CHAPTER 2
LITERATURE REVIEW

The following literature review will provide a detailed overview of the agricultural development over the last decades and the changes in the agricultural extension system. Thereby the focus will be on the Asia-Pacific region and Thailand in particular. The second part of the literature review will focus on the use of information and communication technologies in agriculture, covering various aspects, and will provide an overview of the current state of the research concerning the perceived and real impact of such methods.

2.1 Agricultural Development and Extension

Over the last decade, agricultural has again received more attention from governments and international organisations. According to Dethier and Effenberger (2012) and Patkar et al. (2012) the reason for this new interest in agriculture on an international level are most recently two severe food crisis which highlighted the fragility of the agricultural system and the dependence of some countries on agriculture as well as the publication of two major reports. The World Development Report of 2008 "Agriculture for Development" (The World Bank, 2008) and the report "Agriculture at a Crossroads" (International Assessment of Agricultural Knowledge, Science and Technology for Development, 2009), developed by scientists, decision makers and donor agencies, have shifted the focus back to agriculture by acknowledging the importance of the sector for developing countries and poverty alleviation. Thereby both highlight the dependency of a vast number of people on agriculture, often managing a small size of land, while discussing past trends and future challenges such as climate change and declining natural resources but also possibilities for further development (International Assessment of Agricultural Knowledge, Science and Technology for Development, 2009; The World Bank, 2008).

The current academic and political discussion about declining natural resources and a growing population is not new and has been around for decades. One of the most cited and known reports in this context is "The limits of growth" published by Meadows (1974). Almost two hundred years earlier Malthus (1798) had a similar approach

analysing exponential population growth and its adverse effect. According to him, the agricultural production cannot keep up with the population growth which at the end will result in food insecurity and hunger until a new balance is established. However, predictions and analysis for future scenarios often neglect or do not take into account the technological development as it is difficult to predict. One example is the "Green Revolution" which started in the 1960s and used newly developed high-yielding crop varieties in combination with chemical fertilisers and pesticides to significantly increase agricultural production. As a result of new technologies and inputs in agriculture, it was possible to achieve record harvests in certain countries resulting in almost a doubled food production in developing countries (Patel, 2013). However, the overall effect of the "Green Revolution" is still hotly debated. While one side highlights the improved production and decreased costs for food, other people argue that the development has been unsocial with a significant amount of farmers not able to participate due to financial constraints (Patel, 2013). Furthermore, the impact on the environment has been criticised widely. The modernization or development of the agricultural sector is still often linked with a simplification of agroecosystems, excessive use of irrigation systems and synthetic agricultural inputs as well as improved crop varieties and mechanisation (Riwthong et al., 2015, p. 11). Thereby, this development is often unsustainable and excludes small-scale farmers.

In Thailand, the "Green Revolution" and its technologies were promoted in the 1970s with increasing availability in the 1980s. As a result rice production increased from 2.8 tonnes per hector to 3.8 tonnes due to heavy use of synthetic inputs and new varieties (Amekawa, 2016, pp. 1–2). Along with the introduction of new technologies, the Thai farming sector experienced intensification and stronger market orientation (Aditto, 2011, pp. 18–20). Deforestation and other environmental damages were among the consequences. Shortly after the years of growth, declining world market prices as well as international protection policies lowered Thailand's competitiveness and agricultural production (Aditto, 2011, pp. 18–20). However, during the Asian financial crisis, the agricultural sector has proven to be the backbone of the economy as it suffered the least and people returned to agricultural after losing their jobs (Lauridsen, 1998, p. 1587). Following Thaiprasert (2006), Aditto (2011) argues that agriculture in Thailand shows two different characters. On the one hand it provides food security for Thais and the

world, on the other hand, it is confronted with numerous problems, including low productivity, low incomes and a lack of financial assistance (Aditto, 2011). Currently, a majority of Thai farmers are facing severe problems, some of them still related to the "Green Revolution", but also due to a lack of investment over years and misguided or missing policies. Similar problems can be found in other developing and emerging economies. One of the biggest problems, persistent in Thailand for decades, is the overuse of chemical fertilisers and pesticides and their impact on the environment as well as on farmers' and consumers' health (Praneetvatakul, Schreinemachers, Pananurak, & Tipraqsa, 2013; Riwthong et al., 2015; Schreinemachers, Sringarm, & Sirijinda, 2011). From 1997 till 2007 the farmers at high risk from agricultural chemicals increased from 16 percent to 38.5 (National Economic and Social Development Board, 2012, p. 60). Besides the environmental and health impact, the overuse of such agricultural inputs also increases the cost of production. Furthermore, the agricultural sector, although safe heaven in times of crisis, is threatened by an ageing society and a shift of the workforce to the industrial as well as the service sector, particularly in the urban areas (National Economic and Social Development Board, 2012, p. 60). Such a development can be observed in many other developing and emerging countries mainly in Asia and Africa.

