input supply and production	16	40.0%
	Post-production	7	17.5%
	Marketing and trade	8	20.0%
	Finance and credits	4	10.0%
	Online networks	6	15.0%
	Others (government & regulation bodies)	13	32.5%

3.1.2 Qualitative study approach

To triangulate the findings as means to support recent findings and secondary data collection (relevant research literature) as well as quantitative approach, qualitative research was conducted through semi-structured interviews with young professionals and experts through email, Skype, and an in-person meeting. Information was gathered from secondary sources prior to the interview to develop a questionnaire and an interview guide and verify the findings from the primary data collection. The interview guide became the foundation to collect required information from potential respondents in order to construct the conceptual model (Kumar, 2014). Seven young professionals and experts were interviewed in this research (see Table 7). These people are working in the agricultural-, youth-, and ICT-development as researchers, consultants, NGO leaders, communicators and so on.

Table 7 List of interviewees

No.	Name of interviewee	Occupation	Country	Date of interview	Type of interview	Interview duration	Code
1.	Peter Casier	Online media consultant	Global	12-1-2018	Skype interview	00:47:17	PC, interview, 12-1-2018
2.	Courtney Paisley	Director of YPARD	Global	19-2-2018	Direct meeting	00:43:14	CP, interview,19-2-2018
3.	Kukuh Budi Santoso	Chief Operational Officer at Tanijoy company	Indonesia	6-2-2018	Skype interview	01:12:22	KS, interview, 6-2-2018
4.	Dicky Hasian Zulkarnain	Officer at private food company	Indonesia	7-2-2018	Skype interview	01:03:47	DZ, interview, 7-2-2018
5.	Abhishek Khadka	Nepal Agricultural Department officer	Nepal	11-2-2018	Skype interview	00:48:43	AK, interview, 11-2-2018
6.	Darwin Landicho	Plant Quarantine Inspector at Philippines government	Philippines	17-2-2018	Skype interview	00:42:32	DL, interview, 17-2-2018
7.	Ghanshyam Kandel	Technical Officer at Nepal Agriculture Research Council	Nepal	26-2-2018	Skype interview	00:46:28	GK, interview, 26-2-2018

3.2 Data Analysis

In order to understand and address the specific needs of youth to participate in the agrifood sector using ICT, an exploratory analysis was taken place. This data analysis method collected together the perspective and practice of ICT utilization by the study population in Indonesia, Nepal, and Philippines based on knowledge sharing practices, awareness of ICT, application of ICT, challenges in ICT, and future opportunities of ICT.

At the beginning of the research, general information on the important role of youth and ICT in the agrifood supply chain was gathered from reports and papers. The literature study was focused on how knowledge sharing may occur at specific supply chain and the development of ICT in the

agrifood supply chain, including the current awareness, the general and advance application, the observed challenges, and the future opportunities of ICT utilization, mainly in developing countries. The analyzed study was then used as a benchmark to identify findings from the field research.

Different statistical analyses were performed to find out the specific characteristics of samples in Indonesia, Nepal, and Philippines regarding ICT. The data for the statistical analysis were obtained from the questionnaires spread out to 40 YPARD members in Indonesia, Nepal, and the Philippines. The questionnaire for sub-questions 1, 2, 4, and 5 was designed to test hypotheses and deriving estimates for inferential statistical analysis, while questionnaire for sub-question 3 was solely concerned with properties of the observed data (descriptive statistics).

Finally, qualitative analysis data was done to process answers obtained from a semi-structured interview with experts and young professionals in the agrifood supply chain with an inductive approach. The collected data were then managed and processed using ATLAS.ti software. The methods of analysis and statistical results for a specific section of the findings can be seen in Table 8.

Table 8 Methods and results of quantitative analysis

No	Sub-questions	Analysis method	Result
1	How do young professionals exchange knowledge with and without ICT among stakeholders of the agrifood supply chain?	• Pre-correlation test in MS Excel • Multi variate analysis (MANOVA) in SPSS • Descriptive statistics analysis in SPSS	MANOVA test showed no significant difference in the responses to the questionnaire of respondents from Indonesia, Nepal, and Philippines (Section 4.1).
2	What is the current level of awareness of young professionals in ICT for agrifood supply chain?	• Pre-correlation test in MS Excel • Multi variate analysis (MANOVA) in SPSS • Descriptive statistics analysis in SPSS	MANOVA test showed no significant difference in the responses to the questionnaire of respondents from Indonesia, Nepal, and Philippines (Section 4.2)
3	How do young professionals apply ICT in the current agrifood supply chain?	• Frequency analysis in SPSS • Frequency analysis in MS Excel	Can be seen in section 4.3
4	What are the challenges faced by young professionals in the application of ICT in the agrifood supply chain?	• Pre-correlation test in MS Excel • One-way ANOVA test in SPSS • Descriptive statistics analysis in SPSS	One-way ANOVA test showed no significant difference in the responses to the questionnaire of respondents from Indonesia, Nepal, and Philippines (Section 4.4)
5	What are the future opportunities of ICT for young professionals in the agrifood supply chain?	• Non-parametric test in SPSS • Descriptive statistics analysis in SPSS	The non-parametric test showed no significant difference in the responses to the questionnaire of respondents from Indonesia, Nepal, and Philippines (Section 4.5).

From the statistical analysis result, the study concluded for sub-questions 1, 2, 4, and 5, that the responses coming from study population in Indonesia, Nepal, and the Philippines did not give significant effect on the measured variables. Hence, it was not possible to determine any particular distinctions between the studied countries from the outcome of the analysis. That said, it might be that the study population in Indonesia, Nepal, and the Philippines showed similar attitude towards questions in regards to “knowledge sharing practice”, “awareness of ICT”, “application of ICT”,

“perceived challenges of ICT” and “future opportunities of ICT applications” regardless of their country.

Furthermore, the study was only able to reach a handful of respondents to participate in the survey (40 respondents), despite five times notification both through email and social media (Facebook group). Additionally, limited time available for data collection further adds the challenges to recruit more respondents. These limitations eventually might reduce the validity and reliability of the survey results.

4. Findings

This chapter presents the findings that were collected from the quantitative survey (Appendix A), interviews with experts and young professionals, and secondary data. These findings are the results of research question on the possibilities to enhance and to extend the reach of knowledge using ICT in the agrifood supply chain based on young professionals' standpoint. The findings are then organized in the following order. First, the information on the current knowledge sharing practice is obtained to answer the first research question (RQ 1). Then, information about the awareness of young people towards ICT in the agrifood supply chain helps to answer RQ 2. Findings on the application of ICT by young professionals in the agrifood supply chain answer RQ 3. Next, the challenges faced by young professionals are to answer RQ 4 followed with the future opportunities in the applications of ICT to answer RQ 5. The knowledge sharing practice is discussed first to take a deep dive on the current knowledge sharing practice among study population with and without ICT, while the implications of awareness, application, perceived challenged, and opportunities of ICT to the knowledge sharing practice are further discussed in each section.

4.1 Knowledge sharing practice

The first section of this chapter contains finding of the current knowledge sharing practice in the agrifood supply chain.

Expert interviews and survey on the involvement of actors in the agrifood supply chain were conducted with questions arranged to obtain information on the experience of knowledge sharing in an organization by the respondents. The effectiveness of the organization including the culture of knowledge sharing and how ICT can help the practice of knowledge sharing in the agrifood supply chain were then further explored.

Before proceeding to examine how the study population practice knowledge sharing in their organizations, it will be necessary to reveal the types of knowledge found in this study that takes place in the agrifood supply chain. Table 9 summarizes the identified knowledge sharing activities by respondents in Nepal, Indonesia, and the Philippines and which type of knowledge that the particular activity belongs to.

Table 9 Types of knowledge in AFSC

Country	SC Stage	Knowledge sharing activity	Knowledge type
Indonesia	Growers/ producers	Forecasting market supply and demand	Strategic knowledge
	Growers/ producers	Problem-solving for technical issue at farm	Product-related knowledge, process-related knowledge
	Growers/ producers, retailers	Connecting food growers/producers directly to market	Strategic knowledge
	Growers/ producers	Forecasting planting season	Strategic knowledge
	Growers/ producers, food industry	Tracing and tracking raw material and agricultural products	Product-related knowledge
	Growers/ producers	Updating market price of agricultural products	Strategic knowledge

	Food industry	Communication with supply chain partners at the global level for collaborative decision in food production	Organizational knowledge, strategic knowledge
Nepal	Growers/ producers, research institutes	Learning new issues and trend in agriculture production	Product-related knowledge, process-related knowledge, organizational knowledge, strategic knowledge
	Growers/ producers, research institutes	Agricultural extension to farmers	Product-related knowledge, process-related knowledge, organizational knowledge, strategic knowledge
Philippines	Public organization, wholesalers/ retailers	Communication with supply chain partners regarding legal issues	Product-related knowledge, process-related knowledge,
	Public organization	Accessing knowledge regarding commodity profiles to comply with international trading requirements	Product-related knowledge, process-related knowledge,
	Wholesalers/ retailers	Tracking and tracing agricultural products	Product-related knowledge
Global	Growers/producers, food industry, wholesalers/ retailers, public organization, consumer, private organization	Global online sharing platform for youth to share experience and ideas within the agrifood supply chain	Product-related knowledge, process-related knowledge, organizational knowledge, strategic knowledge

In regards to knowledge sharing practice within the study population, respondents were asked to evaluate how they perceive the current knowledge sharing practice in the organization they are working at and if communication among members is a key factor in knowledge sharing (see Figure 9). The result shows that there was no significant difference in regards to responses of the studied population towards the current knowledge sharing practice ($p>0.05$) (Appendix B). Figure 6 shows the overall result of the Likert-scale survey towards the current knowledge sharing practice of youth in the study population.

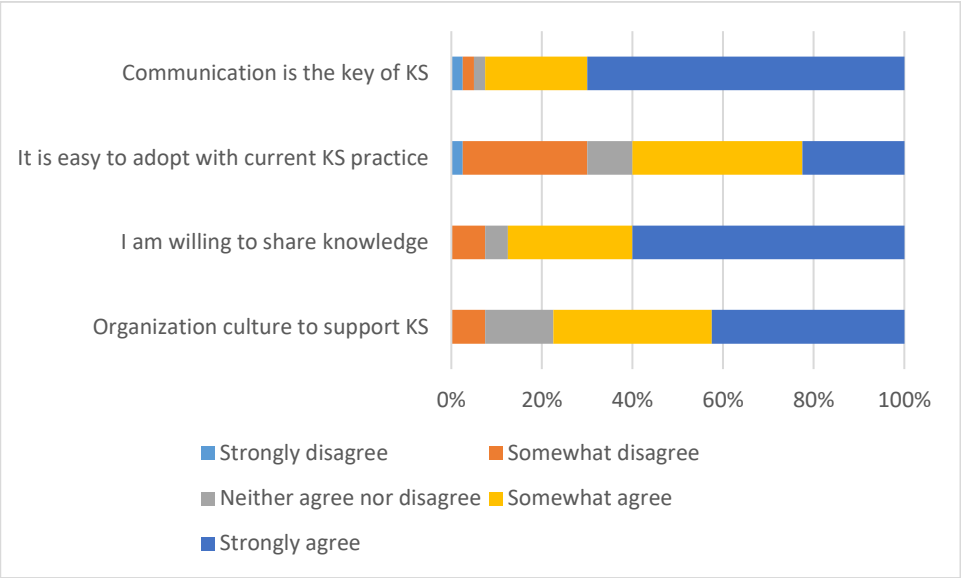

Figure 6 Responses towards statements on "knowledge sharing practice" (n=40)

In the typical knowledge sharing practice, members within the organization are asked to capture the knowledge and to learn it in the form of 'lesson learned'. This includes the past experiences and mistakes, both the unpleasant and the good ones which transform to a form of tacit knowledge, as mentioned by an expert in online media (PC, interview, 12-1-2018). The stored tacit knowledge is then used for other members to be disseminated throughout the firm and to learn from them (Newell, Bresnen, Edelman, Scarbrough, & Swan, 2006). In the next three subsections, factors that influence the knowledge sharing practice in the agrifood supply chain are discussed.

4.1.1 Individual factors

Approximately 70 percent (mean value 4.55±0.876) of the respondents agreed that communication between the actors is key to a successful knowledge sharing practice in response to the statement 'communication is the key of knowledge sharing' (Appendix B.3). In the integration of knowledge within an organization, the involvement of individuals – as a knowledge owner – is important to ensure open knowledge flows. Bock (2005) also confirms that knowledge would only be available if the knowledge owner makes the objects available and should be facilitated.

According to CP, an expert in youth development, (interview, 19-2-2018), knowledge sharing can foster the exchange of experience among peers in a community. For example, the YPARD community members can exchange knowledge with people across borders and sectors about the product and process-related knowledge in the farming system and entrepreneurship or even organizational and strategic knowledge. The exchange of knowledge also creates a sense of belonging where they can comfortably share ideas and to feel as if they are a part of something big. As YPARD is an online community, the flow of knowledge is rather quick and up to date which is rarely found on traditional media. Members get to know others' experiences in a much more interactive and convenient way and easily adopt it to the practices.

Obtaining knowledge to update and predict the market demand are only a few of the benefits in knowledge sharing. Knowledge sharing also allows individuals or organizations to have adequate knowledge to solve problems and be prepared for the range of possible outcomes. As an example, for the farmers with no direct access to the market, knowledge sharing helps them to cut or negotiate the middlemen and therefore more profits for the farmers. Farmers are able to predict in which month they should start planting so that in the harvesting season, farmers can obtain a

relatively higher price than the price set by the middlemen. Farmers can also benefit from planting the adequate amount of crops, hence, no excess nor a shortage of crops to be harvested, as stated by an agriculture entrepreneur (KS, interview, 6-2-2018).

> *"For me (knowledge sharing) is important. For example, the current market demand is one ton of product A. Then, we can estimate how are we going to plant the crop in the future […] It means that there will be people who are willing to buy the product with higher price* (KS, interview, 6-2-2018)*"*.

In agriculture extension, GK, an agricultural researcher, (interview, 26-2-2018) pointed out that knowledge should be made available and transferred so that members are well updated in regards to agriculture production and marketing. Knowledge sharing helps farmers to solve problems regarding production and process in the farm and eventually to reduce the risk of financial loss. Furthermore, knowledge sharing also allows agriculture researchers to identify new issues and trend in agriculture.

Working closely with the primary food producer in the supply chain, knowledge sharing for the food industry is important regarding raw material traceability. As more industries nowadays are moving towards a sustainable practice, it is important to frequently update product and process-related knowledge such as the quantity of supply, and from which supplier or producer did the raw material came from (DZ, interview, 7-2-2018).

