INAUGURAL-DISSERTATION

Information And Communication Technology In Small- Scale Business Based Agricultural Value Chains In Sub-Saharan Africa

Examples from Kenyan and Tanzanian Horticulture

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List of Abbreviations and Acronyms

B2B	Business to business
BMBF	Bundesministeriums für Bildung und Forschung
CA	Communication Authority Kenya
CIA	Central Intelligence Agency
cf.	compare (confer)
DFG	Deutsche Forschungsgemeinschaft
DFID	Department for international Development
e.g.	For example (exempli gratia)
EASSy	Eastern Africa Submarine Cable System
EU	European Union
FAO	Food and Agriculture Organisation
FAOSTAT	Food and Agriculture Organization Statistics Division
FFV	Fruits and vegetables
GCC	Global Commodity Chain
GDP	Gross Domestic Product
GIZ	Gesellschaft für Internationale Zusammenarbeit
GlobalGAP	Global Good Agricultural Practice
GoK	Government of Kenya
GoT	Government of Tanzania
GPN	Global Production Network
GVC	Global Value Chain
HCD	Horticultural Crops Development Authority
HODECT	Horticultural Development Council of Tanzania
Ibid.	something that has been mentioned previously (idem)
ICT	Information and Communications Technology
ICT4D	ICT for Development
ITC	International Trade Centre
ITU	International Telecommunications Union
IXPs	Internet exchange points
Kshs	Kenyan Schilling (1€ = 116 Kshs)
MoA	Kenyan Ministry of Agriculture
NGOs	Non Governmental Organisations
NICTBB	National ICT Broadband Backbone
OECD	Organisation for Economic Co-operation and Development
PPP	Public Private Partnership
QMS	Quality Management System
RVC	Regional Value Chain
SAUT	Saint Augustine University
SIM	Subscriber Identity Module
SMS	Short Message Service
SMME	Small and medium enterprises
SSA	Sub Saharan Africa
TAHA	Tanzanian Horticultural Association
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development

"Technology is neither good nor bad; nor is it neutral."

Melvin Kranzberg, 1986

1 Introduction

In many countries in Sub-Saharan Africa, the agricultural sector plays a significant role in the national and particularly rural economy regarding workforce and income. Hereby, small-scale farmers[1] often form the base of agricultural production producing for local markets or for own consumption (cf. FAFCHAMPS/HILL 2005; ORTMANN/KING 2010). Due to ongoing liberalisation and globalisation processes over the past three decades, high-value agricultural markets evolved being more sophisticated, consolidated and regulated than local markets[2] (cf. MCCULLOUGH et al. 2008). Generally, it is assumed that a integration of small-scale farmers into high- value chains can lead to growth and development through increased income opportunities[3] (e.g. DOLAN/HUMPHREY 2004; OUMA 2010; WEINBERGER/LUMPKIN 2007). Nevertheless, relatively few of small-scale farmers have managed to integrate into international value chains, however one exception can be found in the Kenyan export horticultural sector – where large numbers of small-scale farmers have successfully integrated into global value chains (e.g. DANNENBERG 2012; DOLAN/HUMPHREY 2004). In most other small-scale businesses based in Sub-Saharan Africa, like in Tanzania, a larger export orientation in horticulture has not taken place yet, but commercial production and regional value chains are expanding.

In this regard, studies have identified key challenges facing small-scale farmers in international and regional value chains which include having limited lack of information and knowledge access linked with information asymmetries[4], poor financial and market transactions and structural problems such as too many intermediaries in a value chain. Further challenges are linked to the dependency of small-scale farmers on participation in integrated regional and international value chains. Since these

[1] According to FAO 2012, small-scale farmers manage areas varying from less than one hectare to 10 hectares and are characterized by family-focused motives such as favouring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption. Often they rely on the help of family labour and tend to have poor access to capital.

[2] In Sub-Saharan Africa, a high degree of dualism still exists between traditional domestic food chains and sophisticated coordinated value chains – whether domestic or export.

[3] Nevertheless, this development can also generally be critically discussed since it "goes hand in hand with the loss of thousands of jobs and income sources and the related risks of poverty for the affected households and it is still an open discussion in science and society in how far small businesses can and should be integrated in international value chains" (DANNENBERG/DIEZ 2016: 171).