Therefore, most recently, in one line with the new interest in agriculture, there are again calls for an agricultural revolution, however, under different conditions. Nowadays, international, governmental as well as non-governmental organisations are calling for a more sustainable and inclusive transformation of the sector. One key aspect in this context are small-scale farmers, who are seen as crucial for food security and poverty alleviation (Amekawa, 2016; Duncombe, 2012; Ferris et al., 2014; Food and Agriculture Organization of the United Nations, 2016; Patkar et al., 2012). In Africa and Asia alone small-scale farmers, with land below 10 hectares, are responsible for 80 percent of the food production and essential for food security and income generation (Food and Agriculture Organization of the United Nations, 2013). Agriculture thereby is seen as one of the most promising approaches to reduce poverty as it is four times more efficient in income generation compared to other sectors (Ferris et al., 2014, p. 2). Furthermore, new approaches promote organic agriculture or more sustainable forms of farming, including a reduction of the use of synthetic pesticides and fertilisers, as a solution for agricultural development, protecting and preserving natural resources. As a result, new cultivation

practices have been developed and adopted to certain climate conditions. Alternatives are advertised to replace chemicals used in agriculture, and a stronger market orientation of small-scale farmers is promoted, including access to international markets.

A major contribution to the development of farming in the past has been made by agricultural extension, and it will be of importance in the future. The roots of agricultural extension can be traced back to the United Kingdom in the mid of the 19th century, although agricultural advice has been provided to farmers before (Swanson, 1997). Historically, agricultural extension was provided by universities and other educational facilities directly to farmers and has been later adopted and organised by governments and their related ministries (Swanson, 1997). Since the first appearance the concepts, approaches, goals as well as definitions of the agricultural extension have changed and been further developed.

There is no overall definition but a development over time providing different views of agricultural extension. Most recently Christoplos (2010) defined extension as:

"systems that facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices" (Christoplos, 2010; Natural Resources Institute, 2011).

This definition includes most of of the current perspectives regarding the potential and impact of agricultural extension.

However, the traditional approach, mainly used in developing countries, has been based on a different idea. The concept of training and visits (T&V) was established to promote the dissemination and adoption of new technologies by farmers. This approach was dominating agricultural extension services during the "Green Revolution" with a focus on newly developed agricultural inputs (The World Bank, 2010, p. 2). It was constructed as a top-down teaching system where universities and government agencies visited farms and farmers to show them new achievements and train them (see Figure 4). This extension system later failed in numerous countries as it was cost, time and resource intensive. At the end, underfunded and understaffed systems could not provide an adequate service to the farmer anymore.

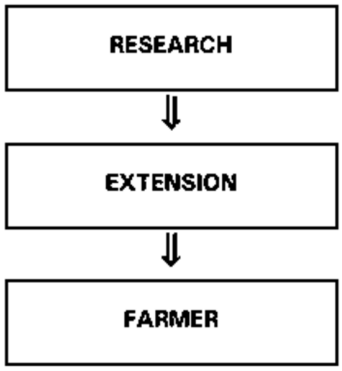

Figure 4 Top-Down Technology Transfer Model

Source: Asopa & Beye, 1997

As a result, various new concepts have been developed following newly defined goals. Over time the top-down extension approaches were converted into a bottom-up system building on the participation of farmers and communities (Qamar, 2006, p. 25; The World Bank, 2010, p. 3). New extension systems are not simply promoting and disseminating new agricultural technologies, but also train farmers on other levels, including sustainable production, agro-ecological system interactions, and marketing or human capacity development (Swanson, 1997). New agricultural extension approaches are thereby in one line with the general shift in agricultural development and the international agenda regarding the future of agriculture. The new methods have been implemented in numerous countries for more than two decades, while other countries are still in the initial state. One of the major changes in the bottom-up system compared to the top-down approach is that it is demand- and not supply-driven (Qamar, 2006, p. 31). Without assessing the environmental circumstances and personal preferences of the farmers, it is not possible to provide them with adequate information and knowledge. Decades of experience and research in the field of agricultural development have shown that it is a crucial part of the planning and designing of agricultural interventions to involve farmers in the process to address their needs (The World Bank Group, 2011, p. 10). As a result, research has focused on identifying the problems and needs of farmers using a participatory approach building on the knowledge of local farmers. Although the number of cross-country analysis are limited, Mittal and Mehar (2014) identified three main categories of information farmers need regardless of their location and commodity:

a) Know-how, which helps a farmer with fundamental information such as what to plant and which seed varieties to use;

b) Contextual information such as weather, best practice for cultivation in the locality; and

c) Market information such as prices, demand indicators, and logistical information.