To conclude, findings show that the motivation to share knowledge is high among respondents. This is highly likely due to the good experience obtained from the knowledge sharing practice and the awareness of the benefits to practice knowledge sharing among stakeholders in the agrifood supply chain.

4.1.2 Organizational factors

In regards to organizational factors to knowledge sharing practice, respondents were asked through the study survey and interviews on how supportive an organization in the knowledge sharing process. The study revealed that almost 80 percent of the respondents agreed that the organizations they are working for are supporting the knowledge sharing practice (mean value 4.13±0.94) (Appendix B.3). This finding is further elaborated in interview result where KS, an agriculture entrepreneur, (interview, 6-2-2018), shared the culture of the organization regarding knowledge sharing practice. At his company, knowledge sharing is highly valuable and therefore a session called "One Day One Sharing" is conducted daily. The session requires everyone to share knowledge and experience among members of the organization, mostly on the current issue of agriculture and how to improve the current practice of the company. Not only within the organization, his company also believes in sharing knowledge and values with the supply chain partner, especially farmers. Occasionally, a successful farmer (external) will be invited to share success story and knowledge with the current farmers they are working with in order to increase the motivation of farmers at the farm. This action was found to be very successful to increase farm productivity (KS, interview, 6-2-2018).

4.1.3 Technology factors

Nowadays, knowledge is easily obtained not only from interactions among individuals but also from the stored knowledge in the digital world (technology factor). ICT plays an important role in providing access to relevant knowledge for the supply chain activities. According to KS, an agriculture entrepreneur, (interview, 6-2-2018), the necessary product-related knowledge like the price for agricultural commodity products are often taken from the internet due to different prices from one market to another in Indonesia and the rapid changes of the price. This finding shows one

of the merits of ICT to increase knowledge sharing. Sections 4.2, 4.3, 4.4, and 4.5 will elaborate more about the roles of ICT to engage young people in the agrifood supply chain by looking at the awareness, application, challenges, and the future opportunities in the applications of ICT.

4.2 Young professionals' awareness of ICT in the agrifood supply chain

This section presents findings on the level of ICT awareness in the agrifood supply chain by young professionals. In the survey, questions were arranged to investigate the experience of ICT usage at work and the perceived value of ICT usage. Figure 7 depicts the degree of agreement of young people within the sample towards the awareness and application of ICT. No significant difference found between the three countries ($p>0.05$), corresponding to the responses coming from the samples for the survey (Appendix B).

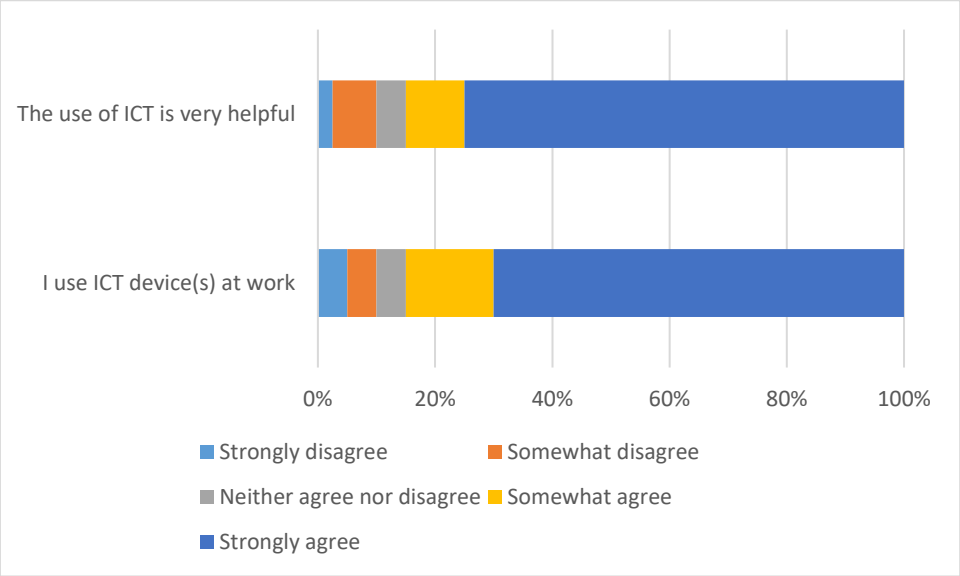

Figure 7 Responses towards statements on "ICT awareness" (n=40)

Based on Figure 7, study findings demonstrate the high awareness of the samples towards ICT in the agrifood supply chain. Over 80 percent of the studied population have incorporated ICT at work and found that ICT is very helpful to simplify their working assignments as a response to the statements 'I use ICT device(s) at work' (mean value 4.40±1.13) and 'the use of ICT is very helpful for the current knowledge sharing at work' (mean value 4.48±1.06) (see appendix B.3) with high correlation value for these statements (R=0.865) (Appendix B.1). It implies that the utilization of ICT devices for professional purposes can further improve the quality of knowledge sharing.

The most common example of ICT awareness is the communication function of ICT where mobile phone is widely used throughout the world and thus putting ICT as an inevitably important device to have at work. For example, in the food industry, correspondences with supply chain partners regarding food production took place with more advanced communication such as the use of email for partners abroad, as mentioned by a food company officer (DZ, interview, 7-2-2018).

> "*We communicate via email and telephone. With local supply chain partner usually through telephone and sometimes email too. With our global partners is usually through email* (DZ, interview, 7-2-2018)".

Nevertheless, there are also a small number of respondents that do not use ICT at work nor believe in the usefulness of ICT. AK, an agricultural researcher, (interview, 11-2-2018) shares his experience on an agricultural extension to farmers in Nepal where ICT is not very useful since many farmers usually do not use modern ICT devices. The extension is normally done by a monthly face-to-face

meeting. The farmers are mostly older people with a tendency to resist technological adoption. It points to the likelihood of digital divide exists in the agrifood supply chain which is a new finding of this study. The digital divide or digital gap refers to a group of older professionals in the agrifood supply chain that are excluded from many of the benefits that ICT can bring due to a higher resistance to technology adoption (Selwyn, 2004).

4.3 Application of ICT in the agrifood supply chain by young professionals

This section reveals the result of ICT applications by the respondents in the agrifood supply chain. The application of ICT is divided by the common devices which are mobile phone, computer, internet, and advanced ICT. Table 10, collected the application of ICT devices in the agrifood supply chain by study population.

Table 10 Applications of ICT by young professionals in study population

Country	ICT application			
	Mobile phone	**Computer**	**Internet**	**Advance ICT**
Indonesia	Problem-solving for technical issue at farm	Field data collection & processing, report writing on field findings, organization financial reporting, forecasting planting season, forecasting food production	Communication with supply chain partners on farm/industry production, updating market price of agricultural products	Data collection and processing using application software and hardware e.g. GPS
Nepal	Information sourcing on agricultural productivity	Centralizing information for agricultural research database, data collection & processing for agricultural research	Updating market information, studying trend in agriculture, farm production monitoring, online learning on agricultural subjects	-*
Philippines	-*	Internal and external organizational communication, data collection & processing for government database	-*	Facilitation of agriculture products' tracking and tracing (geotagging), food safety monitoring

**) no data found or respondents did not mention*

ICT works as a tool to leverage knowledge sharing practice in an organization through functions that will be discussed in this section. Ultimately, ICT can provide the relevant knowledge needed to shape the base of a strategic decision. It became clear from an interview with DL, a government officer in the Philippines that ICT works as a knowledge sourcing tool at a government office (DL, interview, 17-2-2018). The knowledge using ICT-based source is related to strategic knowledge that is important to be a foundation for the next decision making, planning the budget of a project for instance.

> "*Basically if you have a good data or good collection of this (strategic) knowledge, it is important for strategic and effective budgeting. (It is also) to align our activities or to see where are the weaknesses or the strengths of our organization* (DL, interview, 17-2-2018)".

Furthermore, ICT also allows people to engage with each other through a digital channel. That being said, ICT removes all boundaries for an organization to communicate within and outside the organization, and even internationally. For example, a decision made by a food producer with global reach should be based on various perspectives and consensus between managers in the national or regional level (DZ, interview, 7-2-2018). ICT made it possible to overcome the geographical distance between parties with less investment needed.

In recent years, utilization of ICT brought about huge impact in the life of young people and is tightly linked with their activities both at work and in everyday life. It comes in various kinds of way and devices. Table 11 presents the ICT devices that study respondents often use in the daily life and Table 12 shows the ICT devices that the respondents use for work purposes.

Table 11 Frequency analysis of ICT device(s) that are used daily (n=40)

		Responses	Percent of Cases
		N	
Which ICT device(s) do you use in everyday	Radio	6	15.0%
	Computer – not connected to the internet	10	25.0%
	Computer – connected to the internet	37	92.5%
	Tablet	3	7.5%
	Mobile phone	38	95.0%
	TV	13	32.5%
	Satellite	2	5.0%
	Software as a Service (SaaS)	12	30.0%
	Social media	30	75.0%
	Geographical Information System (GIS)	4	10.0%
	Drone	1	2.5%

Table 12 Frequency analysis of ICT device(s) used for work (n=40)

		Responses	Percent of Cases
		N	
Which ICT device(s) do you use at work?	Radio	2	5.0%
	Computer – not connected to the internet	9	22.5%
	Computer – connected to the internet	38	95.0%
	Tablet	5	12.5%
	Mobile phone	31	77.5%
	TV	2	5.0%
	Satellite	2	5.0%
	Software as a Service (SaaS)	17	42.5%
	Social media	23	57.5%
	Geographical Information System (GIS)	5	12.5%
	Drone	3	7.5%

This research categorized the ICT devices into basic ICT and advanced ICT. The basic ICT comprises devices that are often used by people in general, like computer, mobile phone, internet and social

media. The advanced ICT are the devices that require a higher level of skill to operate e.g. application software like Software as a Service (SaaS), cloud computing, etc. and hardware like global positioning system (GPS), geographic information system (GIS) , remote sensing, drone, etc. (Lohento & Ajilore, 2015; Irungu, Mbugua, & Muia, 2015). From Table 8 and 9, traditional ICT device such as radio seems to be rather irrelevant for a knowledge source with only 15 percent users in daily life and even limited further to 5 percent users for working purposes.

4.3.1 Mobile phone application

The wide distribution of phone globally leads to the more advanced development of the mobile phone devices we are having now. What would be interesting to learn is how mobile phones can play a role in improving the agrifood supply chain. Figure 8 presents the frequency of mobile phone usage and Figure 9 illustrates the average hours spent on mobile phone every day of study respondents.

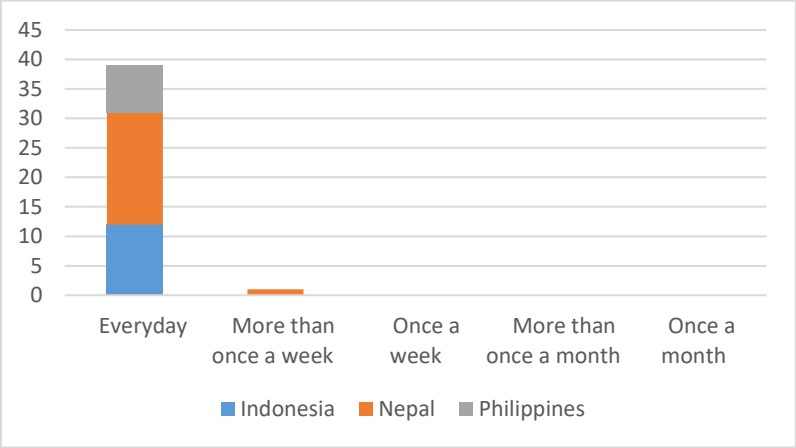

Figure 8 Frequency of mobile phone usage (n=40)

An observation by Nielsen (2013) explains that the majority mobile phone users in Russia, South Korea, Turkey, United Kingdom, and the United States are dominated by millennials age 18-24 and 25-34. It means that in global, mobile phones are widely used among these generational segments. It is also suggested through finding where nearly all respondents ranging from 18-40 years old use mobile phones every day. From Table 8 it was clear that mobile phone adoption has been an integral part of young people's daily lives with 95 percent active users. It is supported by Figure 9 which shows that close to half of the respondents spend more than four days on mobile phone, although this finding is slightly lower than the hours spent on computer or internet.

Table 12 justifies the finding as mobile phone is no longer comparable in the sense of utilization for professional purposes, although it still shares a large majority of around 78 percent. This means that mobile phone is valued as a less formal communication tool (DZ, interview, 7-2-2018). Overall, young people spend more than 4 hours per day making calls, texting or opening social media. It is also interesting to see that all respondents from Indonesia and Philippines use mobile phone every day whereas a small number of respondents in Nepal do not use mobile phone daily. This can be seen in Figure 8 that 2.5 percent of respondents from Nepal indicated that they only use mobile phone every once in a week, compared to the majority that use mobile phone every day.

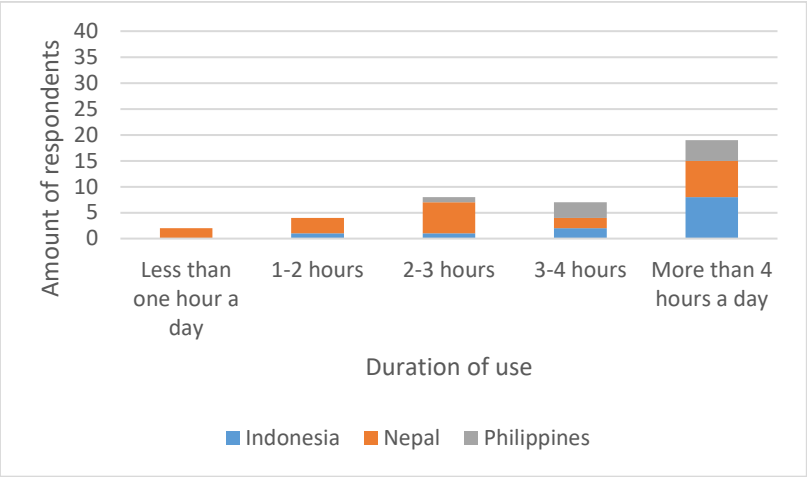

Figure 9 Hours spent on mobile phone per day (n=40)

Mobile phones have numerous functions, e.g. calling and texting with other owners, in addition to the invention of smartphones that allow users to enjoy extra features as a result of technological advances. According to respondents, mobile phones can shorten the distance between their supply chain partners in regards to farm monitoring, as quoted from KS (interview, 6-2-2018), an agriculture entrepreneur in Indonesia:

> *"We have a team in the designated areas and they live with the farmers. I communicate with them via mobile phone, Whatsapp* (KS, interview, 6-2-2018)*".*

In Nepal, an installed application on their mobile phones enables stakeholders to find knowledge regarding agricultural productivity. A group of young people, for example, developed an application where stakeholders can access knowledge on the weather forecast, diseases information, the availability of seed and crops and other agricultural production-related knowledge, as stated by an online media expert (PC, interview, 12-1-2018).