[4] Information asymmetry is a situation where buyers and sellers have different levels of information causing markets to malfunction and fail. It exists in almost all stages of the agricultural value chain in Sub-Saharan Africa, generating inefficiencies across the chain and can also lead to power asymmetries (STIGLITZ/WEISS 1981).

are dominated and controlled by powerful buyers and are often marked by high entry barriers (e.g. complex standards), small producers have difficulty in participating in these value chains (DANNENBERG/KULKE 2014; FAFCHAMPS/HILL 2005; MCCULLOUGH et al. 2008). The critical issue is how these small producers can overcome these challenges by integrating in regional and international agricultural value chains.

In this context, the spread of modern Information and Communication Technologies (ICTs) is widely discussed in science and in the programmes of international development organizations, because they assume that ICTs play an important role in integrating small producers into value chains by creating new market opportunities and increasing a supplier's access to information and knowledge by overcoming spatial constraints (AKER/MBITI 2010; MURPHY/CARMODY 2015; OVERÅ 2006; PORTER 2015). Particularly, the role of ICTs as a medium of dissemination of information and knowledge and improving market linkages in agricultural development has been acknowledged by several scholars (e.g. AKER et al. 2016; MOLONY 2008).

Out of several technological developments in the ICT sector, mobile phones have had the most notable effects. Driven by improved accessibility and affordability through the expansion of mobile networks', adoption within the countries in the Global South has increased enormously in the last 15 years (THE WORLD BANK 2016). Within the African continent mobile phone coverage has expanded rapidly over the past two decades - from largely non-existent networks at the beginning of 2000 to a point where over half of the population in Africa is covered with mobile phone networks. In Africa, the percentage of the population subscribed to mobile phones increased from 9% in 2005 to 63% in 2016 (ITU 2016). Even in rural areas, a large number of people own and use mobile phones due to improved accessibility, coverage and affordability. Additionally, internet use increased from 1% in 2010 to 23% in 2016 (ITU 2016)5. Subscriber growth in Africa is reportedly the fastest in the world with an average adoption rate over 33% (ETZO/COLLENDER 2010). Hence, country-level adoption and usage rates suggest that particularly phones are rapidly becoming an everyday part of life in many African countries and are thus "widely held to be one of the main developmental successes on the continent in the last decade" (MURPHY/CARMODY 2015: xiii).

The fast dissemination of ICTs in Africa is often seen as a success story which has also accompanied a discourse around "Africa Rising" (MAHAJAN 2011). This discourse includes narratives about the world´s fastest growing economy and its economic transformation through large investments.

[5] However, particularly in the context of Africa, data on actual ICT use is not very reliable. There is difficulty in estimating users due to the difference in numbers between subscribers, owners and users since sharing phones and owing numerous SIM cards per person is a common practice. The number of subscriptions per 100 inhabitants compromises the penetration rate that is measured by SIM card holder. However, it is popular to own SIM cards without owning a phone or even to have multiple SIM cards. In short, the mobile phone penetration rates might be an overstatement of the actual number of phone owners, just as they are an understatement of the number of users (JAMES/VERSTEEG 2007).

Hereby, ICTs play a crucial role in reinforcing the economic transformation. In particular, the increasing connectivity to the globalised world and the decoupling of information from their physical repository through ICTs contribute to this understanding of fostering transformation (AKER et al. 2016; KLEINE 2010; MURPHY/CARMODY 2015). These expectations have resulted in various public and private programs and projects funded by international banks and donor organizations such as USAID, FAO and World Bank, which are generally categorized under the term *ICT for development* ("ICT4D"; QIANG et al. 2011; UNDP 2012)[6]. Based on this background and on the general debate surrounding the benefits and disadvantages in the application of ICT4D, a range of applied studies have emerged which argue that ICTs can help to integrate small-scale businesses in agricultural value chains (e.g. AKER et al. 2016; OKELLO et al. 2013). Proponents assume that ICTs can lead to structural changes in agricultural value chains in favour of small-scale farmers, e.g. the disintermediation of middlemen (DONNER/ESCOBARI 2010; GRAHAM 2008). Some even assert that the bargaining power of farmers will be improved through the reduction of information asymmetries (BAUMÜLLER 2012). Moreover, studies provide evidence for the enhanced flow of information and knowledge within value chains, improved financial and market transactions (i.e. producer-buyer coordination) and the reduction of spatial constraints for information and knowledge access (e.g.BOATENG 2011; MORAWCZYNSKI/MISCIONE 2008; MUTO/YAMANO 2009; NAKASONE et al. 2014; OVERÅ 2006).