(Mittal & Mehar, 2014, p. 199)

A more detailed and differentiated view is given by Lokanathan and Kapugama (2012) for the case of Sri Lanka where information on fertilisers, market prices and pesticides are the most important for the farmer. However, they also highlight that the demand for information or new knowledge heavily depends on the stage of the cropping cycle (see Figure 5). In this research both show that, in the case of Sri Lanka, agricultural extension is ranking low when farmers were asked about their source of information (Lokanathan & Kapugama, 2012)

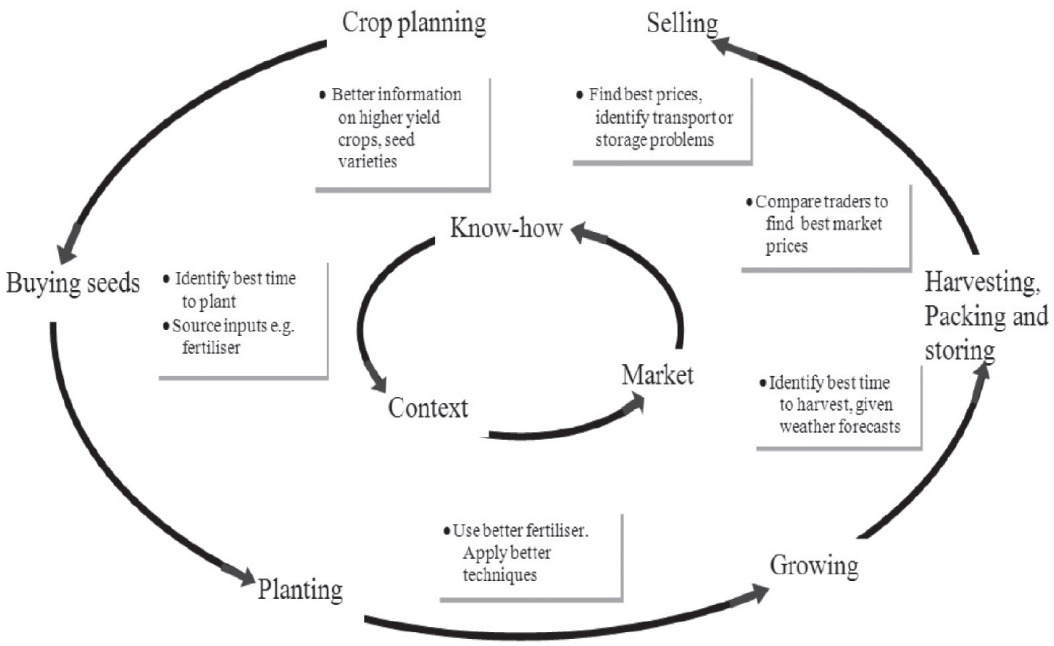

Figure 5 Information Needs of Farmers in the Agricultural Cycle

Source: Mittal, Gandi, & Tripathi, 2010

In the case of Thailand, Euajarusphan (2015) identified that the top three information needs for urban farmers in the Bangkok Metropolitan area are farming techniques, pesticides and pest management, while marketing and agricultural processing are the least important. There is a broad range of issues agricultural extension has to address, in particular, to support small-scale farmers. Jongsakul (2015) highlights thereby the importance of access to market information and knowledge, international standards or certification systems on a local level. Furthermore, it is important using local wisdom and modern technology to make Thai agriculture more sustainable.