4.3.2 Computers application

These days, computers have largely influenced ICT both for personal and professional use. Within the past ten years, the functionality of personal computers (PCs) have become way more advanced, as well as its compatibility with other electronic devices such as digital cameras, TV, mobile handsets or portable media players (Beauvisage, 2009). Study respondents' frequency of computer usage is depicted in Figure 10 and Figure 11 illustrates the average duration of use.

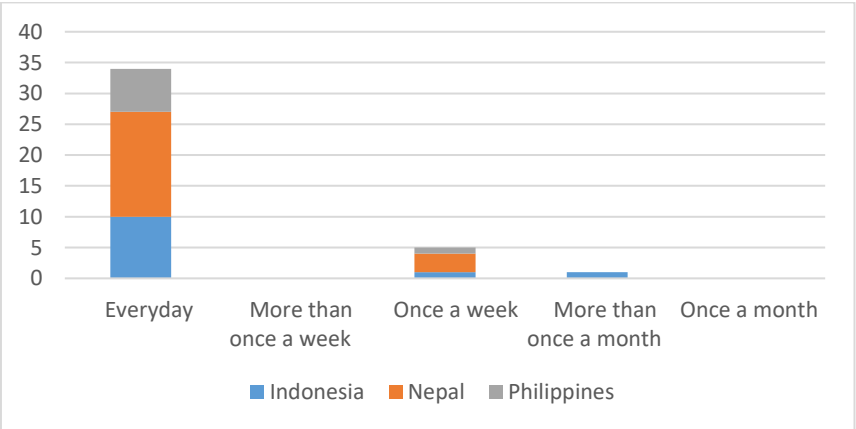

Figure 10 Frequency of computer usage (n=40)

It was recorded in the survey that the studied samples are actively engaged in ICT through the utilization of PCs as seen in Figure 10. Nearly 90 percent of the total respondents operate PCs daily and only a small percentage use PCs with a lot less frequency. More than half of the respondents use PCs for more than four hours per day as depicted in Figure 11. A smaller percentage of respondents from Nepal, Indonesia, and Philippines are using computers for 1-2 hours, 2-3 hours and 3-4 hours per day, with less frequent users, are dominated from Nepal. A computer connected to the internet has surely been a huge part of these young professionals required working equipment, as 95 percent of the respondents confirmed it in the survey (see Table 13).

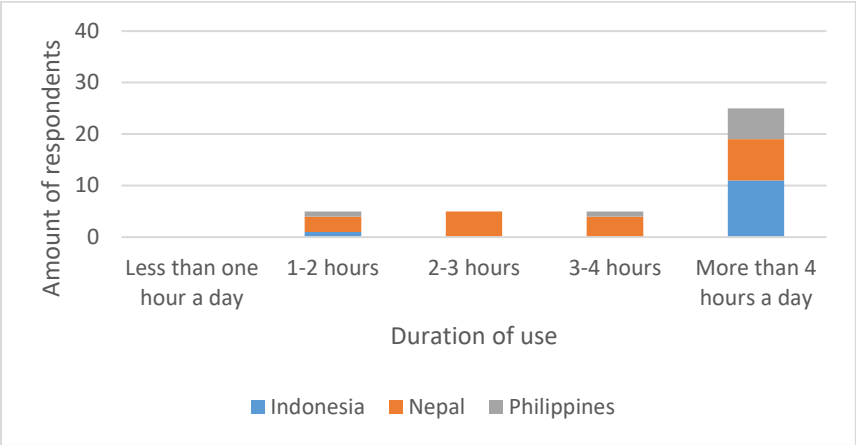

Figure 11 Hours spent on computer per day (n=40)

The flow of knowledge in the agrifood supply chain is enormously high. With the help of better knowledge management system, a firm can improve their agility level by being flexible and responsive to changing environment (Gunasekaran & Ngai, 2003). Computer is one of the ICT tools to help integrating knowledge flows within and outside of an organization. Knowledge regarding product-related, process-related, organizational, and strategic can be obtained by browsing relevant knowledge on a computer connected to the internet. Beyond that, computer is normally utilized to collect data from the field regarding production, report making, and financial reporting at the growers' level, according to an agriculture entrepreneur (KS, interview, 6-2-2018). According to KS, all collected data are then used to forecast the next planting season.

In response to the question: 'For what purpose you use computer at work?', DL (interview, 17-2-2018) who works in the government office commented: 'For computers, we use it for communication, also for research and to obtain and process information as knowledge that can be adopted'. The response confirms to one of the purposes of computer as a communication tool for today's generation as a result of advancing technology.

Computer usage was found to reduce the number of inaccuracy in planning and production in the farm, as mentioned by GK (interview, 26-2-2018), an agriculture researcher, in an interview. With a computerized system, all information can be kept centralized and in a uniform fashion, which in the end increasing its precision and accuracy which is very useful for farmers' knowledge development regarding farm organization.

> "*At present, we work with farmers to identify their problems and to offer solution to them. It is very important to incorporate computerized system so that data will be centralized and also helps to maintain uniformity. There is less chance of bias in data collection. Using a computerized system in data collection makes it easier for data collection and analysis* (GK, interview, 26-2-2018)".

However, since PCs' functions in the agrifood supply chain are closely related to internet connection and advanced usage of ICT, more will be elaborated in the next two sections.

4.3.3 Internet application

About 95% of those surveyed reported using the internet every day and only 5% respondents, all from Nepal, use internet only a few times in a week (see Figure 12). These findings further support the idea of strong youth engagement in the digital worldwide network.

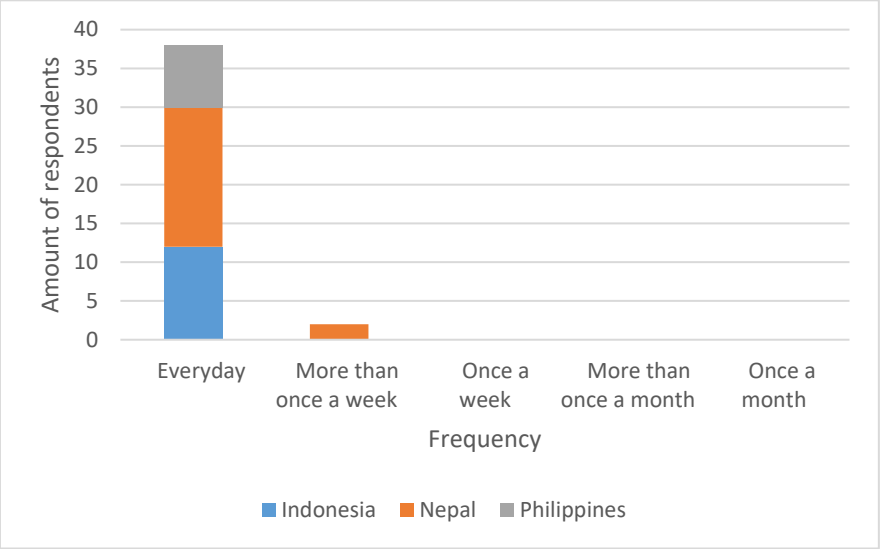

Figure 12 Frequency of internet usage (n=40)

Around two-thirds of the samples indicated that they spent more than four hours per day on internet. Moreover, 15 percent spent 3-4 hours, ten percent spent 2-3 hours, and only five percent reported that they use internet for less than two hours per day (see Figure 13). Of the studied population, respondents with less than 3 hours use of internet per day are all from Nepal.

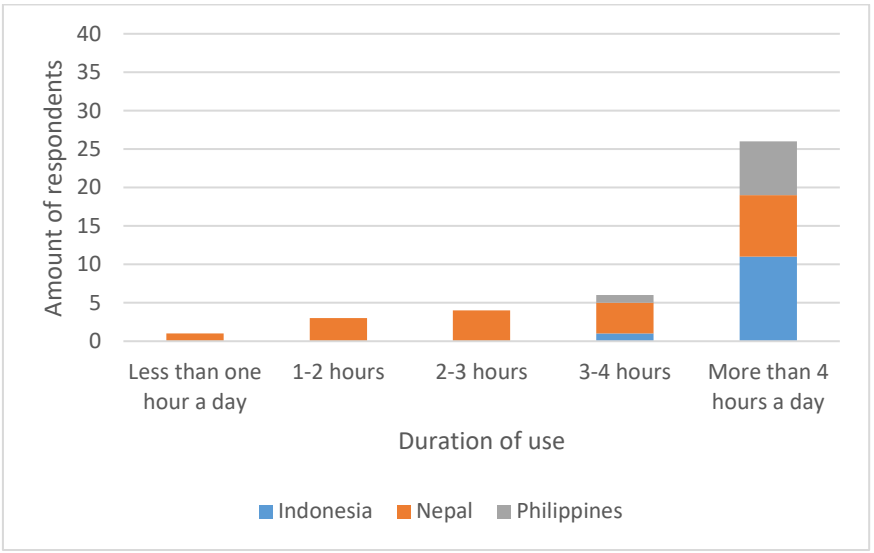

Figure 13 Hours spent on internet per day (n=40)

Of the 40 participants who completed the questionnaire, 77.5 percent indicated that they access internet mostly in PC and mobile phone (see Table 12), 85 percent were found to use the internet

access at the office. Only a small number of respondents indicated that they access internet at public places, or at a relative's house (Table 13).

Table 13 Frequency analysis of internet access location (n=40)

		Responses	Percent of Cases
		N	
Where do you usually access internet?[a]	Personal computer	31	77.5%
	Professional computer (at office)	34	85.0%
	Public place/telecenter/internet cafe	7	17.5%
	At friends/family place	8	20.0%
	Mobile internet on phone	31	77.5%
	Others	1	2.5%

A variety of perspectives were expressed by the interviewees in regards to the application of internet in the agrifood supply chain. With a computer or mobile phone connected to the internet, these young professionals are able to get information on the market update and able to predict the volatility of market price for agricultural product, as stated by an agriculture entrepreneur in Indonesia (KS, interview, 6-2-2018) and agriculture researcher in Nepal (AK, interview, 11-2-2018). Further, internet has sparked a better way for scientists to monitor production and potential diseases in the farm, according to an agricultural researcher (AK, interview, 11-2-2018).

4.3.4 Advanced ICT tools utilization

The advancement of ICT has shifted the paradigm in agriculture. Not only the traditional ICT tools that are being used, advanced ICT tools nowadays have penetrated the agrifood supply chain to increase efficiency and effectiveness of knowledge sharing activity. Table 9 shows that application software such as SaaS, and hardware, e.g. tablet, GIS and drone are seeing a higher percentage of usage for working than the use in daily lives, implying that some ICT tools with a higher level of skill and understanding are needed for working in the agrifood supply chain.

DZ (interview, 7-2-2018), who works in food industry, reported that some SaaS were made available for the employees in food industry due to a huge amount of data that cannot be processed in most of the available software. In the future, more special-designed software and hardware will be launched since the need to speed up the data processing is inevitable. KS, an agriculture entrepreneur in Indonesia, (interview, 6-2-2018) also planned to upgrade the ICT system by having a GPS to position the farms in the portfolio and monitor the production from satellite, which can attract more investors. This, however, may take a longer time as a skilled developer is needed to build the program tailored to the firm needs.

The same idea stated by DL (interview, 17-2-2018), a government officer, in regards to advance use of ICT. To comply with importing rules in Japan, the source of agricultural products must be traceable. So far, the government office in the Philippines applies *Google Earth* software to map the source of agricultural products that are produced in the Philippines. By applying it, fraud can be decreased since every batch of production is traceable through ICT. Furthermore, production can be carefully inspected and monitored for food safety reasons in a real-time situation.

4.4 Perceived challenges of ICT in the agrifood supply chain

This section provides current challenges of ICT in the agrifood supply chain. To analyze the perceived challenges of ICT in the agrifood supply chain, several analyses were conducted based on the questionnaire and the interviews with samples from Indonesia, Nepal, and the Philippines and some experts. The questions for the survey were arranged to understand the impact of cost, skill, access and infrastructure, and government support to ICT usage in the agrifood supply chain. The statement of 'internet cost is expensive in where I live' is related to the cost of ICT. The statements

of ‘I do not know how to use a computer for work’, ‘I do not know how to use an internet for work’, ‘I do not know how to use mobile phone for work’, and ‘there is no training to use advance ICT devices’ are related to skill. Then, the statements of ‘the internet connectivity is unreliable’, ‘it is difficult to find access in where I live’, ‘the electricity supply is unreliable in where I live’, ‘the internet speed is not stable in where I live’, ‘I do not have personal computer at home’, and ‘I cannot find internet provider in where I live’ are related to access and infrastructure.

The test between-subjects effect showed that the null hypothesis for all variables was not rejected since the p-value was above 0.05 for all variables. Hence, it is clear that the country differences did not give a significant difference among the questions variables related to “perceived challenges of ICT” (appendix C.2).

To identify the mean values of response for each statement, a descriptive analysis was done (appendix C.3). The summary of perceived challenges of ICT by the studied samples is presented in Figure 14.