While the majority of the ICT4D community follows an optimistic and technologically deterministic perspective by equating technological modernisation with economic and social development, critical perspectives show the limitations of the ICTs and also outline the negative effects (e.g. CARMODY 2012; ETZO/COLLENDER 2010) For example, for the small-scale enterprises, the proliferation of technology, such as mobile phones, may increase the inequalities between the wealthier enterprises, which are able to afford mobile phones, and the poorer enterprises, which are not able to afford mobile phones and are, therefore, at risk of being excluded from new possibilities (CARMODY 2012; HEEKS 2014). Further concerns exist that divergent levels of access to ICTs and uneven global flows of information will exacerbate economic and socio-spatial segregation, known as the 'digital divide' (GRAHAM 2011). Conceptually, it is criticised that most of the positive assumptions are overestimated without sophisticated empirical proof and conceptual background information (e.g. HEEKS 2010; MURPHY 2013). Often, cited studies are "speculative, anecdotal, vague and/or lacking a clear grounding in empirical evidence beyond a single case study community, and/or program initiative" (MURPHY/CARMODY 2015: xv). Additionally, ICT4D studies often lack the structural context and "geographic sensitivity" (MURPHY/CARMODY 2015: 50), including different socio-economic and institutional contexts that differentiate the effects of ICT use. Currently and to the best of my

[6] The origin of this discourse is partly related to the empirical importance of ICTs, but also to the work of scholars and practitioners and the "powerful imaginaries that corporations and mainstream media outlets have constructed regarding the potential of ICTs" (MURPHY/CARMODY 2015: 10).

knowledge, it is unclear to what extent and under what conditions ICTs affect the agricultural value chain integration of Sub-Saharan small-scale producers.

Therefore, the aim of this research is, on the one hand, to analyse the empirical phenomenon of expanding ICT use within horticultural value chains in Kenya and Tanzania. On the other hand, this thesis aims to improve the understanding of the conditions and effects of ICT use within small-scale based value chains in Sub-Saharan Africa. This will be achieved through a comparison of different integrated small-scale farmers producing commercially and a comparison between small-scale farmers using ICTs and those not using ICTs as well as farmers using different types of ICT. Thus, this thesis provides a differentiated understanding of how ICTs are used by small-scale farmers in horticultural value chains and how this affects small-scale based horticultural value chains.

I argue that the GVC framework provides a valuable lens to analyse these contemporary value chain dynamics - the integration of small-scale farmers in horticultural value chains and the use of ICTs within those chains due to its focus on governance and coordination (GEREFFI et al. 2005). However, it needs to be complemented with insights from other literatures - relational proximity and knowledge - in order to make the framework more applicable to explain the effects and the conditions of ICT use by small-scale farmers. Applying and adapting the framework for horticultural value chains in Kenya and Tanzania helps to answer the general research question:

To what extent and under which conditions does the use of ICTs affect small-scale based horticultural value chains and in how far can these developments provide general explanations of value chain dynamics in Sub-Saharan Africa?

The research question can be divided into several topics. First, based on different ICT use types, the effects of ICT use on farming regarding access to knowledge, distribution channels and bargaining positions are analysed. Second, the effects of ICTs on value chains are examined including simple information and complex knowledge flows, financial and market transactions. It will be further questioned how value chain structure, its coordination types and relational proximity between producer and buyer influences the ICT effects on small-scale farmers. Third, the question of the spatial implications of ICT use is addressed. The potential and limitations of particularly mobile phones to reduce spatial constraints in order to access different types of knowledge will be researched in the context of Tanzanian horticultural farmers.

This research is based on a mixed methods case study of the horticultural value chains in Mt. Kenya, Kenya and Mwanza, Tanzania. Extensive fieldwork was conducted in different areas across both regions in Autumn 2013 and Spring 2015, yielding 368 surveys and 120 semi-structured interviews.

Following the current introduction, Section 2 presents the theoretical considerations and the research framework including the Global Value Chain framework, the approach of agricultural value chains, knowledge concepts and the current debate about ICTs in the Global South including the concept about relational proximity. The research framework and hypothesis will be outlined in section 2.4. Chapter three highlights the broader research setting and methodology. Chapters four to six form the body of the empirical research and present a collection of stand-alone papers which have been published (Chapter 4), or are forthcoming at the time when this thesis was submitted (Chapter 5, 6). All the articles are based on the empirical data that was collected in 2013 and 2015. Each of them provide a brief introduction to the subject, the theoretical framework, and methodology and follows a clear line in terms of research question and topic. The co-author for all the articles is Peter Dannenberg. Additionally, Gilbert Nduru is the second co-author for the first article.