However, for small-scale farmers, not only in Thailand, the acquisition of relevant information is still often a significant problem as either there is no possibility to gain such information or the collection is related to costs the farmer cannot bear. Extension services often cannot help the farmer to overcome those barriers due to cost, time or capacity restrictions. In some countries extension officers are responsible for 1500 to 3000 farmer exceeding the recommended number of 1:400 by far (Batchelor, Scott, Manfre, Valverde Lopez, & Edwards, 2014, p. 273). As a result, there is often an information asymmetry between the stakeholders involved in the agricultural value chain. According to Baumüller (2015), this asymmetry can lead to a lower productivity of farmers. Following several other studies Ali and Kumar (2011) add that information and knowledge are necessary to adopt improved and efficient agricultural as well as post-harvest practices in addition to appropriate marketing strategies. In particular, the access to markets and market information is highly discussed. An active role of farmers in the value chain is seen as crucial for the improvement of their livelihood situation and the development of the agricultural sector b9

In general, farming was never so time-critical and knowledge-intense as today (Brugger, 2011, p. 4). As a result, information asymmetries and knowledge deficits emerged along the agricultural value chain and between the stakeholders involved, which often cannot be compensated by agricultural extension. Therefore new concepts, approaches and technologies are required to overcome the information asymmetry and to disseminate knowledge among the stakeholders.

2.2 Information and Communication Technologies and Agricultural Extension

One concept to reach more farmers and provide them with on-time information and knowledge, tailored to their needs, is the use of information and communication technologies. Information and Communication Technology is a term which is used widely nowadays, across all sectors. According to the comprehensive guide on "ICT in Agriculture" published by the World Bank Group in 2011, ICT can be defined as: *"[...] any device, tool, or application that permits the exchange or collection of data through interaction or transmission. ICT is an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers." (The World Bank Group, 2011, p. 3)*

In more detail the term is explained by Asenso-Okyere and Mekonnen (2012):

"Information and communication technologies (ICTs) generally refer to an expanding assembly of technologies that are used to handle information and aid communication. These include hardware, software, media for collection, storage, processing, transmission and presentation of information in any format (i.e., voice, data, text and image), computers, the Internet, CD-ROMs, email, telephone, radio, television, video, digital cameras etc. The advent of personal computers, the Internet and mobile telephone during the last two decades has provided a much wider choice in collection, storage, processing, transmission and presentation of information in multiple formats to meet the diverse requirement and skills of people" (Asenso-Okyere & Mekonnen, 2012).

The opportunities offered by these new technologies and their dissemination have also been recognised by the United Nations and its International Telecommunication Union. During the World Summit on the Information Society (WSIS) 2003 in Geneva and 2005 in Tunis representatives discussed and acknowledged the potential provided by ICTs across all sectors, including agriculture (2005a, 2005b, 2003b; United Nations, 2003a). As one of the main contributors, the Food and Agriculture Organization of the United Nations (FAO) highlighted the need to bridge the rural digital divide to provide agricultural workers with the access to information and knowledge (Food and Agriculture Organization of the United Nations, 2005). In the context of FAO's strategy towards the WSIS 2005, it also emphasises existing challenges and warns of emerging problems, such as a possible increase in gender inequality, and seeing ICT as a panacea (Food and

Agriculture Organization of the United Nations, 2005). The potential use of ICTs in agriculture, discussed during the WSIS in 2003 and 2005, resulted in the new term "e-agriculture" which is defined as:

" […] an emerging field in the intersection of agricultural informatics, agricultural development and business, referring to agricultural services and information delivered or enhanced through the Internet and related technologies. More specifically, it involves the conceptualization, design, development, evaluation and application of new ways to use existing or emerging information and communication technologies (ICTs).

E-Agriculture goes beyond technology, to promote the integration of technology with multimedia, knowledge and culture, with an aim to improve agricultural activities locally, regionally and worldwide. Facilitation, support of standards and norms, technical support, capacity building, education, and extension are all key components to e-Agriculture" (Food and Agriculture Organization of the United Nations, 2005).

The World Summit on the Information Society can be seen as the starting point for the growing interest in the use of ICT in agriculture and development. Since 2003 there has been an increasing number of research projects and publications focusing on information and communication technologies and their potential impact on agriculture (Duncombe, 2012).

However, there have been studies before. A comprehensive literature review by Adeya (2003) summarises the existing research on ICT, with a focus on poverty, before the WSIS in 2003. In the chapter on ICT in agriculture, Adeya highlights first projects and studies conducted in Asia, particularly India, and Africa with a focus on farmer's information needs in connection with the role of rural female farmers. The review examines the early stage of research and highlights possibilities and challenges for ICT in the sectors of agriculture, culture, education, governance, health and gender.