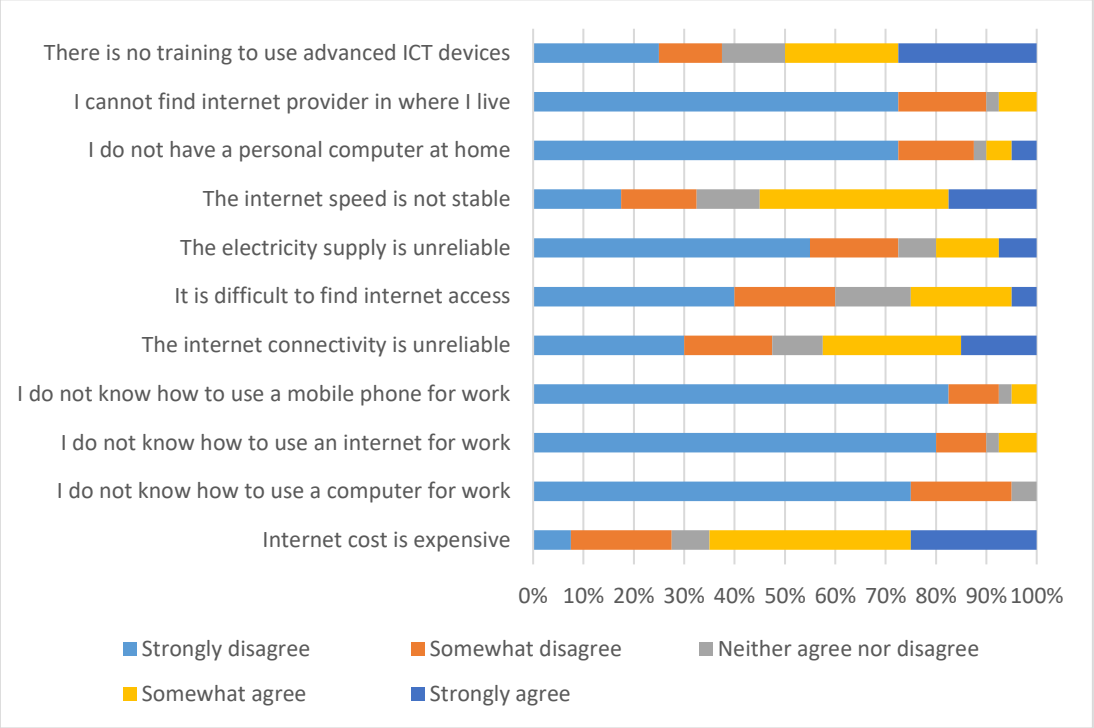

Figure 14 Responses towards statements on “challenges of ICT” (n=40)

4.4.1 Cost

As reported earlier, ‘cost’ is identified as one of the main aspects to influence the respondents’ perception towards ICT challenges in the agrifood supply chain. In response to the statement ‘internet cost is expensive’, among 40 respondents, around 65 percent agreed that internet subscription is still unaffordable in the studied countries (mean value 3.55±1.28) (see Appendix C.3). It is confirmed by interviews with PC (interview, 12-1-2018) and KS (interview, 6-2-2018), that stated high cost is what often hinders the full utilization of ICT in the agrifood supply chain.

However, this finding is different from what AK (interview, 11-2-2018) expressed where internet cost is getting cheaper from year to year in Nepal.

"*Recently it's getting cheaper in comparison to last year. $2.5 for 2.5 gigabytes (GB) of data. Last year it was $8 for 1 GB mobile data* (AK, interview, 11-2-2018)".

4.4.2 Skill

To measure the current state of ICT skills of the samples, this study focuses on the proficiency level of young professionals to use computer, mobile phone, internet and advanced ICT devices. Negative responses were found towards the statements 'I do not know how to use mobile phone for work' (mean value 1.38±0.87), 'I do not know how to use internet for work' (1.30±0.76), and 'I do not know how to use computer' (mean value 1.30±0.56) (see Appendix C.3). It is also confirmed by interviews where the samples in Indonesia and Philippines are more digital literate since they mostly have basic ICT education since at primary school. These views surfaced mainly in respect to what DL (interview, 17-2-2018), a government officer, and KS (interview, 6-2-2018), an agriculture entrepreneur, have expressed.

On the contrary, more than half of the participants indicated that no training is provided to use more advanced ICT devices in response to the statement 'there is no training to use advanced ICT devices' (3.15±1.58) (see Appendix C). It showed that the majority of respondents do not receive training to use advanced ICT tools for agricultural-related activities.

Another challenge related to the lack of skill is also found due to the emerging 'digital divide' as mentioned in section 4.2. A common view among interviewees was that there is a gap between younger professionals with their older colleagues which in the end might affect the productivity of an organization, as mentioned by an agriculture entrepreneur in Indonesia and government officer in the Philippines (KS, interview, 6-2-2018; DL, interview, 17-2-2018).

"*The challenge is especially with the old ones in our office who are having a bit of difficulty about using new technology. Also, especially those cloud-based technologies, for example, Google Drive and Facebook groups* (DL, interview, 17-2-2018)".

Nevertheless, an advance ICT system is not something that is generally learned at school. Thus, young professionals and older professionals often have difficulties in operating it without proper training provided in prior, said a food company officer (DZ, interview, 7-2-2018).

4.4.3 Access and infrastructure

There are no clear boundaries to define whether an internet connection in the studied countries is reliable or not. To what the study has observed, half of the respondents agreed that internet connectivity is unreliable and the other half do not have problems on connectivity in response to the statement 'the internet connectivity is unreliable in where I live' (mean value 2.80±1.51) (Appendix C.3). There is also no clear to define if respondents have difficulties in finding internet access, in response to the statement 'it is difficult to find internet access in where I live' (mean value 2.30±1.32) (Appendix C.3). However, almost two-thirds of the participants (70%) said that the speed of internet is rather unstable in response to the statement 'the internet speed is unstable' (mean value 3.23±1.39) (Appendix C.3).

In regards to the infrastructure, the majority of respondents indicated that electricity is well-supplied in response to the statement 'the electricity supply is unreliable' (mean value 2.00±1.36) (Appendix C.3). Furthermore, around 70 percent of the samples responded negatively to the statement 'I do not have a personal computer at home' (mean value 1.55±1.11) (appendix C.3)

which implies that these 70 percent own a computer at home. Nevertheless, a small number of respondents in Nepal suggested the opposite.

4.4.4 Government support

It is well noted that in developing countries, development is distributed unevenly throughout the country. This study observed that some of the participants do not have problems in operating ICT while there are participants with difficulties in accessing ICT tools. It is likely due to the policy of the concerned government to prioritize the access and infrastructure of ICT in some areas, as mentioned by agriculture entrepreneur in Indonesia (KS, interview, 6-2-2018). It is no longer the issue of individual competence and skill in using ICT devices as an online media expert said:

> "*I think people these days are born with technology and with the knowledge, and the attitude to use technology. I think it's more the availability of infrastructure and also affordability of infrastructure* (PC, interview, 12-1-2018)".

Challenges also come from the government where, for instance, China has strict rules applied towards internet service. It holds up the accessibility to reach young professionals in China to be more involved in the global level in regards to online engagement, as stated by a youth expert in YPARD (CP, interview,19-2-2018).

Supports from the government to use ICT in the agrifood supply chain can come in many forms. For example, AK (interview, 11-2-2018), agricultural research in Nepal, pointed out that Asian Development Bank gives funding to the Nepal Government for climate resilient agriculture program to maximize the use of ICT in agriculture. Furthermore, the government of Nepal should also be responsible for providing and manage internet access across the country, as mentioned by agriculture researcher in Nepal (GK, interview, 26-2-2018). Its role is as important as assuring a fair trade for telecommunication companies. DL (interview, 17-2-2018), a government officer in the Philippines, expressed that government's policy can significantly transform the digital landscape of the country by opening up the economy to international partners to invest in infrastructure such as elevating broadband connection within the Philippines.

4.5 Future opportunities of ICT for youth in the agrifood supply chain

This section provides possible opportunities of future ICT application for young people in the agrifood supply chain.

In regards to the future opportunities in the application of ICT for youth in the AFSC, this study conducted a qualitative and quantitative study within the study population. The quantitative study consisted of a survey and the result was analyzed using non-parametric test and descriptive statistics. The questions were arranged to investigate respondents' perspective on the trend and future development of ICT as what they see it now to examine a room of improvement for the current ICT applications in the agrifood supply chain. The results show that the studied populations did not give a significant difference towards the questions variables related to "future opportunities in applications of ICT".

Figure 15 depicts the summary of responses from young professionals in Indonesia, Nepal, and the Philippines towards statements related to the perceived future opportunities.

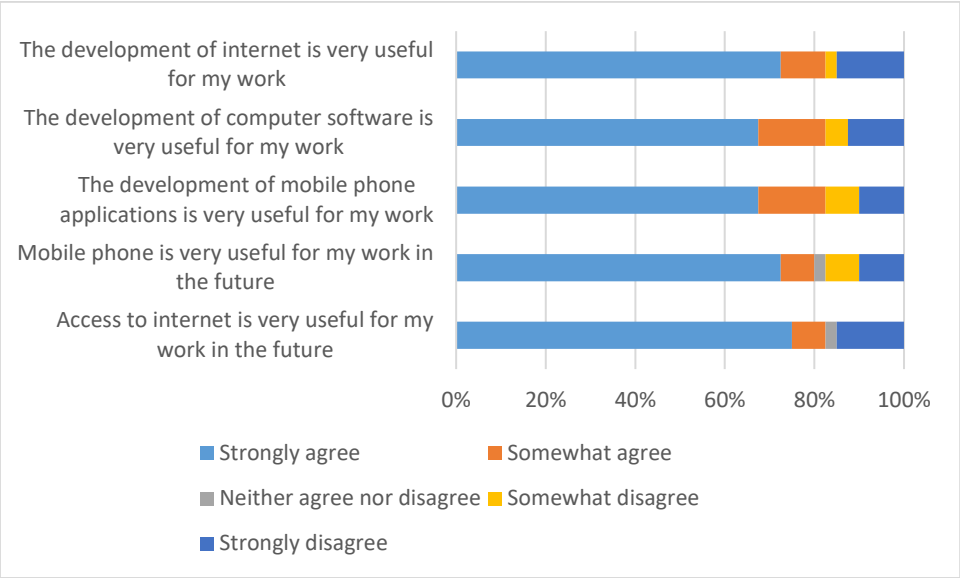

Figure 15 Responses towards statements on "ICT opportunities" (n=40)

Figure 15 reveals that the studied samples have a positive attitude towards the future development of ICT in the agrifood supply chain. This can be seen from the high values obtained from the collected responses for the development of mobile phone applications, computer software, and internet as a response to the statements 'the development of mobile phone applications is very useful for my work in the future' (mean value 4.23±1.37), 'the development of computer software is very useful for my work in the future' (mean value 4.20±1.42), and 'the development of internet is very useful for my work in the future' (mean value 4.23±1.48) (Appendix D.3). The future willingness to use internet and mobile phones by the participants also show a positive trend with mean values 4.28±1.50 and 4.24±1.39, respectively corresponding to the statements 'access to internet is very useful for my work in the future' and 'mobile phone is very useful for my work in the future' (Appendix D.3).

The quantitative findings are supported by the interviews with experts and young professionals in the study population. KS (interview, 6-2-2018), an agriculture entrepreneur, believes that in the future, more agricultural companies will be benefited from the development of ICT if said company's organizational operations are technology-based whenever and wherever possible. Many young people cannot see themselves living without technology in the future. There will be an increasing number of working tasks that demand a better information management system as a base for quick decision making at the highest level of management, according to government officer in the Philippines (DL, interview, 17-2-2018).

Nevertheless, the readiness and willingness of the young professionals are of utmost importance. These intrinsic motivations are what driving young people to embrace and develop ICT for future agrifood supply chain, according to a youth development expert and an officer at food industry (CP, interview,19-2-2018; DZ, interview, 7-2-2018).

However, more attention should be paid to the development of ICT infrastructure for agricultural production, as mentioned by GK, an agriculture researcher, when asked about the readiness of new era of ICT:

> "*I like to be introduced in more advanced ICT tools (for agricultural research and production) but these are not available at this time* (GK, interview, 26-2-2018)".

GK (interview, 26-2-2018), an agriculture researcher, also pointed out the importance of having the regular training of basic and advanced ICT and the support from the government regarding policy and budget, etc.

In the next chapter, discussions of the findings on the knowledge sharing practice, the awareness of ICT, ICT applicability, challenges, and future opportunities of ICT in the agrifood supply chain from the respondents' point of view in Nepal, Indonesia, and the Philippines will be provided.

5. Discussions and Conclusions

This part of the thesis discusses the findings emerged from the quantitative and qualitative analyses results covered in the previous chapter, as well as literature study. The first major sections will discuss the key findings on the samples' perspectives towards ICT in the agrifood supply chain. Section 5.1 presents the discussion on the knowledge sharing practices in the agrifood supply chain. In section 5.2, the discussion about the awareness of ICT in the agrifood supply chain among young professionals is revealed, and later on, the application of ICT is discussed in section 5.3. The challenges of ICT in the agrifood supply chain from the standpoint of young professionals and the future opportunities in the applications of ICT are discussed in section 5.4 and section 5.5, respectively. The summary of the identified aspects is described in the last part of this chapter.

5.1 Knowledge sharing practice in the agrifood supply chain

From the previous chapter, this study has defined the current knowledge sharing practice by study population in Nepal, Indonesia, and the Philippines, either by involving ICT tools or practicing traditional knowledge sharing, within the agrifood supply chain. Knowledge sharing practice provides opportunities for an organization to maximize its ability to close the possible gaps and create solutions which give them a competitive advantage (Lin, 2007).

Study finding reveals that the types of knowledge in the current knowledge sharing activity are quite ranging from product-related knowledge, process-related knowledge, organizational knowledge, and strategic knowledge (p. 23-24). Findings also show different knowledge sharing activities in different supply chain stages, such as forecasting, communication with supply chain partner, agricultural extension, access to technical and legal information, and so on (p. 23-24). This evidence shows that the agrifood sector is a knowledge-based and knowledge-intensive sector and provides room for youth to participate as agrifood professionals (Mammo, 2015).

Three main factors were found to influence the knowledge sharing process. These factors; individual factors, organizational factors, and technological factors, will be discussed separately in the next sub-sections.

5.1.1 Individual factors

In the study findings, the majority of respondents (70%) agreed that communication between actors is an important key for a successful knowledge sharing (p. 25). Knowledge sharing also enables individual to develop a sense of belonging in an organization where they can comfortably share knowledge and feel appreciated. Furthermore, knowledge sharing allows individuals or organizations to have adequate knowledge to solve a problem and prepare for the range of possible outcomes. The good experience obtained combined with the awareness of benefits from the knowledge sharing practice are found to influence the knowledge sharing practice positively.

Additionally, in the integration of knowledge within an organization, involvement of individuals – as a knowledge owner – is important to ensure open knowledge flows. Bock (2005) confirms that knowledge would only be available if the knowledge owner makes the objects available and should be facilitated. It confirms the study's theory of that the motivation of an individual to share knowledge is an important touchstone for promoting knowledge sharing practice.

5.1.2 Organizational factors

The study findings show that 80 percent of respondents agreed that the organization culture where the respondents are working at is supporting the knowledge sharing practice (p. 25). It is also supported by the statement of one of the interviewees, stating that knowledge sharing practice is highly valuable for the operations of organizations (KS, interview, 6-2-2018) (p. 26). It was shown by the facilitation of knowledge sharing activity and continuous knowledge creation activity (p. 26). This finding shows that many firms are now aware of the benefits of knowledge sharing activity and believe that maintaining positive knowledge sharing culture is important to provide long-term sustainability and success of organizations (Ipe, 2003).