The structure of the remainder of this empirical part is as follows:

The first paper (chapter three), *The use of modern information and communication technologies in smallholder agriculture: Examples from Kenya and Tanzania* was published in 2015 in the widely read journal of the ICT4D community *Information Development*. By using data from dissimilar types of farmers, this chapter provides a broad and differentiated picture on ICT usage. A typology of ICT use is identified that helps to explain some of the potential effects of ICTs on small-scale farmers. Further, it shows in how far the use of ICTs has effects on farming, especially on knowledge access, in terms of providing the possibility to use different distribution channels, and on the bargaining position of the farmer.

The second paper in chapter four, *Analysing the effects of Information and Communication Technologies (ICTs) on the integration of East African farmers in a value chain context* was published in 2017 in the Zeitschrift für Wirtschaftsgeographie. Within the broader GVC framework, this paper discusses how far ICTs can affect the integration of farmers into value chains. Further, it argues that those effects depend on the respective value chain structure, its coordination, and the relational proximity between the chain actors.

The third paper in chapter five, *A Spatial Perspective on Access to Knowledge and Mobile Phone Use – Examples from Tanzanian farmers* was published in 2018 in Tijdschrift voor Economische en Sociale Geografie. This paper combines concepts about knowledge, spatial and relational proximity with ICT4D studies by looking at the example of horticultural small-scale farmers in Tanzania. The potential and limits of mobile phones to overcome the spatial constraints of remote farmers to access external knowledge is the focus of the analysis. It is argued that the potentials of mobile

phones for knowledge access differs according to the relational proximity between individuals and the type of knowledge accessed.

The last chapter summarizes the results of all three articles and further publications by answering the research questions and hypotheses.

2 Theoretical Considerations

This section outlines the core concepts and provides an outline of the overall theoretical framework on which the research is based. It establishes the link between ICTs and Global Value Chains to examine the interrelations between the two in the horticultural sector in Kenya and Tanzania. First, I will outline how the framework of Global Value Chains has been conceptualised including considerations of knowledge types and transfer within value chains. Secondly, it will be explained how the Global Value Chain concept can be applied within horticultural value chains by outlining the contemporary dynamics of those chains. The third part includes the main arguments within the ICT4D debate regarding small producers in value chains in the Global South and relational proximity.

2.1 Global Value Chain framework

Since the global food crisis of 2007 and 2008, the value chain integration of small-scale farmers has received particular attention since supporting agricultural smallholders is critical for the rural economy regarding workforce and income. Large numbers of applied studies and reports have been developed by the development community postulating the value chain approach as a development concept (cf. FRANZ et al. 2014; e.g. GIZ 2012). Particularly for the agricultural sector and the inclusion of small-scale farmers there are a number of manuals and guidebooks from development agencies (CATTANEO 2013). The scientific community has also developed a great interest in this topic, producing a large number of studies on how small-scale farmers are integrated into supply chains around the world (e.g. FRANZ et al. 2014; ORTMANN/KING 2010). Many case studies using value chain approaches have focused on agricultural products, in particular emphasising the ongoing change from local production to more market-oriented cash crop production (e.g. DANNENBERG/NDURU 2013; HASSLER/FRANZ 2013; NEILSON/PRITCHARD 2011). The increasing dependence of small-scale farmers within interregional and international value chains is of particular importance for the scientific and development community.

In general, a value chain is the sequence of production or value-adding activities leading to and supporting end users of a particular product (STURGEON 2001). It is used as a general term to understand the relationships and activities of economic exchange between actors at different nodes of the chain. Constitutive elements of the value chain are a territorial expression and an institutional framework and material interconnections, so-called input-output relationships at the interfaces resulting from value-creating steps (KULKE 2017).

In economic geography, overlapping names and concepts have been given to this sequence of activities including the Global Commodity Chain Concept (GCC; see e.g. GEREFFI 1996,2001b), its successor the Global Value Chain Concept (GVC; see e.g. GEREFFI et al. 2005; GIBBON et al. 2008) and the concept of Global Production Networks (GPN; see e.g. COE et al. 2008; HENDERSON et al. 2002)[7]. These studies outlined the fact that the constituting elements of such value chains go beyond the exchange of products and financial transactions between the actors and usually also include the exchange of crucial knowledge and a governance structure in which the different actors are coordinated (usually by powerfull drivers or lead firms; GEREFFI et al. 2005). Both the governance structure and the exchange of information and knowledge are central for the research framework of this thesis.

