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1. INTRODUCTION

Agriculture sector is not very popular among youth although it accounts for roughly one-third of global gross-domestic product (World Bank, 2008) which means it has a lot of potentials to be discovered for poverty eradication. 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 agriculture as 'dirty laboring work' and low-income career (Lohento & Ajilore, 2015).

It created a situation where the number of farmers is declining while the average age of people working in agriculture slowly climbs up. On the other hand, the number of world population keeps on growing and therefore the global economy should be able to make sure that in 2050, a projected of 9.3 billion people can have a decent living. Next to the age demographics concern, a heap of challenges in the agriculture sector such as climate change, policy, and low technology support for smallholder farmers would make it difficult to achieve food sufficiency in the near future.

To bridge this gap, information and communication technologies (ICTs) can play a role, for example by increasing the 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 (Lohento & Ajilore, 2015). However, most of the current farmers are not familiar with the usage of ICT to connect them with the information they need.

Youth, on the other hand, can potentially tap into this niche market and create opportunities through ICTs. Roughly 80 per cent of the youth population in 104 countries are active internet users (ITU, 2017). These young people play various roles along the agrifood supply chain, hereinafter referred to as young professionals. That being said, young people have the potential to get 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 farmers. Within the framework of this research, we use several empirical case studies to identify the current and best practices for young professionals in agricultural development through the utilization of ICTs.

2. YOUTH IN AGRICULTURE

In most developing and emerging economy regions, youth make up about twenty per cent of the total population. In 2010, more than 85 per cent of youth in developing and emerging countries represented more than half of the youth all over the world (Proctor & Lucchesi, 2012). Thus, youth should stand in the center of development. However, a growing disinterest of youth to engage in agriculture, which is one of the vital sectors in development, is becoming a major concern.

Young people today tend to look for a career in urban areas rather than in the agrifood sector. For most of them, agriculture is perceived as an unattractive field with a low-income career. This is due to the fact that small-scale farmers are often left with lacks of support to grow, either in technology, policy, or financing (Lohento & Ajilore, 2015). This condition encourages young people to migrate to urban areas in the hope of having a decent earning and wider career options.

Agriculture is indeed a very fragmented industry. However, it has a broad range of distinct occupations (farmers, processors, marketers and distributors) that young people can seize. In many cases, agriculture relies on inputs from various sources, often in a specific geographical area that is able to enhance the local economy. Particularly in agribusiness, an increasing number of companies in the area of processed foods, beverages, nutrition, and the plantation sectors boosts the absorption of labors with various background and skills requirement (Puri, 2012). Important to note that albeit the plethora of opportunities in agriculture, it appears that the labor markets have been polarized where the demand for high-skilled workers has risen (Michaels, Natraj, & Van Reenen, 2014). Over the past couple of decades, the demand for unskilled workers is having a decline and thus raising the unemployment rates (Wood, 1995). Therefore, supplying a well-trained workforce along the agrifood supply chain should be the current priority (Conroy, 2000).

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3. APPLICATIONS OF ICT IN AGRICULTURE

In the globalization era, ICTs are complementary with human capital, and rapid falls in quality-adjusted ICT prices have therefore increase skill demand (Michaels et al., 2014). ICT growth may have primarily increased the demand for highly educated workers. ICT, on the other hand, is essential to enhance agricultural practice and improve the current information service relative to providing the user's information needs (Lesaoana-Tshabalala, 2001). To attract youth to get involved in agriculture, we need to make the agricultural profession ICT-based and a knowledge-intensive sector. The youth need to see that agriculture is being transformed through modern ICTs (Mammo, 2015).

Delivering relevant information to farmers has been long identified as one of the keys to enhance farmers' and agricultural workers' livelihoods. This extension service is defined by Gebremedhin, Hoekstra and Tegegne (2006) as:

A service of information, knowledge and skill development to enhance adoption of improved agricultural technologies and facilitation of linkages with other institutional support

services (input supply, output marketing and credit).

However, the current world-wide practice of extension service is valued as less efficient and effective. For example, by sending out extension personnel which only focus on a more centralized, hierarchical and top-down management system. In fact, a bottom-up approach is needed in the conventional extension process to create a visible impact in the developing world (ICRISAT, 2007). Other constraints in this practice are found, namely credit and input supply services availability, appropriate technology, lack of political commitment, high costs, and the problem of scale (Gebremedhin, Hoekstra, & Tegegne, 2006; Aker, 2010).