5.1.3 Technology factors

Based on findings in Section 4.1.3 on technology factors, it is clear that knowledge sharing is enhanced by integrating ICT into the system. It can be seen from an example of an agricultural entrepreneur (KS, interview, 6-2-2018) where knowledge on product-related is usually obtained from the digital world to get the latest update knowledge on the market (p. 26). The knowledge network development process facilitated by ICT is not only limited to providing relevant knowledge but also to select and process the knowledge in a format that is understandable by stakeholders (Chapman & Slaymaker, 2002). It would be further supported by the provision of robust and updated knowledge and the practical function of ICT to create linkages for partnership in knowledge sharing (Chapman & Slaymaker, 2002). In the next section, this study will discuss the level of ICT awareness among young professionals in the agrifood supply chain.

5.2 Building ICT awareness in the agrifood supply chain among young people

This section will discuss the collected findings on the experience of using ICT in the agrifood supply chain and the perceived benefits of using ICT from the young professionals' perspectives provided in section 4.2.

Findings show that the knowledge sharing practice without ICT is done in traditional agricultural extension to farmers, where it points out to the condition where the digital divide exists between the growers/producers SC stage and the researcher level, or older professionals and younger professionals (p. 28). It is reflected in the interview with AK (interview, 11-2-2018) (p. 28). However, there was a sense of ineffectiveness in traditional knowledge sharing practice among the respondents. Aker (2011) also questions whether traditional agricultural extension programs were just unorganized or barely functioning at all. Anderson and Feder (2004) argue that on top of the costly implementation, traditional agriculture extension has several constraints e.g. limited scale and sustainability, unsupportive policy environments, weak linkages of research-extension, low motivation and accountability of field officer, and the very few evidence on the successful implementation of such extension on farmers' welfare.

On the other hand, many respondents expressed their positive impressions towards the use of ICT in the knowledge sharing process. It is shown by the high mean values towards the statements 'I use ICT device(s) at work' (mean value 4.40±1.13) and 'the use of ICT is very helpful for the current knowledge sharing at work' (mean value 4.48±1.06) (see appendix B.3) with high correlation value for these statements (R=0.865) (Appendix B.1) (p. 27). It implies that the utilization of ICT devices for professional purposes can further improve the quality of knowledge sharing.

The high awareness, as mentioned by one interviewee, is highly likely due to education on basic ICT that has been introduced to these millennials since at school. As a consequence, youth nowadays are more literate in the digital world. The early education on ICT has been suggested to increase the

level of awareness and competences on ICT successfully. This finding corroborates the idea of Hawkridge (1990), who suggested that introduction of ICT into the school curriculum should be fostered to prepare the children for the future job quest as ICT is a powerful tool to stimulate personal and organizational development. Furthermore, these young professionals also have been exposed with the benefit they can obtain from the utilization of ICT regarding knowledge sharing.

The further goal can be targeted to integrating ICT in the early education system to develop knowledge-rich society. Yuen, Law, and Wong (2003) hold the view that assimilation of ICT to facilitate learning process at schools will positively impact the student capacities for self-learning, problem-solving, information seeking and analysis, critical thinking, and social skills.

5.3 Applying youth-friendly ICT in the agrifood supply chain

This section, the application of ICT in the agrifood supply chain by young professionals will be discussed.

Youth are highly likely to be the key players in the modern transformation of the agrifood supply chain. Present situation shows an overwhelming scene where technology has become an integral part of young people's daily lives. The digital world is largely populated by youth equipped with at least a mobile phone, computer, and internet. Three most common ICT devices very much attached in the lifestyle of young people. It has marked a new era where interaction between people is mediated by online social platform or the so-called social media, and highly-structured tasks can be simplified by the integration of advanced ICT.

5.3.1 Mobile phone application

Mobile phone has undeniably changed the way young people live and work. Although the use of mobile phone for work purposes is less frequent than it is in the daily life according to this study, the fact that mobile phone is always kept within arm's reach of young people is a pivotal base to construct the idea of how influencing it is in the agrifood supply chain (p. 30). In general, mobile phone has somehow replaced the function of traditional landline phone by providing wireless and a much more convenient way of communicating with supply chain partners through verbal or written communication. Moreover, the invasion of smartphones allows these young professionals to keep a 'mini' personal computer in their pocket whereas the function of mobile data gives the benefit to access knowledge whenever and wherever.

A set of mobile phones' features were identified in this research with respect to communication and knowledge access. An array of mobile applications turns down the barrier of urban-rural migrations. For example, messenger application such as *Whatsapp* is a convenient communication tool to monitor the field situation without the physical presence of managers. Some other applications on mobile phone enable stakeholders to access relevant knowledge to be adopted in agriculture, e.g. weather forecast, pest and diseases information, seed and crops availability, and trading tool (PC, interview, 12-1-2018) (p. 31).

5.3.2 Computer application

The utilization of computer in the agrifood supply chain can improve the agility level of a firm by being flexible and responsive to the changing environment (Gunasekaran & Ngai, 2004). With the immense high flow of information, computer can manage the integration of information through data collection, data processing, financial reporting, and forecasting tools, through which the result can be adopted to leverage the knowledge capacity. The application of SaaS, for example, gives benefit for end users to have software based on the needs that can be maintained and controlled

through web-based interfaces (Hu, Chen, & Lin, 2011; Liu, Wang, Sun, Zou, & Yang, 2014). Further on SaaS and other advance computer-based ICT will be discussed in section 5.3.4 on advanced ICT.

According the finding, computer usage can reduce the number of information distortion in the planning and production stage across the supply chain (p. 32). It works by providing a scalable model obtained through computer programming which can decrease supply chain cost and identify the critical point in the supply chain to close the shortcomings (Fleisch & Tellkamp, 2005).

5.3.3 Internet application

Much has been said about how the agrifood landscape has changed as a result of the internet. Exploring potential links of internet has important implications of how it should be further developed to get more young people engaged in agrifood supply chain. In regards to the study findings, the benefits of internet are ranging from communication tool, marketing tool, educational tool, to geo-information tool (p. 33). It makes the internet a powerful tool to enhance the agrifood supply chain. Some interesting trends in the study reveal that there is a strong engagement of young professionals with the internet. The vast majority of respondents (95%) indicated that they access the internet on a daily basis, either on personal computer or mobile phone, some with more advanced ICT devices such as a tablet (Table 11, p. 29). Two-thirds of the studied young professionals spent more than four hours per day on internet (Figure 13, p. 33). Thus, it is safe to say that young people have the opportunity to enhance their livelihoods through internet utilization given the right support and direction.

Another noteworthy finding is where, or through which device, these young professionals normally access the internet. 60 percent of those who responded indicated that they access internet on office PC while 77.5 percent access it from mobile phone (Table 12, p. 29). This high percentage dispenses an opportunity for the optimization of mobile phone use in developing countries. With the invasion of smartphones, rather than just for a lifestyle, youth can be equipped with mobile applications that are beneficial to enhance the quality of the agriculture value chain. This approach is highly applicable in rural and urban communities and potential to reduce youth unemployment. For instance, young people can be the creator of mobile applications to help farmers to access knowledge on the weather forecast, diseases, or the availability of seed and crops (PC, interview, 12-1-2018) (p. 31).

5.3.4 Advance ICT tools utilization

The last ten years have seen an advancement of ICT in regards to agriculture development. Thus, stakeholders should head towards understanding the importance of placing ICT as a strategic tool and to recognize the importance of ICT devices availability (Kodama, 2013). Some young professionals reported the use of advanced ICT tools in the supply chain to increase the efficiency and effectiveness of supply chain activities (Section 4.3.4). Advance ICT software like SaaS is usually provided by companies for employees to process a huge amount of data (p. 34). On top of it, SaaS can be tailored to the demand of the firm. This specially designed software is mainly found in global-oriented firms and start-ups. SaaS is not necessarily available in the food producer/growers level, mainly when farmers are dominated with older farmers with higher resistance towards advance ICT devices despite the enormous potential of SaaS application to leverage food production performance. However, Iddings and Apps (1990) suggested that the participation of farmers to adopt SaaS can be increased by providing training to the farmers and adequate access to the knowledge needed in the field. In this case, young people can play a role as ICT facilitators to train the farmers on how to utilize ICT for food production.

Another most common use of advanced ICT in the current study is the geo-information tool such as GPS (p. 34). This geo-information tool can provide users with the latest information about time and position that can be accessed anywhere and through any devices (Hori, Kawashima, & Yamazaki, 2010). Other spatial technology tools that can be useful for agrifood activity are geographic information systems (GIS) and remote sensing (RS). These tools allow the collection and analysis of field data that are not possible before the presence of computer (Milla, Lorenzo, & Brown, 2005). The adoption of these tools can be useful for food-conscious consumers and to increase food safety if traceability of the food source is needed by the consumers.

Since modern agriculture is highly knowledge-intensive and highly driven by the flow of knowledge (Parwez, 2014), advance ICT plays an important role to accelerate the effective and efficient dissemination of knowledge. However, ICT appliance in the agrifood supply chain is facing a problem. Lack of training was found to be one of the major constraints. The present finding seems to be consistent with Gelb's (2005) findings that show that the lack of education and training on ICT was the dominant alleviating adoption factor of ICT. The adoption barriers of ICT will be discussed further in section 5.4 on perceived challenges of ICT utilization.

5.4 Perceived challenges of ICT utilization in the agrifood supply chain

This section will discuss the observed challenges in the agrifood supply chain from the young professionals' point of view.

The implementation of ICT in the agrifood supply chain does not always run smoothly. Some significant drawbacks hold up the integration of ICT into the current system and thus 'pulling' the young people to engage in the agrifood supply chain. Some main constraints of ICT utilization are identified in this research, as seen in Table 14 below. These challenges are divided into four aspects, namely cost, skill, access and infrastructure, and government support. All respondents indicated the same challenges related to the cost, access and infrastructure, and the government support, except for the skill column where the additional challenge was found from respondents in Nepal.

Table 14 Main constraints of ICT utilization

Country	Challenge			
	Cost	**Skill**	**Access & infrastructure**	**Government support**
Indonesia	Expensive internet subscription	Digital divide between the young professionals and the seniors	Unreliable and unstable internet connection	Poor information management system
Nepal	Expensive internet subscription	• Digital divide between the young professionals and the seniors • No pre-training for advance ICT tools	Unreliable and unstable internet connection	Poor information management system
Philippines	Expensive internet subscription	Digital divide between the young professionals and the seniors	Unreliable and unstable internet connection	Poor information management system

The study found that there are four primary bottlenecks in the ICT utilization that hinder the involvement of youth in the agrifood supply chain, two of which are related to skill. The first factor is a digital gap in the supply chain between the young professionals and the seniors (p. 35). It also accords with earlier observations, which showed that ever since many people left agriculture sector due to industrialization, those who remain in the field are usually illiterate and do not have equal

access to resources or assets (Richardson, 1997). This situation leads to a higher resistance to technology adoption or innovations in agriculture production. The absence of willingness to try innovation can be associated with the risk perception of an individual and organizations culture (Shalley & Gilson, 2004). According to Bazerman et al. (1997), people tend to avoid risk and uncertain results and therefore tend to resist new technology.

Regarding 'skill' challenge, the unavailability of training for advanced ICT tools was also mentioned as a factor that hinders the adoption of ICT in the agrifood supply chain by the studied population (p. 35). To overcome this, organizations should set the perspective towards the importance of incorporating advance ICT tools in the supply chain (Galanouli, Murphy, & Gardner, 2004). Adequate resources, sufficient time, and technical and social support are named as important factors for successful training programs (Cox, Preston, & Cox, 1999).

The third major challenge is lack of adequate infrastructure to support ICT and can be linked to support from the government (p. 36-37). Support from government for ICT adoption can be in the form of (a) national policies, long-term strategies, and global involvement (b) mainstreaming the thinking concerning digital inclusion (c) establishing collaboration with professional bodies, NGOs, private initiatives, international bodies, influencers (d) working on regulations that can enhance ICT benefits to business and the public (e) collaborating with IT sector, local government, project managers, rural communities, end users and researchers (f) encouraging and promoting ICT adoption partnership (Gelb et al., 2008).

From the study population, many young professionals from Indonesia, Nepal, and the Philippines also mentioned the unaffordable cost of data service (p. 35). This finding corroborates the idea of Lohento and Ajilore (2015) where despite the increasing infrastructure coverage and cheaper devices, the cost to maintain a connection to data service remains a challenge for young people, especially rural youth.

5.5 Future opportunities in ICT applications for youth the agrifood supply chain

This section delivers the discussion of future opportunities of ICT in the agrifood supply chain.

There are plenty of ways to preserve the future of food and agriculture, and it can be started by paving the way for youth to get involved in the supply chain. Youth will have a high willingness to put in more contributions in the agrifood field given adequate supports. This is mirrored by the study findings where 80 percent of respondents are willing to contribute in enhancing the knowledge sharing practice in the supply chain in response to the statement 'I am willing to share knowledge with supply chain partner' (mean value 4.40±0.90) (Appendix B.3) and believe that future development of ICT will accelerate economic developments as revealed in Figure 15 (p. 38) (Appendix D.3).

The quantitative findings are then confirmed by interviews with experts and young professionals. KS (interview, 6-2-2018), an agriculture entrepreneur in Indonesia, believes that in the future, more agricultural companies would benefit from the development of ICT if organizational operations are technology-based (p. 38). Many young people cannot see themselves living without technology in the future. Correspondingly, more working tasks will demand a better information management system as the base for quick decision making at the highest level of management and present itself as an opportunity for young people to play an important role. For example, Global Knowledge Partnership (GKP, 2003) acknowledged youth as more open to the adoption and implementation of ICT-facilitating adoption processes into traditional practices which makes youth the ideal candidates

to be trained as IT facilitators. Additionally, with the previously mentioned traits, young people can also help farmers in creating ICT applications to improve profitability and efficiency, while reducing the costs through a data-driven approach (Jayaraman et al., 2016).

ICT, on the other hand, also provide room for youth to stand out and bring forward youth-specific issues to the table. ICT allows youth to gather different perspectives and exchange ideas and knowledge regarding product-related, process-related, organizational and strategic issues which will result in new and innovative outcomes. Utilizing ICT, youth can learn and participate in understanding what is it like to take part in a nation's development (Bachen et al., 2008; Hafkin, 2002). For example, YPARD platform allows members to exchange knowledge with people across borders and sectors, as mentioned in the literature study and interview. The sharing of knowledge creates a sense of belonging where they can comfortably share ideas and to feel like a part of something bigger. This eventually, will lead to higher youth participation in the development process.