Duncombe (2012) provides another literature review which analyses the use of mobile phones in the agricultural sector and rural development in more detail. The review shows that the rapid technological development together with the global dissemination of cell phones has led to an increase of interest in the field of mobile phones in agriculture and rural development. The majority of the studies considered in his paper are located in South Asia (e.g. India, Sri Lanka) and Africa (e.g. Ghana, Kenya, and Uganda). This is

in one line with the areas of research identified in Adeya's review on ICT in 2003. Duncombe furthermore distinguishes between the focus of each study and the methods used for analyzation. Most of the studies follow a mixed method approach to analyse the needs for ICT, the adoption of mobile phones and to assess the output. The evaluation of the impact of cell phones, however, is dominated by quantitative methods (Duncombe, 2012).

Another comprehensive overview regarding the opportunities and challenges of ICT in agriculture is provided by The World Bank Group (2011). In the e-sourcebook "ICT in Agriculture. Connecting Smallholders to Knowledge, Networks and Institutions" the authors are focusing on the different impacts of ICT in the agricultural sector, such as impacts on productivity and efficiency. Additionally the report focus on the opportunities created by ICT, including gender equity.

ICT can have an impact on almost every part of agricultural activities from providing advice for the most suitable crops and cultivation methods up to the access to market information and platforms. Therefore, De Silva and Ratnadiwakara (2008) grouped the farm related processes into six stages.

In their paper Silva and Ratnadiwakara highlight that all stages of the simplified value chain are linked with information search costs, particularly high in the decision and growing stage (see Figure 6).

Figure 6 Information Search Costs by Stage

Source: De Silva and Ratnadiwakara (2008)

The reduction of transaction cost is, according to Qiang, Kuek, Dymond, and Esselaar (2011), one of the biggest impacts mobile phones can have. Qiang et al. highlight the possibilities farmers could have through mobile devices, such as better access to information or extension service, and also show the impacts on farmers, including higher income as well as lower transaction costs (see Figure 7). A total number of 92 applications for agriculture and rural development are summarised by Qiang et. al. with numerous projects having a significant impact on income, yield, efficiency and access to finance.

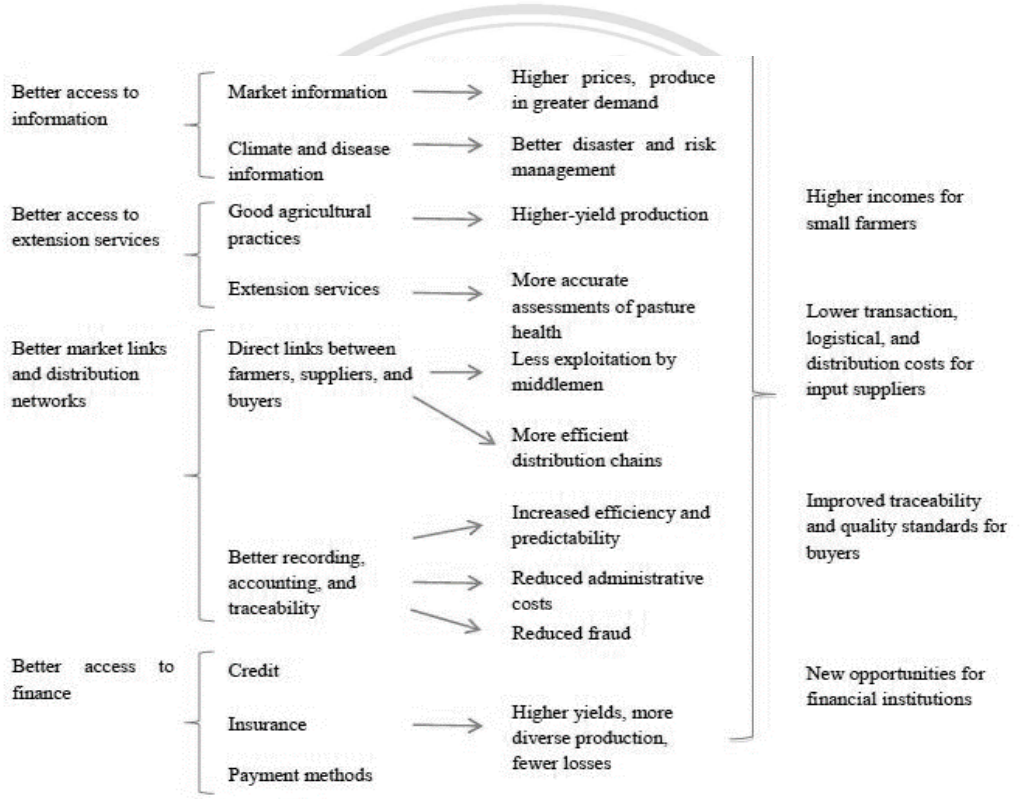

Figure 7 Potential Impacts of Mobile Phones

Source: (Qiang et al., 2011, p. 17)