The GCC approach puts great effort into the analysis of the level of inclusion or dependency of suppliers from the Global South and two distinct types can be differentiated; producer-driven and buyer-driven chains focusing on the power of the lead firm to determine the production process along the chain (GEREFFI 1996). Since this approach focuses on a bimodal distinction between these two types and does not include conceptual considerations on upgrading, it is often also criticised for being too simple (GIBBON et al. 2008; HENDERSON et al. 2002). As a consequence, the GVC framework was developed, putting more emphasis on the question of how exchanges are coordinated instead of only who has the power in the chain (GEREFFI et al. 2005). Further, the GPN framework which was developed after the GVC approach focuses more on networks which are defined as the generic form of economic organization rather than a combination of functions, activities and transactions in which specific products or services are produced that are subsequently distributed and consumed (COE et al. 2008). While the GPN approach has its analytical advantages in the reflection of the influence of the state and other actors in the regional context of the chain (FRANZ 2010; HENDERSON et al. 2002), the governance considerations of the GVC provide an understanding of coordination in value chains and inter-firm relationships which are central in this thesis and is why the GVC framework is used.

The GVC framework distinguishes five analytical types of governance ranging from market-based structures to hierarchal supplier systems with a lead firm at the top. Those types are based on three key determinants:

[7] For a detailed overview, see DIETSCHE (2011).

I. The complexity of transactions and knowledge transfer that is required to sustain a particular transaction (e.g. product and process specifications).
II. The codifiability of information and knowledge.
III. The capability of actors involved in relation to the requirements of the transactions (DANNENBERG/KULKE 2014: 122; GEREFFI et al. 2005: 85).

In each governance type, lead firms take more or less direct control over the production process (GEREFFI et al. 2005). Therefore, the effect of governance structures on e.g. farmers can vary (FRANZ et al. 2014). The ideal categories - hierarchy, captive, relational, modular and market-based - contain a range from the highest to the lowest degree of explicit coordination and power asymmetry between the lead firm and the suppliers (GEREFFI et al. 2005; GIBBON et al. 2008).

Nevertheless, the typology of the concept has also been critiqued as being highly stylized and too idealistic (see e.g. COE et al. 2008; NADVI 2008). Often the general "chain approach" is criticised for being too linear and vertical, and lacking horizontal dimensions. Others have argued that the empirical work using the GVC approach has paid too much attention to lead firms and "large, often transnational corporations as producers or buyers driving commodity chains and providing functional leadership" (CRANG et al. 2013: 16). Further, its application for the real-world context is questioned, pointing "to the complexity and richness of on-the-ground processes" (COE 2011: 395). Linked to this, several authors have criticised the classification of empirical examples into the governance typology (e.g. DANNENBERG 2012; DOLAN/HUMPHREY 2004). Thus, it is generally questionable to what extent a typology is appropriate to explain the current coordination structures and dynamics. For example, it can be possible that in a chain there is an integration of value chain segments at the beginning of the chain, while simultaneously independent structures exist at the end of the value chain. However, the governance types have proven useful to explain the relationships in international value chains and the success of companies participating in these chains. Moreover, concerning the governance and coordination of value chains, the GVC has already proved to be of use to analyse agricultural value chains in Africa and other regions of the Global South (e.g. BARRIENTOS et al. 2016; BRAUN/DIETSCHE 2008; DOLAN/HUMPHREY 2000), including studies in Kenya (e.g. DANNENBERG 2011; DOLAN/HUMPHREY 2004; OUMA 2010).

As indicated, there are various understandings of the terms "coordination" and "governance" [8], which have been discussed and applied in the global value chain literature (GEREFFI 1996; GEREFFI et al. 2005; HENDERSON et al. 2002). Linked to this, the thesis distinguishes between the terms governance and coordination to capture the complex structures of the agri-food sector (also see DIETSCHE 2011; FRANZ et al. 2014; PONTE/STURGEON 2014). Based on Ponte and Gibbon (2005),

[8] Some authors see problems due to the different use of certain terms like governance and coordination (DIETSCHE 2011; FRANZ et al. 2014). Sometimes, the two terms are even discussed synonymously.

coordination is understood as the mechanism of economic processes between the actors at each segment of the value chain. In contrast, governance includes the overall organization of the whole value chain. The term governance refers to the definition of conditions for integration into the value chain, like "rules and conditions" (Ponte and Gibbon 2005: 3), as well as their enforcement. I argue that the distinction is helpful, because different "forms of coordination may exist at different segments in the same value chain. These forms of coordination do not categorize the governance of the overall chain. It is thus necessary to distinguish 'immediate' forms of coordination from the overall mode of governance" (PONTE/GIBBON 2005: 6).