5.6 Conclusions

This research highlights the vast applicability and potential of ICT utilization by youth in the agrifood supply chain. It is reflected through the main research question: "What are the possibilities to enhance and to extend the reach of agricultural knowledge using ICT along the agrifood supply chain from the standpoint of young professionals?". The objectives of this research are to understand and address the specific needs of youth in regards to ICT utilization, to support better understanding among stakeholders in agrifood supply chain, and to involve and engage more youth in the agrifood supply chain. That is why, proceeding with the investigation on the knowledge sharing practice, the level of awareness of ICT, the current applications of ICT, what challenges are it poses, and the future opportunities in the applications of ICT, all was conducted from the standpoint of young professionals in Indonesia, Nepal, and the Philippines.

SRQ1: ***How do young professionals share knowledge with and without ICT among stakeholders of the agrifood supply chain?***

The quest to answer this question started from finding out the current knowledge sharing practice with and without ICT within the agrifood supply chain. Knowledge sharing is crucial to ensure a successful supply chain. The finding suggests that agrifood supply chain is a knowledge-intensive sector. Three main factors were found to influence knowledge sharing practice, namely individual, organizational, and technology factors. According to the study population, the motivation to share knowledge is obtained from the positive perception of its benefits. The respondents also believe that knowledge should be made available and therefore make communication as a key for successful knowledge sharing process.

The organization also plays an important role to ensure smoother knowledge sharing process in the agrifood supply chain. The support from the organization can come in the form of knowledge sharing activity facilitation and ensure the activity's sustainability.

Lastly, specific emphasis was given to the technology factors; the use of ICT in the agrifood supply chain by young professionals. In the knowledge sharing process, technology provides easier access to knowledge and enables users to get the latest knowledge from its advancement. A further emphasis of ICT utilization in the agrifood supply chain is answered in the next four sub-research questions.

SRQ2: ***What is the current level of awareness of ICT in agrifood supply chain by young professionals?***

In regards to the level of ICT awareness, it is not surprising that today's generations of youth are well aware of the benefits of ICT. This particular advantage owes its mark to the successful education of ICT integrated into their school curriculum at an early stage. On the contrary, finding reveals a lower level of awareness at growers/producers level, due to the high resistance of technology adoption which often found in older farmers. This condition leads to the likelihood of digital divide's existence between the younger and the older professionals.

SRQ3: ***How do young professionals apply ICT in the current agrifood supply chain?***

General ICT devices used by respondents were found to help improving the agrifood supply chain, namely mobile phones, computer, and internet. Some more advanced ICT devices were also utilized by young professionals. These ICT tools are versatile as they can aggregate demands for farm inputs, allow free access to knowledge on crop management and expert advice, weather forecasts, and information on prevailing prices in local and global markets.

SRQ4: ***What are the challenges faced by young professionals in the application of ICT in agrifood supply chain?***

The incorporation of ICT devices is facing drawbacks from the digital gap between younger and older professionals in organizations and the unavailability of training for advanced ICT tools. Additionally, the lack of support from the government gives an impact on the slow development of ICT infrastructure. Consequently, youth suffers from unreliable and unstable access to knowledge. It is also observed that ICT is still not fully optimized due to a relatively high cost for young professionals to maintain a connection to data service, largely on the rural youth.

SRQ5: ***What are the future opportunities in applications of ICT for young professionals in agrifood supply chain?***

Last but not least, ICT provides various opportunities for youth to be more involved in the agrifood supply chain through the utilization of ICT. Youth have a more open to innovations attitude and potentials to take the lead in the integration of innovation in an organization using ICT. Conversely, ICT provides room for youth to participate in the supply chain and connects across borders through online engagement, sharing knowledge on agricultural issues and trend.

Finally, this study aimed to answer the main research question:

What are the possibilities to enhance and to extend the reach of agricultural knowledge using ICT and support better understanding among the actors of agrifood supply chain from the standpoint of young professionals?

The main research question will be answered based upon the results that have been retrieved, combining the results of the literature review and empirical research, by reflecting upon the theoretical framework as illustrated in figure 16.

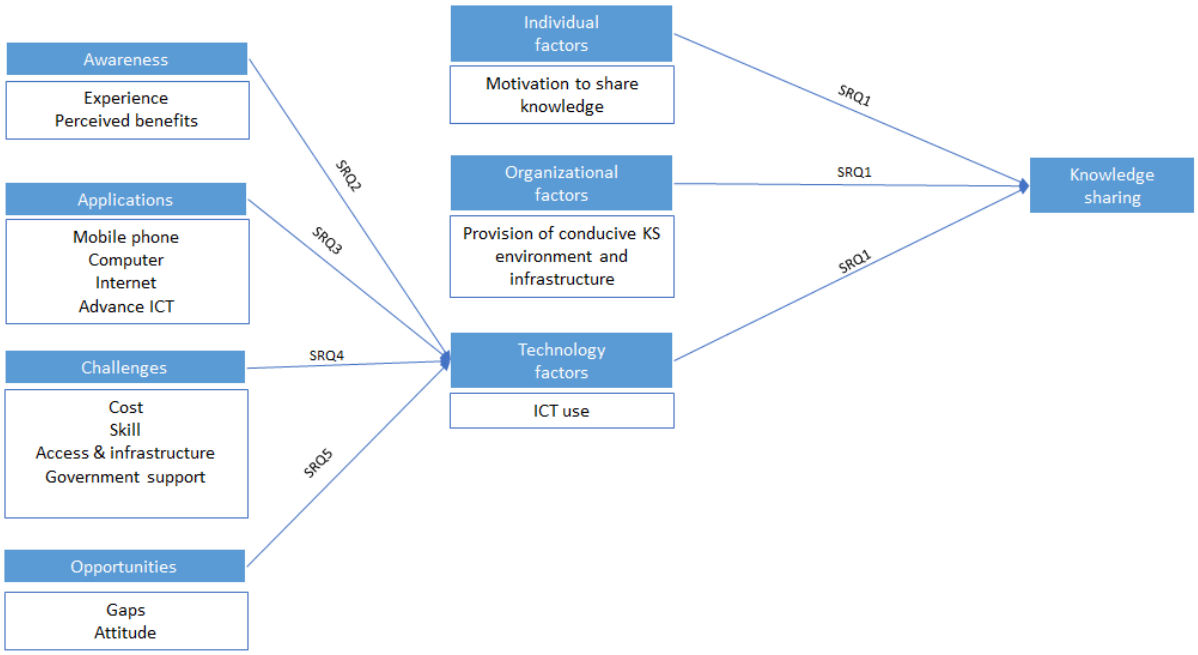

Figure 16 Theoretical framework of the study

Essentially, ICT is a valuable tool to enhance and extend the reach of agricultural knowledge. According to this study, the agrifood sector is a knowledge-intensive sector and therefore the utilization of ICT could enhance the knowledge sharing practice, and consequently to the whole supply chain. Furthermore, the incorporation of ICT has been found to support a better understanding among the actors of the agrifood supply chain. Our study suggests that young people have the capabilities and potential to incorporate ICT in the agrifood supply chain to leverage knowledge sharing practice.

It is shown by the high awareness of our studied population towards ICT in the agrifood supply chain. These young people have been exposed to ICT education at school at an earlier period, unlike the current older adults, which results in the higher competency of ICT and the likelihood of digital divide. The presence of the digital divide between younger and older professionals in an organization can be minimized to ensure full optimization of ICT. Organizations may head towards an open-culture, knowledge-intensive, and more open attitude towards innovation. Young people can be trusted to take the lead to ensure smoother ICT adoption in the agrifood supply chain. Furthermore, the organization should make training for advance ICT available in order to increase efficiency and effectiveness of supply chain practices.

The ICTs infrastructure should be revamped to provide broader internet access throughout the whole country. The collaboration of government, professional bodies, NGOs, private initiatives, international organizations, and influencers are pivotal to construct policies and strategies and to open up more partnership opportunities.

This study suggests that in many cases, ICT initiatives are seen to be less effective (or ineffective altogether) when the goals for their use are not clear. Therefore, specific and well-defined goals for ICT in the agrifood supply chain should be prepared and planned thoroughly to achieve a successful agrifood supply chain. It also means that ICT devices should be developed to meet the requirements of actors in the agrifood supply chain, especially for the current and future young professionals.

Furthermore, young people can be directed to help in the 'designing', development, and implementation of ICT for future use in the agrifood supply chain.

However, the utilization of ICT in the agrifood supply chain would not be successful without the motivation of an individual to share knowledge and support from the organization. Our finding suggests that with the positive experience obtained combined with the awareness of benefits from the knowledge sharing are found to influence the knowledge sharing practice positively. Moreover, the organization plays an important role by facilitating knowledge sharing and continuous knowledge creation activities to promote a positive knowledge sharing culture.

Taken together, the results of this study suggest that young people have the capability and motivation to enhance and extend the reach of agricultural knowledge using ICT and support better understanding among the actors of agrifood supply chain. However, some challenges have to be eradicated such as high price of ICT devices and maintenance, the lack of trainings for advanced ICT, lack of access and infrastructure, and the digital divide between younger and older professionals, and between supply chain partners. Support from organizations and government are needed to speed up the process of ICT adoption and implementation. Furthermore, young people can be engaged in this process during the 'designing', development, and implementation stages of ICT for the future use in the agrifood supply chain.

6. Limitations and suggestions

The first part of this chapter will present the study's limitations and suggestions for further research in the future. Later, recommendations for further research are presented in the last part of this chapter.

6.1 Limitations of study

The findings in this report are subject to at least three limitations. First, the sample size for both qualitative and quantitative studies is relatively small and included only members of YPARD. Therefore the results hardly represent the general view of young professionals. Larger sample size would be a strong recommendation to strengthen the results and allow a further investigation on the differences between each country for future research. Consequently, the study will be able to provide a broad generalization towards a bigger sample size. Furthermore, a different result could have been obtained provided a different set of countries or in an extended study's scope and population.

Secondly, in this study, we only collected general views from young professionals across the supply chain in order to obtain respondents and secondary data on aspects affecting the knowledge sharing in the agrifood supply chain. In turn, it may result in bias and reducing the applicability to a specific agrifood supply chain. Therefore, future research can be directed to a more specific area and actors of the supply chain to have a more focus and specific result.

Thirdly, the types of respondent selected for this research are limited to growers/producers, researchers, manufacturers, wholesalers/retailers, and government officer spread out in Nepal, Indonesia, and the Philippines. Of which, some of the roles are represented by only one respondent, making it difficult to draw a general conclusion. Personal perception of respondents towards the study variables may affect the results. Therefore, providing comprehensive perspectives of young professionals in the agrifood supply chain specifically in Nepal, Indonesia, and the Philippines is not possible. It is suggested to have more than one respondent from each profession in the agrifood supply chain for each of the country studied.

6.2 Suggestions for further research

This final section is written to help students and other researchers in the selection and design of future research directions that could be foreseen.

Our results seem to indicate that there is an interaction between the motivation of young professionals as an individual to share knowledge and support from the organization to foster the ICT adoption in the agrifood supply chain. This was not fully covered by our research although ICT can certainly play a role in growing the motivation of an individual to share knowledge and how an organization should support ICT utilization in order to engage more young people. Our distinction between the individual factor, organizational factor, and technology factor point towards interesting avenues of research. A more elaborate study of the interaction of these different factors to the knowledge sharing practice would be an interesting contribution to research in this area.

References

Ali, J., & Kumar, S. (2011). Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain. *International Journal of Information Management*, *31*(2), 149–159. https://doi.org/10.1016/j.ijinfomgt.2010.07.008

Aliu, A., & Halili, A. (2013). The impact of Information and Communication Technologies as a tool to facilitate growth in the manufacturing sector in Republic of Kosovo. *Procedia Technology*, *8*(Haicta), 465–470. https://doi.org/10.1016/j.protcy.2013.11.060

Arts, J. W. C., Frambach, R. T., & Bijmolt, T. H. A. (2011). Intern . J . of Research in Marketing Generalizations on consumer innovation adoption : A meta-analysis on drivers of intention and behavior. *International Journal of Research in Marketing*, *28*(2), 134–144. https://doi.org/10.1016/j.ijresmar.2010.11.002

Bachen, C., Raphael, C., Lynn, K. M., McKee, K., & Philippi, J. (2008). Civic Engagement, Pedagogy, and Information Technology on Web Sites for Youth. *Journal Political Communication*, *25*(3), 290–310.

Bazerman, M. H., Messick, D. M., Tenbrusel, A. E., & Wade-Benzoni, K. A. (1997). *Environment, Ethics, and Behaviour*. San Fransisco: The New Lexington Press.

Beauvisage, T. (2009). Computer usage in daily life. In *CHI '09 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 575–584).

Bergman, J., Jantunen, A., & Saksa, J. M. (2004). Managing knowledge creation and sharing – scenarios and dynamic capabilities in inter-industrial knowledge networks. *Journal of Knowledge Management*, *8*(6), 63–76. https://doi.org/10.1108/13673270410567639

Bierly, P. E., Kessler, E. H., & Christensen, E. W. (2000). Organizational learning, knowledge and wisdom. *Journal of Organizational Change Management*, *13*(6), 595–618. https://doi.org/https://doi.org/10.1108/09534810010378605

Bock, G.-W., Zmud, R. W., Kim, Y.-G., & Lee, J.-N. (2005). Behavioral Intention Formation in Knowledge Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate. *MSI Quarterly*, *29*(1), 87–111.

Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2007). *Supply Chain Logistics Management*. Boston: McGraw Hill.

Breen, R. (2005). Explaining Cross-National Variation in Youth Unemployment: Market and Institutional Factors. *European Sociological Review*, *21*(2), 125–134.

Carmody, P., Burrell, J., Oreglia, E., Management, I., Benson, A., Jafry, T., … Chisita, C. T. (2015). *New realities , new challenges : new opportunities for tomorrow ' s generation*. *Information Technology for Development* (Vol. 21). https://doi.org/10.1080/1389224X.2014.997255

Cox, M., Preston, C., & Cox, K. (1999). What Motivates Teachers to Use ICT? In *British Educational Research Association Annual Conference*.

Crone, M., & Roper, S. (1999). Local Learning from Multinational Plants : Knowledge Transfers in the Supply Chain, (46).