The potential of ICT to connect farmers with the information 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 information. (Bell, 2015; Lohento & Ajilore, 2015). This is supported by the increasing mobile phone coverage and mobile broadband subscriptions in Africa, Asia and Latin America (Figure 1 & Figure 2).

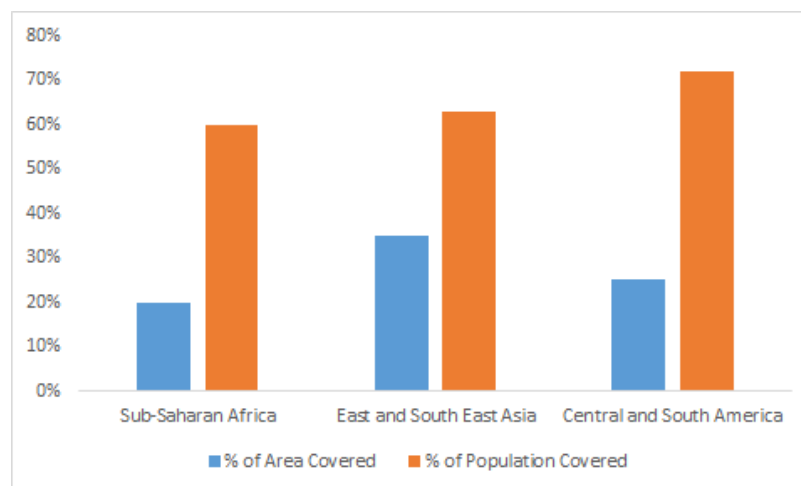


Figure 1. Area and Population with Mobile Phone Coverage in 2009, by region (Aker, 2010)

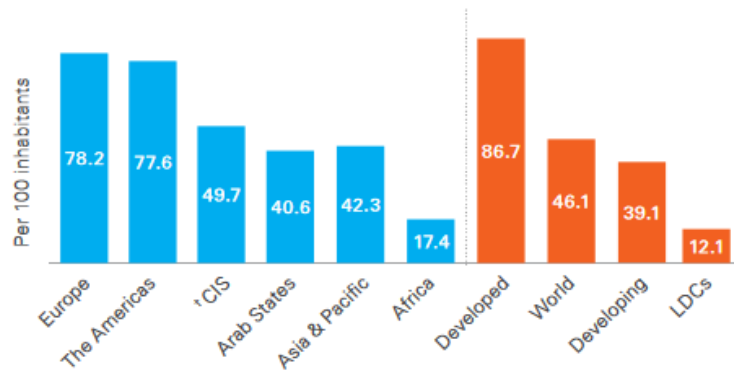


Figure 2. Mobile Broadband Subscriptions in 2015 (ITU, 2015)

ICT enables a reliable and rapid access to information support from experts which is important to foster the adaptation of strategies and knowledge on a large scale. We have seen the success stories of ICT for agricultural development through various case studies. For example, Ali and Kumar (2011) encountered the improvement of decision-making capabilities of Indian farmers along the supply chain due to a better delivery of information and service. A study by Lio and Liu (2006) also suggests that in 81 countries over the period from 1995 to 2000, ICT positively affected the agricultural productivity through effective market information and therefore increasing the bargaining power of farmers.

Our study aims to understand the utilization of ICT by young professionals to extend knowledge and information to stakeholders at various stages of the supply chain. Therefore, ICT uses in the supply chain is discussed in relation to four determined aspects according to Lohento and Ajilore (2015): 1) input supply and production; 2) post-production; 3) marketing and trade; and 4) access to financing that supports supply chain activities.

3.1 Supply & Productions

ICT adoption is able to promote agricultural productivity through an appropriate and effective production planning. This includes the efficient use of key resources such as water, fertilizers, and land, managing farm activities from selecting the crops to monitoring production, getting new information on the weather forecasts and market prices without having the presence of extension agency, finding out suitable locations and prices of supporting input tools such as seed and fertilizers (Lohento & Ajilore, 2015).