Despite the recourse to the value chain approach, the present study is not a GVC analysis, but rather an analysis of a group of actors within the horticultural value chain in Tanzania and Kenya and their use of ICTs. The focus is set on the direct value chain links between producers and buyers (exporters, middlemen, traders) and only for the Tanzanian and Kenyan side. This thesis does not examine the actors beyond exporters, since it is assumed that the use of ICTs by farmers does not influence the wider value chain parts and vice versa. Although categorizations are made with the help of the approach, the focus of the study is on the form of coordination and ICT usage and its impact on information and knowledge flows, financial and market transactions. It is assumed that depending on the different coordination form between a farmer and buyer, ICTs are used differently and thus has different effects on farming. It will be analysed how far ICT use affects the structure of a value chain and the different activities of farmers within these chains, e.g. knowledge and financial transfer.

In this context, the GVC framework also emphasizes the importance which ICTs can have on the organization and governance structure of the chain, which can include new power relationships (GEREFFI 2001a). Already in 2001, GEREFFI outlined the possible transformative power of ICT for value chains using the example of the internet. Here he identified large internet gatekeepers like Yahoo or AOL as powers which could "deconstruct" (GEREFFI 2001b) large professional chains such as the automobile industry. However, even though the conceptual standard work of GEREFFI, et al. (2005) later included Kenyan horticultural value chains, Gereffis` ICTs considerations focused on large-scale e-commerce but not on the conceptual considerations of ICTs interventions in small-scale based value chains in the Global South. To sum up, the increased use of ICTs in horticultural production systems can be expected to significantly change the structure of the value chains and the impact that these have on the actors involved.

Information and knowledge flow

Value chain studies have outlined that the constituting elements of value chains go beyond the exchange of products and financial transactions between the actors and usually also include the

exchange of knowledge in which the different actors are coordinated (cf. GEREFFI et al. 2005). As pointed out, information and knowledge flows among actors of a value chain are a crucial component of GVCs as they influence the governance structure, market access and upgrading activities. "Communication is key within a value chain in order to establish and strengthen relations between stakeholders and effectively circulate information and knowledge as well as resources and agreements" (BODE et al. 2008: 8). The GVC concept underlines the importance that available and accessible knowledge can have on the coordination and the organization of value chains and on the chances of firms to successfully integrate themselves into these chains. This was also underlined in studies on small-scale businesses based value chains (e.g. DANNENBERG 2012; HASSLER/FRANZ 2013; STRASSER et al. 2013). Several studies emphasized the importance of access to information and knowledge in order to participate in GVCs (e.g. GEREFFI 2001b; KARIUKI 2006). With knowledge, agricultural smallholders are able to e.g. reduce input costs, improve production and can have a better position in negotiations with buyers. For example, KARIUKI (2006) notes access to timely information is the major basis for reasonable decision making for a farmer. This includes information on the type and quality of products demanded, market regulations, season of demand and prices. Thus, information asymmetries can lead to an inability to access international markets for several reasons according to BODE et al. (2008): lacking knowledge of price definitions and demand may lead to under- or over-production; lack of knowledge about types of customers can hinder market opportunities, limited knowledge of production technologies may decrease competitiveness, and missing knowledge on quality standards may lead to a mismatch of supply and demand. Entrepreneurial skills like knowledge of production marketing, contracts, financing, and bookkeeping also determine the capability to enter GVCs (KARIUKI 2006: 47).

Since knowledge and information access via ICTs is likely to be influenced by the type of knowledge I differentiate between simple information, complex knowledge and local and external information and complex as well as tacit and codified knowledge[9]. This differentiation of knowledge is important to understand why ICTs can be used to transfer knowledge in certain situations and why not. Further, it is crucial for the understanding of the spatial implications of knowledge transfer.

2.2 Dynamics in horticultural value chains

Literature on GVC analysis traditionally addressing the industrial sector has expanded to the agricultural sector within the last two decades (e.g. DOLAN/HUMPHREY 2004; PONTE/GIBBON 2005). As

[9] Since this conceptual background has been outlined in detail in paper one/chapter four and paper three/chapter six, the author omits it out to refrain from repetition.

this study analyses the horticultural value chain, research findings about the main characteristics of horticultural value chains will be presented briefly in this section.

As mentioned before, the agricultural production system in general and the horticultural system in particular have been undergoing great changes in their functions and characteristics. Traditionally, horticultural producers participated in spot markets, where demand and supply prevailed and the highest bidder purchased the available product. Individual farmers determined the crop varieties grown, their desired quality levels and the production processes used. Thus, market-driven coordination systems dominated. In these chains, the products could easily be traded due to simple, clear product specifications (ORTMANN/KING 2010).