Dath, T. N. S., Rajendran, C., & Narashiman, K. (2009). A conceptual framework for Supply Chain

Management with specific reference to a developing economy. *International Journal of Logistics Systems and Management*, *5*(5), 473. https://doi.org/10.1504/IJLSM.2009.024250

Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change*, *33*(2), 255–298.

Fleisch, E., & Tellkamp, C. (2005). Inventory inaccuracy and supply chain performance: A simulation study of a retail supply chain. *International Journal of Production Economics*, *95*(3), 373–385. https://doi.org/10.1016/j.ijpe.2004.02.003

Galanouli, D., Murphy, C., & Gardner, J. (2004). Teachers perceptions of the effectiveness of ICT-competence training. *Journal Computers & Education*, *43*(1–2), 63–79. https://doi.org/10.1016/j.compedu.2003.12.005

Garbach, K., Lubell, M., & DeClerck, F. A. J. (2012). Payment for Ecosystem Services: The roles of positive incentives and information sharing in stimulating adoption of silvopastoral conservation practices. *Agriculture, Ecosystems and Environment*, *156*, 27–36. https://doi.org/10.1016/j.agee.2012.04.017

Gelb, E., Maru, A., Brodgen, J., Dodsworth, E., Samii, R., & Pesce, V. (2008). Adoption of ICT * Enabled Information Systems for Agricultural Development and Rural Viability.

Gelb, E., & Parker, C. (2005). Is ICT Adoption for Agriculture Still an Important Issue ? *ICT in Agriculture: Perspectives of Technological Innovation*, 1–8. Retrieved from http://departments.agri.huji.ac.il/economics/gelb-main.html

GKP. (2003). *Knowledge for Development Series*. Bukit Jalil. Retrieved from http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan020001.pdf

Gunasekaran, A., & Ngai, E. W. T. (2003). The successful management of a small logistics company. *International Journal of Physical Distribution & Logistics Management*, *33*(9), 825–842.

Hare, H. (2007). *ICT in Education in Ethiopia*. Retrieved from https://www.infodev.org/infodev-files/resource/InfodevDocuments_402.pdf

Harkin, M. (2005). ICT Adoption as an Agricultural Information Dissemination Tool–An historical perspective. *ICT in Agriculture: Perspectives of Technological Innovation. E. Gelb, A. Offer Editors. The Hebrew University of Jerusalem. Center for Agricultural Economic Research*, 1–6. Retrieved from http://departments.agri.huji.ac.il/economics/gelb-harkin-3.pdf

Hawkridge, D. (1990). Who needs computers in schools, and why? *Computers & Education*, *15*(1–3), 1–6.

Hoegl, M., Parboteeah, K. P., & Munson, C. L. (2003). Team Level Antecedents of Individuals' Knowledge Networks*. *Decision Sciences*, *34*(4), 741–770. https://doi.org/10.1111/j.1540-5414.2003.02344.x

Hori, M., Kawashima, E., & Yamazaki, T. (2010). Application of Cloud Computing to Agriculture and Prospects in Other Fields. *FUJITSU Sci. Tech. J*, *46*(4), 446–454.

Hu, S. C., Chen, I. C., & Lin, Y. L. (2011). Building cost-efficient computer-aided learning environments via virtualization and service-based software. *Communications in Computer and Information Science*, *217 CCIS*(PART 4), 525–529. https://doi.org/10.1007/978-3-642-23339-5_96

Huggins, R., & Izushi, H. (2002). The Digital Divide and ICT Learning in Rural Communities: Examples of Good Practice Service Delivery. *The Journal of the Local Economy Policy Unit*, *17*(2), 111–122.

https://doi.org/https://doi.org/10.1080/02690940210129870

Iddings, R. K., & Apps, J. W. (1990). What Influences Farmers' Computer Use? *The Journal of Extension*, *28*(1).

Ipe, M. (2003). Knowledge Sharing in Organizations: A Conceptual Framework. *Human Resource Development Review*, *2*, 337–359. https://doi.org/10.1177/1534484303257985

Irungu, K. R. G., Mbugua, D., & Muia, J. (2015). Information and Communication Technologies (ICTs) Attract Youth into Profitable Agriculture in Kenya. *East African Agricultural and Forestry Journal*, *81*(1), 24–33. https://doi.org/10.1080/00128325.2015.1040645

ITU. (2017a). ICT Facts and Figures. Retrieved September 17, 2017, from http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.asp

ITU. (2017b). ICT Facts and Figures 2017. Retrieved October 12, 2017, from https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx

Jabareen, Y. (2009). Building a Conceptual Framework: Philosophy, Definitions, and Procedure. *International Journal of Qualitative Methods*, *8*(4), 49–62. https://doi.org/10.1177/160940690900800406

Jayaraman, P. P., Yavari, A., Georgakopoulos, D., Morshed, A., & Zaslavsky, A. (2016). Internet of things platform for smart farming: Experiences and lessons learnt. *Sensors (Switzerland)*, *16*(11), 1–17. https://doi.org/10.3390/s16111884

Kodama, M. (2013). The Advancement of ICT Tools and Knowledge, and Innovation Management. In *Competing through ICT Capability* (pp. 23–37). London: Palgrave Macmillan.

Kumar, R. (2014). *Research Methodology*. (S. Publishing, Ed.). London.

Lesaona-Tshabalala, B. V. (2009). *Agricultural information needs and resources available to agriculturalists and farmers in a developing country with special reference to Lesotho*. University of Johannesburg. Retrieved from http://hdl.handle.net/10210/1850

Li, S., & Lin, B. (2006). Accessing information sharing and information quality in supply chain management. *Decision Support Systems*, *42*(3), 1641–1656. https://doi.org/10.1016/j.dss.2006.02.011

Liao, H., & Lu, H. (2008). The role of experience and innovation characteristics in the adoption and continued use of e-learning websites, *51*, 1405–1416. https://doi.org/10.1016/j.compedu.2007.11.006

Lin, H. F. (2007). Knowledge sharing and firm innovation capability: An empirical study. *International Journal of Manpower*, *28*(3–4), 315–332. https://doi.org/10.1108/01437720710755272

Liu, Z., Wang, S., Sun, Q., Zou, H., & Yang, F. (2014). Cost-aware cloud service request scheduling for SaaS providers. *Computer Journal*, *57*(2), 291–301. https://doi.org/10.1093/comjnl/bxt009

Lohento, K., & Ajilore, O. (2016). Chapter 5 ICT and Youth in Agriculture, (October).

Mammo, Y. (2015). *ICTs in Linking Farmers to Markets: Innovative Mobile Applications and Lessons Learned from the Past and the Future* (ICTs for agriculture No. 15/11).

Michaels, G., Natraj, A., & Van Reenen, J. (2014). Has ICT polarized skill demand? Evidence from eleven countries over 25 years. *Review of Economics and Statistics*, *96*(1), 60–77.

Milla, K. A., Lorenzo, A., & Brown, C. (2005). GIS, GPS, and Remote Sensing Technologies in Extension Services: Where to Start, What to Know. *Journal of Extension*, *43*(3).

Mohlameane, M., & Ruxwana, N. (2014). The Awareness of Cloud Computing: A Case Study of South African SMEs. *International Journal of Trade, Economics and Finance*, *5*(1), 6–11. https://doi.org/10.7763/IJTEF.2014.V5.332

Newell, S., Bresnen, M., Edelman, L., Scarbrough, H., & Swan, J. (2006). Management Learning. *Management Learning*, *37*(2), 167–185. https://doi.org/10.1177/1350507606063441

Nielsen. (2013). The Mobile Consumer: A Global Snapshot, (February), 11. Retrieved from http://www.nielsen.com/content/dam/corporate/uk/en/documents/Mobile-Consumer-Report-2013.pdf

Parwez, S. (2014). Food Supply Chain Management in Indian Agriculture: Issues, Opportunities and Further Research. *Munich Personal RePEc Archive*, (56184).

Purnama, S. H., & Lee, Y. (2010). An Assessment of Readiness and Barriers towards ICT Programme Implementation : Perceptions of Agricultural Extension Officers in Indonesia National Central University , Taiwan. *International Journal of Education and Development Using Information and Communication Technology*, *6*(3), 19–36.

Richardson, D. (1997). The Internet and rural and agricultural development. *FAO: Rome, Communication for Development*.

Roberts, J. (2000). From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. *Technology Analysis and Strategic Management*, *12*(4), 429–443. https://doi.org/10.1080/713698499

Salin, V. (1998). Information Technology in Agrifood Supply Chain. *International Food and Agribusiness Management Review*, *1*(3), 329–334.

Selwyn, N. (2004). Reconsidering Political and Popular Understandings of the Digital Divide. *New Media Society*, *6*(3), 341–362. https://doi.org/10.1177/1461444804042519

Shalley, C. E., & Gilson, L. L. (2004). What leaders need to know: A review of social and contextual factors that can foster or hinder creativity. *Leadership Quarterly*, *15*(1), 33–53. https://doi.org/10.1016/j.leaqua.2003.12.004

Shih, S. C., Hsu, S. H. Y., Zhu, Z., & Balasubramanian, S. K. (2012). Knowledge sharing-A key role in the downstream supply chain. *Information and Management*, *49*(2), 70–80. https://doi.org/10.1016/j.im.2012.01.001

Stricker, S., Emmel, M., & Pape, J. (2003). Situation of Agricultural Information and Communication Technology (ICT) in Germany. *Information Technology for a Better Agri-Food Sector, Environment and Rural Living*, (July), 690–698. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.3.2789&rep=rep1&type=pdf

Sumberg, J., N. A. Anyidoho, J. L. D. te L. and K. W. (2012). Title: Introduction: The Young People and Agriculture 'Problem' in Africa Citation : Sumberg, J., N. A. Anyidoho, J. Leavy D. te Lintelo and K. Wellard. (2012). 'Introduction: The young people and agriculture "problem" in Africa' ., *43*, 1–8. https://doi.org/10.1111/j.1759-5436.2012.00374.x/abstract

Tsolakis, N. K., Keramydas, C. A., Toka, A. K., Aidonis, D. A., & Iakovou, E. T. (2013). ScienceDirect Special Issue : Operations Management Review Agrifood supply chain management : A

comprehensive hierarchical decision-making framework and a critical taxonomy. *Biosystems Engineering*, *120*, 47–64. https://doi.org/10.1016/j.biosystemseng.2013.10.014

UN. (2016). *YOUTH AND ICT*. Retrieved from http://www.un.org/esa/socdev/documents/youth/fact-sheets/youth-icts.pdf

UNESCO. (2012). *The six EFA goals*. *Youth and skills. Putting education to work*.

United Nations. (2011). *Fact Sheet: Information and Communication Technology*.

Van Baalen, P., Bloemhof-Ruwaard, J., & Van Heck, E. (2005). Knowledge sharing in an emerging network of practice: The role of a knowledge portal. *European Management Journal*, *23*(3), 300–314. https://doi.org/10.1016/j.emj.2005.04.008

Várallyai, L., & Herdon, M. (2013). Reduce the Digital Gap by Increasing E-skills. *Procedia Technology*, *8*(Haicta), 340–348. https://doi.org/10.1016/j.protcy.2013.11.045

Vorst, J. Van Der, & Beulens, A. J. M. (2005). Innovations in logistics and ICT in food supply chain networks, (May 2014).

Wabwoba, M., Wanyembi, G., & Mutua, S. M. (2013). Pervasiveness of green ICT awareness amongst Kenyan ICT personnel. *International Journal of Application or Innovation in Engineering and Management*, *2*(1), 93–104. Retrieved from http://ijaiem.org/volume2Issue1/IJAIEM-2013-01-15-021.pdf

Wang, S., & Noe, R. A. (2010). Human Resource Management Review Knowledge sharing : A review and directions for future research. *Human Resource Management Review*, *20*(2), 115–131. https://doi.org/10.1016/j.hrmr.2009.10.001

Wasko, M. M., & Faraj, S. (2005). Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice. *MIS Quarterly*, *29*(1), 35–57.

White, B. (2012). Agriculture and the Generation Problem: Rural Youth, Employment and the Future of Farming. *IDS Bulletin*, *43*(6), 9–19. https://doi.org/10.1111/j.1759-5436.2012.00375.x

Wolfert, J., Verdouw, C. N., Verloop, C. M., & Beulens, A. J. M. (2010). Organizing information integration in agri-food-A method based on a service-oriented architecture and living lab approach. *Computers and Electronics in Agriculture*, *70*(2), 389–405. https://doi.org/10.1016/j.compag.2009.07.015

YPARD. (2017). About YPARD. Retrieved September 20, 2017, from http://ypard.net

Yuen, A. H. K., Law, N., & Wong, K. C. (2003). ICT implementation and school leadership: Case studies of ICT integration in teaching and learning. *Journal of Educational Administration*, *41*(2), 158–170. https://doi.org/10.1108/09578230310464666

Zins, C. (2007). Conceptual Approaches for Defining Data, Information, and Knowledge. *JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY*, *58*(4), 479–493.