For example, the Ministry of Water Resources and Irrigation in Egypt has been implementing an Integrated Water Resource Management Action Plan. This ICT tool aims to improve the management of irrigation and drainage and to increase the efficiency of

irrigated agriculture water use and services. Through this project, Egypt is able to increase 20 per cents of yield production and can even re-use the drainage water (eTransform Africa, 2012).

A similar thing has also been done by a group of students from Indonesia where they created a technology to automatically irrigate and fertilize a land which can be controlled by SMS or mobile web, namely *SIRAMIN*. An additional feature of this technology lies in its ability to notify users when the land needs to be irrigated. Farmers are then able to produce high-quality products and boost the yields (SIRAMIN, 2017).

3.2 Post-Production

In the post-production phase, farmers are challenged with post-harvest problems such as contamination, handling of perishable products, or nutrient losses. These constraints would lower the value of a product and therefore give a disadvantage both to farmers and consumers. In this stage, ICTs can play an important role in product identification and differentiation, smart packaging for appeal, and labelling and traceability to increase quality and safety. ICTs have also helped to prevent products deterioration through proper storage in a systemized warehouse, in which ICTs is used to manage products and inventories, record movements, handle grading and sorting, and to develop consistent valuation methods for the products (Lohento & Ajilore, 2015).

3.3 Marketing & Trading

ICTs are widely used especially for marketing where farmers are able to gain access to markets, bargain and conduct transactions, send and receive money, improve marketing logistics and reduce transportation costs. It also allows farmers to sell the product in larger volumes by the aggregation of produce with other farmers and hence increase

collective and individual profits (Lohento & Ajilore, 2015).

A group of young people in Indonesia saw an opportunity to utilize ICT to connect farmers directly with consumers, cutting the long-existence of middlemen who often inflict a financial loss to small farmers. In their research, there is 80 per cents price gap between the buying price from farmers and selling price to end-consumers. The gap was caused by the presence of middlemen in the supply chain who have higher capacity in the market and thus able to control the price. These young entrepreneurs created a platform where consumers can still buy crops in a relatively small amount, with a reasonable price. Farmers, on the other hand, can still enjoy a relatively high and stable price and hence generates more income. It works by collecting orders from consumers through *Limakilo* mobile application, up to a certain amount and then sending the collected orders directly to farmers by cutting out middlemen.

Limakilo adapts an e-commerce technology for its business model, which enables purchasing, selling, and exchanging of goods and services activities over a computer network, such as the internet, where transactions or terms of sale are performed electronically (Limakilo, 2017; Zacharoula, Christiana, & Georgios, 2012). With this advantage, *Limakilo* is able to collect and deliver orders faster as a consequence of shorter supply chain and nevertheless, helping the government to control the market price of various commodities better.

3.4 Access to Finance

With ICTs, farmers nowadays can gradually improve their livelihood with better access to finance. Smallholder farmers, notably, benefited from ICT for example by the mobilization of credit through savings or credit societies, or by obtaining direct access to funding organizations and investors. On the other hand, the lending institution can access farmer's credit history through credit information sharing (CIS) in order to provide considerations to creditors in giving loans to farmers. In the case of agricultural insurance schemes, ICTs can make it less complicated to verify claims for weather-related losses (Lohento & Ajilore, 2015).

A great sample of financial access delivery to rural farmers using ICT is the platform *iGrow Asia*. *iGrow* helps the local farmer, idle lands, and investors in producing high-quality organic crops. To date, *iGrow* has been successfully employing more than 2200 farmers spread over 1197 hectares of lands in Indonesia and yielding more than 500 tons of high-quality ground nuts. Furthermore, *iGrow* has been the source of income to the farmers, landlords, and investors.

The platform connects farmers, landlords, investors, and buyers of agriculture products to work together in an integrated farming schemes. *iGrow* identifies which crops that are currently in high demand in the market, having a stable price and desirable characteristics. It works by connecting farmers with potential land and after that *iGrow* opens an investment opportunity to urban communities (iGrow, 2017).