Okello, Kirui, Gitonga, Njiraini, and Nzuma (2014) compared the benefits of ICTs over the traditional agricultural information transfer in more detail, identifying four major aspects in which ICTs offer a cheaper and better way:

i) communicating knowledge and information to rural farmers

ii) delivering education and training modules to farmers

iii) improving smallholder farmers' access to markets and agricultural credit

iv) empowering farmers to negotiate better prices, and

v) facilitating and strengthening networking among smallholder farmers. (Okello et al., 2014, p. 264)

Most of the current research focuses thereby on the use of ICTs, particularly mobile phones, for market access and price information.

Among the most cited publications regarding the impact of cell phones are Aker (2008) and her study of the grain market in Niger and Jensen (2007) and his study on fishers in Kerala, South India. Aker (2008) found out that an increase in mobile coverage has a positive effect on grain traders and consumer, however, has no significant effect on farmers. Jensen (2007) on the other side analysed how the introduction of mobile phones among fishers in the area can reduce price volatility and leads to a higher price for fishers (see Figure 8). Furthermore, according to him, mobile phones can have a significant positive impact on the reduction of product losses.

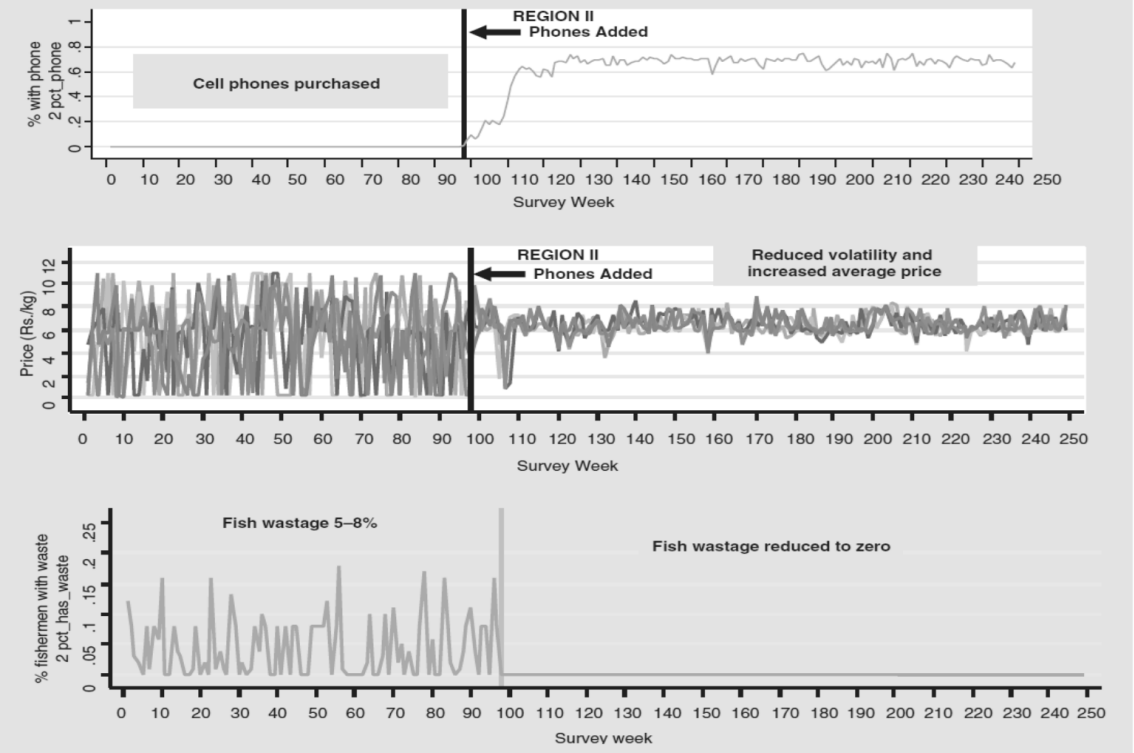

Figure 8 Cell Phone Impact on Fishers in Kerala (SW India)

Source: The World Bank Group, 2011: 54 based on Jensen, 2007

According to the World Development Report 2016, similar effects have been identified for ICT projects in Ghana, Peru, Niger and the Philippines (The World Bank Group, 2016b, p. 91). Another study from India, conducted by Raj (2013), found out that farmers adopted more sustainable practices while raising their income and saving time and input costs through ICT solutions (Raj, 2013, pp. 125–127). Several other studies in India have shown similar impacts on the adoption of agricultural practices or the income of farmers and have proven that information and communication technologies are more efficient than traditional extension (Raj, 2013, pp. 115–116).