Appendices

Appendix A

Questionnaire design

No	Code	Questions	Area of Investigation
Introduction			
1	Q1	What is your name?	
2	Q2	How old are you?	
3	Q3	Are you? • Male • Female	
4	Q4	Which country are you from? • Indonesia • Nepal • China	
5	Q5	What is your email address?	
6	Q6	What is your occupation in the agrifood supply chain?	
7	Q7	In which sector(s) are you working at? (you can choose more than one) • Input supply & production • Post-production • Marketing & trade • Finance & credits • Online networks • Others (please specify)	It is possible that one's occupation can play several roles in the supply chain
Current knowledge sharing practice in agrifood supply chain and awareness of ICT			
9	Q8_1	It is easy to adopt with new knowledge with the current knowledge sharing practice • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	The suitability of current knowledge sharing practice for work
10	Q8_2	Communication with supply chain partner is the key to improve the quality of the supply chain • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	The importance of knowledge sharing with supply chain partner
11	Q8_3	My organization's culture encourage me to share knowledge and information with supply chain partner • Strongly disagree • Disagree • Neutral	

		• Agree • Strongly agree	
12	Q8_4	I am willing to share knowledge with supply chain partner • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	The culture of organization to share knowledge among supply chain partner using ICT
13	Q8_5	I use ICT device(s) (personal computer, laptop, mobile phone, internet, etc.) at work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	The willingness to share knowledge among supply chain partner using ICT
14	Q8_6	The use of ICT is very helpful for the current knowledge sharing at work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	Interest to use ICT
Application of ICT in agrifood supply chain			
15	Q9	Which ICT devices do you use in everyday life? • Radio • Computer – not connected to the internet • Computer – connected to the internet • Tablet • Mobile phone • TV • Satellite • Office software • Social media • Geographical Information System (GIS) • Drone • Others (please specify)	ICT devices used for general purpose
16	Q10	Which ICT devices do you use specifically for work? • Radio • Computer – not connected to the internet • Computer – connected to the internet • Tablet • Mobile phone • TV • Satellite	ICT devices used for working purpose

		• Office software • Social media • Geographical Information System (GIS) • Drone • Others (please specify)	
17	Q11	How often do you use computer? • Everyday • More than once a day • Once a day • Once a month • More than once a month	Frequency of computer used
18	Q12	On average, how many hours per day do you spend on the computer? • Less than one hour a day • 1-2 hours • 2-3 hours • 3-4 hours • More than 4 hours a day	
19	Q13	How often do you use mobile phone? • Everyday • More than once a day • Once a day • Once a month • More than once a month	Frequency of mobile phones used
20	Q14	On average, how many hours per day do you spend on mobile phone? • Less than one hour a day • 1-2 hours • 2-3 hours • 3-4 hours • More than 4 hours a day	
21	Q15	How often do you use internet? • Everyday • More than once a day • Once a day • Once a month • More than once a month	Frequency of internet used
22	Q16	On average, how many hours per day do you spend on the internet? • Less than one hour a day • 1-2 hours • 2-3 hours • 3-4 hours • More than 4 hours a day	
23	Q17	Where do you usually access internet? (you can choose more than one) • Personal computer • Professional computer (at office)	Location of access

		• School or university • Public place/telecenter/internet cafe • At friends/family place • Mobile internet on phone • Other (please specify)	
Challenges of ICT			
24	Q18_1	Internet cost is expensive in where I live • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	Perceived challenges when using ICT in terms of cost, skill, access, and infrastructure
25	Q18_2	I do not know how to use a computer for work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
27	Q18_3	I do not know how to use an internet for work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
27	Q18_4	I do not know how to use a mobile phone for work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
28	Q18_5	The internet connectivity is unreliable in where I live • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
29	Q18_6	It is difficult to find internet access in where I live (e.g. at work, public places) • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
30	Q18_7	The electricity supply is unreliable in where I live	

		• Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
31	Q18_8	The internet speed is not stable in where I live • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
32	Q18_9	I do not have a personal computer at home • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
33	Q18_10	I cannot find internet provider in where I live • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
34	Q18_11	There is no training to use advanced ICT devices such as GPS, drones, and/or special software for work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
Future opportunities of ICT			
35	Q19_1	Access to internet is very useful for my work in the future • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	Perceived future opportunities of ICT in the agrifood supply chain
36	Q19_2	Mobile phone is very useful for my work in the future • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
37	Q19_3	The development of mobile phone applications is very useful for my work	

		• Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
38	Q19_4	The development of computer software is very useful for my work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
39	Q19_5	The development of internet is very useful for my work • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	
Other Information			
40	Q21	Are you willing to be contacted further when more information is needed from you? • Yes • No	

Appendix B

An initial correlation test used to examine the relationship strength between statements of the survey filled by respondents from different countries and reduce the redundancy for multivariate ANOVA (MANOVA) test (Table 10). The variables with low correlation coefficients (≤0.8) were used in the MANOVA. The MANOVA test aims to test whether the factor "Indonesia", "Nepal", and "Philippines" were significantly different by using all the question variables simultaneously. If some variables proved to have high correlations, these variables were dropped to avoid multi-collinearity, which can reduce the power of MANOVA test. The Wilk's Lambda test statistics showed that the null hypothesis was not rejected since the p-value was above 0.05. Furthermore, the Wilk's lambda was 0.7, which means that only around 30% of the total variance that is accounted for by the differences between countries. Hence, it is clear that the country differences did not give a significant difference among the questions variables related to "knowledge sharing practice" and awareness".

1. Result of pre-correlation test for "knowledge sharing practice" and "awareness of ICT"

	Q8_1	*Q8_2*	*Q8_3*	*Q8_4*	*Q8_5*	*Q8_6*
Q8_1 "It is easy to adopt with new knowledge with the current knowledge sharing practice"	1					
Q8_2 "Communication with supply chain partner is the key to improve the quality of the supply chain"	0,3176	1				
Q8_3 "My organization's culture encourage me to share knowledge with supply chain partner	0,3794	0,7322	1			
Q8_4 "I am willing to share knowledge with supply chain partner"	0,2720	0,7321	0,8650	1		
Q8_5 " I use ICT device(s) (personal computer, laptop, mobile phone, internet, etc.) at work"	-0,056	0,506	0,6054	0,6848	1	
Q8_6 "The use of ICT is very helpful for the current knowledge sharing at work"	0,2139	0,6571	0,4950	0,6545	0,5764	1

2. Result of multivariate tests for "knowledge sharing practice" and "awareness of ICT"

Multivariate Tests[a]						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.975	256.733[b]	5.000	33.000	.000
	Wilks' Lambda	.025	256.733[b]	5.000	33.000	.000
	Hotelling's Trace	38.899	256.733[b]	5.000	33.000	.000
	Roy's Largest Root	38.899	256.733[b]	5.000	33.000	.000

Country	Pillai's Trace	.274	1.079	10.000	68.000	.390
	Wilks' Lambda	.742	1.062[b]	10.000	66.000	.404
	Hotelling's Trace	.326	1.043	10.000	64.000	.419
	Roy's Largest Root	.234	1.591[c]	5.000	34.000	.189
a. Design: Intercept + Country						
b. Exact statistic						
c. The statistic is an upper bound on F that yields a lower bound on the significance level.						

3. Result of descriptive statistics analysis for "knowledge sharing practice" and "awareness"

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I rely on real-time information for work	40	1	5	3.97	1.143
It is easy to adopt with new knowledge with the current knowledge sharing practice	40	1	5	3.50	1.198
Communication with supply chain partner is the key to improve the quality of the supply chain	40	1	5	4.55	.876
I use ICT device(s) (personal computer, laptop, mobile phone, internet, etc.) at work	40	1	5	4.40	1.128
The use of ICT is very helpful for the current knowledge sharing at work	40	1	5	4.48	1.062
My organization's culture encourage me to share knowledge with supply chain partner	40	2	5	4.13	.939
I am willing to share knowledge with supply chain partner	40	2	5	4.40	.900
Valid N (listwise)	40				

Appendix C

A correlation test was done in MS Excel to examine the interaction between questions. The result shows that Q18_3 'I do not know how to use an internet for work' and Q18_4 'I do not know how to use a mobile phone for work' are highly correlated (R=0.800). In order to avoid multi-collinearity, Q18_4 was removed from the list for the test between subjects-effect. Therefore, Q18_1, Q18_2, Q18_3, Q18_5, Q18_6, Q18_7, Q18_8, Q18_9, Q18_10, and Q18_11 went through a test between-subjects effect. The variables with low correlation coefficients (≤0.8) were used in the test between-subjects effect (one-way ANOVA). This test aims to see whether the factor "Indonesia", "Nepal", and "Philippines" were significantly different by testing the variability between two factors. In this case, the countries of respondents (Indonesia, Nepal, and China) and the eleven statements in the questionnaire related to "perceived challenges of ICT". If some variables were found to have high correlations, these variables then dropped to avoid multi-collinearity, which can reduce the power of one-way ANOVA test.

1. Result of pre-correlation test for "perceived challenges of ICT"

	Q18_1	*Q18_2*	*Q18_3*	*Q18_4*	*Q18_5*	*Q18_6*	*Q18_7*	*Q18_8*	*Q18_9*	*Q18_10*	*Q18_11*	*Q18_12*
Q18_1 "Internet cost is expensive in where I live"	1											
Q18_2 "I do not know how to use a computer for work"	0,16	1,00										
Q18_3 "I do not know how to use an internet for work"	0,04	0,50	1,00									
Q18_4 "I do not know how to use a mobile phone for work"	0,06	0,44	0,80	1,00								
Q18_5 The internet connectivity is unreliable in where I live"	0,02	0,01	-0,04	0,01	1,00							
Q18_6 "It is difficult to find internet access in where I live (e.g. at work, public places)"	0,10	0,25	0,37	0,47	0,53	1,00						
Q18_7 "The electricity supply is unreliable in where I live"	0,03	0,02	0,26	0,33	0,74	0,67	1,00					
Q18_8 "The internet speed is	0,09	0,13	0,37	0,42	0,46	0,64	0,67	1,00				

not stable in where I live"											
Q18_9 "I do not have a personal computer at home"	0,09	0,08	0,10	0,13	0,56	0,62	0,65	0,53	1,00		
Q18_10 "I cannot find internet provider in where I live"	0,09	0,10	0,15	0,23	0,05	0,02	-0,10	-0,05	0,03	1,00	
Q18_11 "There is no training to use advanced ICT devices such as GPS, drones, and/or special software for work"	0,12	0,45	0,31	0,41	0,25	0,50	0,27	0,39	0,32	0,24	1,00

2. Result of tests of between-subjects effects for "perceived challenges of ICT"

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Q18_1	5.700[a]	2	2.850	1.812	.178
	Q18_2	1.608[b]	2	.804	2.757	.077
	Q18_3	4.300[c]	2	2.150	3.172	.054
	Q18_5	8.808[d]	2	4.404	2.047	.143
	Q18_6	11.775[e]	2	5.888	3.847	.030
	Q18_7	21.433[f]	2	10.717	7.022	.003
	Q18_8	20.133[g]	2	10.067	7.181	.002
	Q18_9	32.558[h]	2	16.279	14.200	.000
	Q18_10	2.533[i]	2	1.267	1.033	.366
	Q18_11	3.600[j]	2	1.800	2.532	.093
Intercept	Q18_1	443.187	1	443.187	281.751	.000
	Q18_2	53.233	1	53.233	182.512	.000
	Q18_3	56.635	1	56.635	83.569	.000
	Q18_5	267.207	1	267.207	124.217	.000
	Q18_6	169.899	1	169.899	111.016	.000
	Q18_7	202.533	1	202.533	132.711	.000
	Q18_8	111.488	1	111.488	79.532	.000
	Q18_9	325.269	1	325.269	283.732	.000
	Q18_10	82.504	1	82.504	67.289	.000
	Q18_11	73.248	1	73.248	103.049	.000
Country	Q18_1	5.700	2	2.850	1.812	.178
	Q18_2	1.608	2	.804	2.757	.077
	Q18_3	4.300	2	2.150	3.172	.054
	Q18_5	8.808	2	4.404	2.047	.143
	Q18_6	11.775	2	5.888	3.847	.070
	Q18_7	21.433	2	10.717	7.022	.054
	Q18_8	20.133	2	10.067	7.181	.065
	Q18_9	32.558	2	16.279	14.200	.060
	Q18_10	2.533	2	1.267	1.033	.366
	Q18_11	3.600	2	1.800	2.532	.093
Error	Q18_1	58.200	37	1.573		
	Q18_2	10.792	37	.292		
	Q18_3	25.075	37	.678		

	Q18_5	79.592	37	2.151		
	Q18_6	56.625	37	1.530		
	Q18_7	56.467	37	1.526		
	Q18_8	51.867	37	1.402		
	Q18_9	42.417	37	1.146		
	Q18_10	45.367	37	1.226		
	Q18_11	26.300	37	.711		
Total	Q18_1	568.000	40			
	Q18_2	80.000	40			
	Q18_3	105.000	40			
	Q18_5	402.000	40			
	Q18_6	280.000	40			
	Q18_7	318.000	40			
	Q18_8	232.000	40			
	Q18_9	491.000	40			
	Q18_10	144.000	40			
	Q18_11	114.000	40			
Corrected Total	Q18_1	63.900	39			
	Q18_2	12.400	39			
	Q18_3	29.375	39			
	Q18_5	88.400	39			
	Q18_6	68.400	39			
	Q18_7	77.900	39			
	Q18_8	72.000	39			
	Q18_9	74.975	39			
	Q18_10	47.900	39			
	Q18_11	29.900	39			

a. R Squared = .089 (Adjusted R Squared = .040)
b. R Squared = .130 (Adjusted R Squared = .083)
c. R Squared = .146 (Adjusted R Squared = .100)
d. R Squared = .100 (Adjusted R Squared = .051)
e. R Squared = .172 (Adjusted R Squared = .127)
f. R Squared = .275 (Adjusted R Squared = .236)
g. R Squared = .280 (Adjusted R Squared = .241)
h. R Squared = .434 (Adjusted R Squared = .404)
i. R Squared = .053 (Adjusted R Squared = .002)
j. R Squared = .120 (Adjusted R Squared = .073)
k. R Squared = .331 (Adjusted R Squared = .295)

3. Result of descriptive statistics analysis for "perceived challenges of ICT"

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Internet cost is expensive in where I live	40	1	5	3.55	1.280
I do not know how to use a computer for work	40	1	3	1.30	.564
I do not know how to use an internet for work	40	1	4	1.38	.868
I do not know how to use a mobile phone for work	40	1	4	1.30	.758
The internet connectivity is unreliable in where I live	40	1	5	2.80	1.506

It is difficult to find internet access in where I live (e.g. at work, public places)	40	1	5	2.30	1.324
The electricity supply is unreliable in where I live	40	1	5	2.00	1.359
The internet speed is not stable in where I live	40	1	5	3.23	1.387
I do not have a personal computer at home	40	1	5	1.55	1.108
I cannot find internet provider in where I live	40	1	4	1.45	.876
There is no training to use advanced ICT devices such as GPS, drones, and/or special software for work	40	1	5	3.15	1.578
Valid N (listwise)	40				

Appendix D

The non-parametric test was chosen because the distribution of data did not satisfy the statistical assumption for ANOVA. The quantitative study regarding "future opportunities of ICT" was analyzed using the non-parametric test (Kruskal-Wallis test). The Kruskal-Wallis test statistics showed that the null hypothesis was not rejected since the p-value was above 0.05.

1. Result of non-parametric test for "future opportunities of ICT"

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The medians of Q19_1 are the same across categories of Country.	Independent-Samples Median Test	.337	Retain the null hypothesis.
2	The distribution of Q19_1 is the same across categories of Country.	Independent-Samples Kruskal-Wallis Test	.211	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

2. Result of descriptive statistics analysis for "future opportunities of ICT"

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Access to internet is very useful for my work in the future	40	1	5	4.28	1.450
Mobile phone is very useful for my work in the future	40	1	5	4.25	1.391
The development of mobile phone applications is very useful for my work	40	1	5	4.23	1.368
The development of computer software is very useful for my work	40	1	5	4.20	1.418
The development of internet is very useful for my work	40	1	5	4.23	1.476
Valid N (listwise)	40				