During the last two decades the agricultural sector has become increasingly globalized and professionalized (cf. LEE et al. 2012). Large supermarkets and retailers dominate the sector, not only in established western markets, but also in developing markets. A limited number of powerful lead firms vertically coordinate agricultural value chains which have become more concentrated (REARDON et al. 2009). Even though a number of different buyers and governance structures exist in these chains, most authors classify them as buyer-driven (DOLAN/HUMPHREY 2004). In these structures, the coordination of small, formally independent producers was achieved through supply contracts made by more powerful actors (in this case, the retailers). While the lead firms can choose from many producers due to their demand oligopoly and, if necessary, also exclude producers from the chain, often the producers depend on these lead firms due to the lack of alternative opportunities (DANNENBERG/NDURU 2013; DOLAN/HUMPHREY 2004). In the wake of rising buyer demands, the product requirements have become increasingly complex and difficult to codify. To meet these demands, producers are increasingly dependent on intensive exchanges with buyers (DOLAN/HUMPHREY 2004). The development of private process-oriented standards was decisive for this (e.g. GLOBAL Gap). Thus, many exporters implemented their own quality management system (QMS)[10] from within which they source their products. Usually farmers are managed and contracted by the exporter through such a system (DANNENBERG 2012; OUMA 2010). GEREFFI et al. (2005: 85) noted since standards have to be met which do not apply to the domestic market, a gap between the competencies required for the export market and the local market develop. There is, therefore, a need for vertical integration or increased monitoring and control by the exporters. The nature of supplier relationships between producers and exporters is therefore of great importance for a successful export market. However, mixed results exist regarding a clear classification of the horticultural value chain to one of the five governance types. These supplier relationships cannot be

[10] According to DANNENBERG (2012: 156), an outgrower scheme is defined as follows: usually it includes a large farm owned by the exporter and a large number (often several hundred) of formally independent, small family farms (with a farm size of less than 5 hectares). They are bound to the exporter (either in writing or within the framework of a handshake agreement) and deliver to him exclusively.

clearly assigned to any one governance type, but rather to coordination patterns with captive, relational and market-based characteristics (see also GIBBON & PONTE 2005). Nevertheless, detailed insights were provided by DANNENBERG (2012) who characterized the different distribution channels from Kenyan small-scale farmers exporting horticultural produce to the EU (see Figure 1):

Route A: The exporter hierarchically controls the production and distribution of the produce. Often the exporters source from their own farms. Additionally, they buy from individual small-scale farmers.

Route B: Contracted farmers produce crops according to prescribed production methods and standards, mainly in a QMS. Exporters are responsible for coordinating and controlling production with this QMS and provide technical and financial assistance. The dependent farmers have limited capabilities and responsibilities and are tightly linked to the exporter (captive).

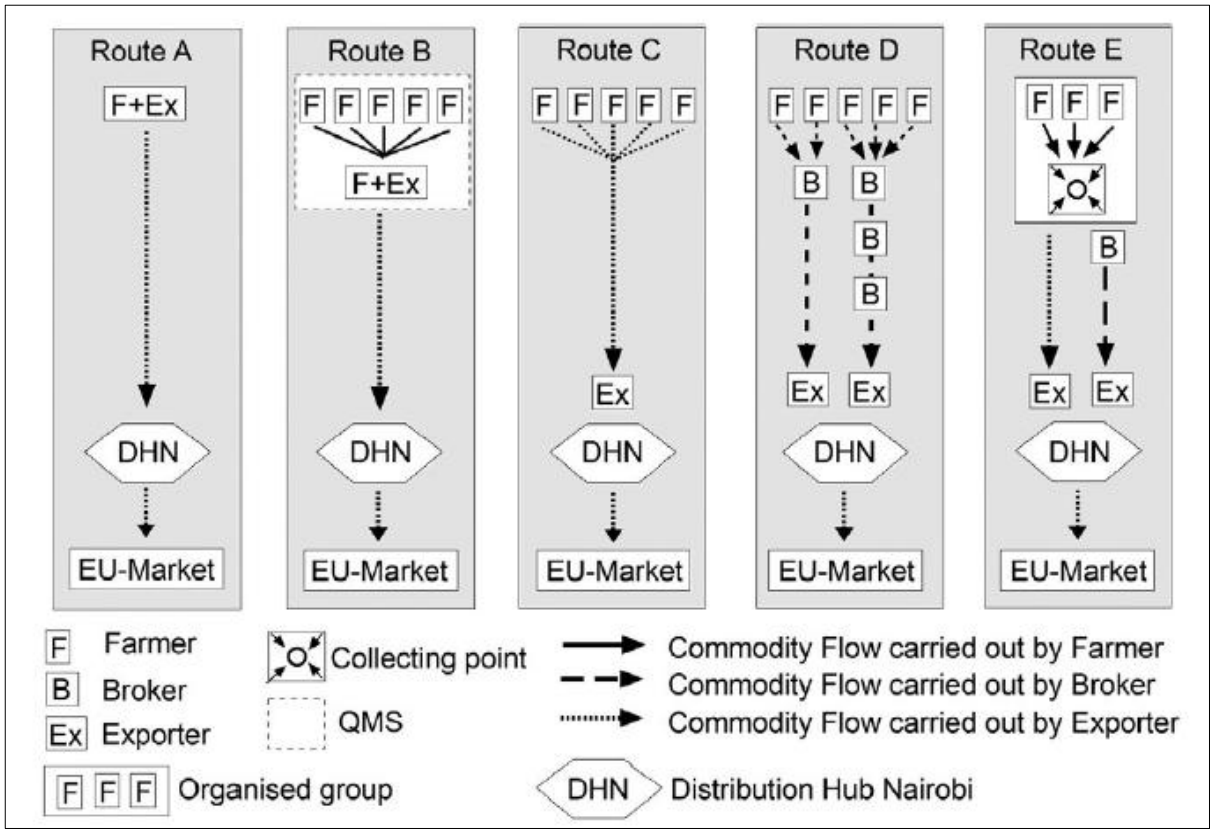
Route C: Farmers are independent producers who sell directly to exporters, but not exclusively and thus are not part of a QMS. However, exporters provide them with valuable knowledge about standards requirements (relational).