3.5 Online Networks

Another use of ICT for agriculture is to provide a platform for actors in the agrifood supply chain to exchange minds and ideas with each other and to inspire people to get involved in the movement. Some youth platforms such as *Youth for Change* and *Young Professionals for Agricultural Development* (YPARD) are also able to facilitate young people to encourage an active participation of youth and showcase success stories in the network. For young professionals, the social networks can offer myriad of opportunities. It engages youth to be involved in agriculture in a way that they enjoy, as the United Nations acknowledges young people as savvy and creative users of ICT (UN, 2017).

4. CHALLENGES OF ICT IN AGRICULTURE

Back in the 19th and 20th centuries, as each successive wave of automation eliminated some jobs in some sectors and occupations, entrepreneurs saw these opportunities to redeploy labor and thus workers needed to learn necessary skills to survive in the labor markets. In the 21st century, technological change is even faster and more pervasive, replacing the tasks that previously had only been done by men (Brynjolfsson & McAfee, 2012).

The constraints do not stop there. Millions of people have then left agriculture and thus the age of farmers are aging. Even though we have discussed the benefits of ICT to modernize agriculture activities, still a number of challenges hold up the adoption of ICTs particularly in emerging countries. These challenges come from the technical adoption of ICTs and some specific constraints (Lohento & Ajilore, 2015).

The low willingness of the government to invest in ICTs has some negative impacts on the agriculture productivity. For most young professionals or other stakeholders, the ultimate barrier to ICTs adoption is associated with costs. Furthermore, a poor connectivity and unreliable internet and mobile network services hinder young people to optimize the use of ICTs for agriculture activities. Additionally, the low proficiency in digital literacy for most stakeholders in agriculture. 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

(Varallyai & 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).

5. FUTURE OPPORTUNITIES OF YOUTH

We have reviewed the benefits of ICTs to empower agriculture societies and challenges that may hinder the utilization of ICTs. ICTs is a powerful tool to bring sustainable development and eradicate poverty and socioeconomic inequalities (Varallyai & Herdon, 2013). Next comes the major questions, to what extent can youth participate in agriculture development using ICTs? 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 ICTs in the chain. This makes ICT to play a vital role in the growth and generating job opportunities and/or growing a numerous e-entrepreneurs (Aliu & Halili, 2013).

A strong background to encourage youth in boosting agricultural productivity is the lack of progress in creating, disseminating and using ICT (Varallyai & Herdon, 2013). For instance, farmers have usually been 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. Thus, they were ideal candidates to be trained as IT facilitators (Global Knowledge Partnership, 2003).

Additionally, young people can also help farmers in creating an ICT application to improve profitability and efficiency, while reducing the costs. This smart farming system is called *big data* where it allows farmers to foresee insights in farming operations, drive real-time operational decisions, and redesign a business model (Wolfert et al., 2017). Next to it, 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 at the online marketplace.

ICTs also provide room for youth to speak up their voice and bring on the table youth-specific issues. Young people nowadays are vastly under-represented in government, business, political, and social institutions. They are less interested in public affairs and therefore have limited capacity and knowledge in civic issues. ICT sector serves as one of the last platform 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 et al., 2008; Hafkin, 2002). For example, in YPARD community, members are able to launch a discussion or contribute to existing debates on a forum or create a

blog post to share any information and thoughts regarding agriculture (YPARD, 2017).

6. CONCLUSION

ICTs keep a plethora of opportunities in agricultural development, food security, and rural development. In the agri-food supply chain, ICTs can potentially modernize the agriculture activities from farm to fork. Notably, for farmers, ICTs can manage the key resources and help in the production planning efficiently and effectively. In regards to financial aspects, ICTs open up a modern way for farmers to get in touch directly with customers and therefore generate more income to the farmers. The communication flow in ICTs allows farmers to access financing from investors and interacting with experts and peers and hence increase the agriculture productivity.

Realizing that the age of farmers is aging, youth have to be implicated because they are those who will lead the world tomorrow and ICTs is an essential key. To build a strong youth in ICTs community and reducing the digital gap, special attention must be paid to the investment and supporting policies of ICT in rural areas. The future of this digital revolution is endless for youth to stop the rot of unemployment and keep agriculture alive. Engaging young people can start by allowing these creative and avid ICT users to disseminate information and exploring the digital world as e-entrepreneurs to address essential problems in the agrifood supply chain. Increasing the capabilities of youth and providing sufficient infrastructure are important to optimize ICTs in boosting agricultural productivity.

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