Most of the current research results are derived from India or certain Africa countries. The reasons for this focus are the strong agricultural sector in the countries and a large number of small-scale farmers. On their website the GSM Association (GSMA) tracks implemented mobile projects in several sectors of developing countries, including agriculture. According to the GSMA, the top three countries with the most ICT projects in agricultural are India (25), Kenya (18) and Ghana (8) with several million users (see Figure 8).

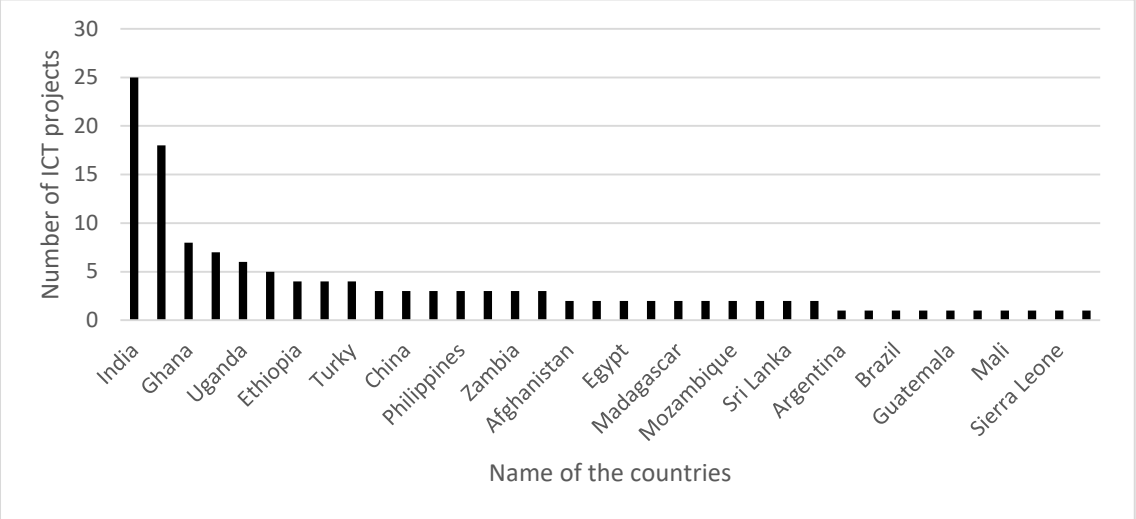

Figure 9 Number of ICT Projects in Agriculture by Country

Source: Own illustration based on GSMA, 2016

One of the most cited and successful project, regarding the number of users, is e-Choupal from India with over four million users (Shoham, 2016, p. 5).

Compared to India, Thailand is still among the early adopters of ICTs in agriculture. According to the tracking software of GSMA, Thailand has currently only two projects using mobiles in the agricultural sector. One project called Farmforce supported by the Syngenta Foundation for Sustainable Agriculture and the SMS-service provided by dtac and Rak Ban Kerd Foundation. Another project which is not listed by GSMA is a GAP certification scheme optimised for mobile devices and computers which shall enable farmers to adopt certifications more easily and help to track the progress (Food and Agriculture Organization of the United Nations, 2015). Of those three projects, the services under the "Smart Farmer" project of dtac, in cooperation with Rak Ban Kerd Foundation, are the furthest developed and promoted the most, while the others are still in their pilot stage. Most recently a new project has been proposed using information kiosks to provide rice farmers in Thailand with information and connect them with governmental institutions (Sangbuapuan & Guha, 2015). However, information kiosks are an instrument which has been used before in other countries but has been replaced mostly through the adoption of mobile devices by farmers.

Most of the current research on ICT focuses on the use of cell phones for communication purposes such as phone calls and text messages. However, recent developments in the ICT sector offer new opportunities in the use of mobile phones. The introduction of smartphones one decade ago enabled users to access information through video, audio and text messages. The combination of new designs for information dissemination together with mobile broadband and a user-friendly interface can thereby have a significant impact on the farmer. Therefore, companies, organisations and individuals are developing a variety of smartphone applications to help farmers in all six stages of the value chain (Hoffmann et al., 2014).

However, the literature on smartphones in agriculture is still limited. Most of the literature still focuses on the adoption of the technology and less on its impact. An introduction to existing applications is provided by Kern (2015). The general impact of smartphones and mobile broadband on society and the economy was highlighted by Hartje and Hübler (2015), GSMA (2015) and Sarwar and Soomro (2013). According to them smartphones and mobile broadband can have a significant impact on household's income level as well as the overall economic development of a country.

The use of smartphones in agriculture so far has been mainly researched in industrialised nations, where the majority of people already have access to them. Dehnen-Schmutz, Foster, Owen, and Persello (2016) for example investigated the use of smartphones and applications in France and Britain, where a survey revealed that 84% used their smartphone for farm management on a daily base using four different application on average. Csótó (2015), on the contrary, showed that only 45% of the survey participants were using a smartphone in Hungary and that farming applicants were almost non-existing in the local language. Hoffmann et al. (2014) summarised in their paper the current state concerning smartphone applications for agricultural purposes and found out that there is so far a limited amount available, but it is consistently growing. Beside the research about potential impacts, a substantial amount of papers focuses primarily on the design and development of such technologies such as Patel, Thakkar, and Radadiya (2014), Gelogo, Kim, and Kim (2014), Murakami, Utomo, Hosono, Umezawa, and Osawa (2013) or Agrawal, Atray, and Sattiraju (2013).

In general, two approaches can be distinguished. First, in industrialised countries the use of modern ICTs, such as smartphones, the internet or drones, is rapidly spreading, mainly in the context of precision agriculture, using big data to optimise agriculture inputs and outputs. In developing and emerging economies on the other side basic ICTs, such as basic phones, televisions or radio are still dominating, although, smartphones are catching up. In those countries, ICTs are mainly used to disseminate knowledge and relevant information to the farmer to either improve his position in the agricultural value chain or his overall farming practices. Successful projects thereby have to follow three aspects of agricultural work as highlighted by Bell (2015):

1. Identifying farmers' problems and opportunities – What do they need and want?

2. Promoting behaviour change – What is practical and relevant to meet the needs?

3. Collect feedback – How can each step be improved? (Bell, 2015, pp. 5–6)

Although there have been several success cases on the implementation of information and communication technologies, such as described by Jensen (2007), the focus on ICTs in agriculture has also been criticised, and barriers of adoption were identified. Despite the fact that ICTs have spread rapidly and also reached disadvantaged groups, there are still 800 million people without access to mobiles and even 4.3 billion

without internet access often related to income, age, location and gender (The World Bank Group, 2016b, p. 104). To fully reap the benefits of ICT projects everyone, in particular people in the bottom 40 percent of the income distribution, needs to have access to mobile technologies and the internet. However, even people with access to those technologies face barriers participating in e-agricultural projects. According to Anoop, Ajjan, and Ashok (2015) technical and language skills were the most important barriers in their study, followed by the irrelevance of content, lack of reliability, lack of awareness and cost involved. Fiedling and Ninsiima (2012) point out that literacy and language are crucial facts for the adoption and success of those projects. Another success factor is the trust of the farmer in the service (Fiedling & Ninsiima, 2012, p. 2).

However, the biggest criticism regarding ICT projects, in general, is the sustainability of such. Although Bell (2015) acknowledges the potential impacts and benefits resulting from ICT projects in agriculture, he also mentions that numerous programs have shown limited benefit or have been terminated, often due to missing funding. Similar concerns are raised by Ferris (2012) who emphasizes that there are only a limited amount of standardized off-the-shelf products to support farmers and it is currently difficult to identify long-term success stories as "the development community is currently navigating through a somewhat chaotic period of ICT proliferation" (Ferris, 2012, p. 16). The lack of continuous funding of such interventions as well as missing cooperation on all levels is also highlighted by Shoham (2016). He points out that collecting information and knowledge for farmers is costly and only a small number of services is commercially oriented. Most of the projects provide the information for free resulting in unsustainable business practices and termination of the service once the funding has dried up. According to him, cooperations between governments, commercial or private providers and the farmers are needed to overcome this problem (Shoham, 2016, p. 2).

Concluding, the overall criticism aims on the fact that information and communication technologies should not be seen as a panacea itself but need to be backed up by investments in other sectors, such as infrastructure or education, and also have to address the needs of the farmers (The World Bank Group, 2016b, p. 92). ICT interventions should therefore not be technological-driven but demand-driven (The World Bank Group, 2011, p. 11).