Route D: Market-based supply relationships that include farmers who sell via intermediaries ("broker/middlemen"[11]). No contracts and support are provided by them and exporters are not able to control the production process. The intermediary, in turn, sells to the exporter (or to other brokers) and is often the only possible marketing option due to the remoteness of many farms. Thus, the middlemen can be seen as the linkage between exporter and farmer.

Route E: Many farmers are horizontally organised in farmer groups (self-help groups) who collectively sell to producers (either exporters or broker). This association has a beneficial effect both internally and externally due to the cost-sharing of infrastructure investments, mutual learning, the exchange of knowledge and a strengthened negotiating position in purchasing, in the use of services and in the sales organization. Possible disadvantages are, in turn, free-rider effects and increased transaction costs.

Figure 1. Routes of horticultural exports between farmers and exporters; source: Dannenberg/Nduru (2013), p. 155.

[11] Definition broker/middlemen according to DANNENBERG (2012): Usually one-person firm, which mostly buy relatively small quantities of several small farms, usually less than 5 ha. These are often young men from farming families who do not have their own farms due to a lack of opportunities or interest, but have sought alternative employment through transport and trade and, as a result, often have only limited skills and resources for a professional trade.



A relatively new development is the expansion of Regional Value Chains (RVC) including regional lead firms (i.e. supermarkets[12], wholesalers) that trade within one region or country (e.g. East Africa, Kenya). This trend provides producers with optional channels between traditional domestic markets, and regional or global value chains. In most cases, these RVCs are closely linked with GVCs since they often have the same suppliers (BARRIENTOS et al. 2016). In a recent study on horticultural produce in Kenya, KRISHNAN (2016) identified that farmers often strategically diversify their market portfolio by simultaneously participating in both value chains leading to improved bargaining positions and income. However, the rapid growth of regional and south-south trade between developing countries over the last two decades has been relatively underexplored by value chain or related production network analysis (cf. HORNER 2016) and, thus, this thesis aims to contribute by characterising these chains and analysing the effects of ICTs on their structure and coordination.

In the following analysis, the focus is on global value chains including small-scale farmers producing for the export market and regional value chains including farmers producing for the regional market (local market, wholesale market, supermarket).

[12] Numerous studies have focused on the expansion of modern retail chains within countries of the Global South (led by the three largest retailers Wal-Mart, Carrefour and Tesco) over the past two decades (e.g. REARDON et al. 2009), and on the expansion of regional supermarkets owned and operated within Sub-Saharan Africa (SSA). Leading supermarkets provide a full product range, including fresh fruit and vegetables. Some supermarkets have their own procurement companies, such as Fresh and Juicy in Kenya and Tanzania.

2.3 Information and Communication Technologies in Africa

The history of ICTs in Africa began in 1987 with the first conversation by mobile phone in the Democratic Republic of Congo. Before that, the majority of the population was entirely dependent on face-to-face interaction for the conduct of daily business, because fixed-line telephones and postal services were poorly developed. With the worldwide introduction of mobile phones, Africa has gained a huge opportunity to promote communication networks without the difficult, cost-intensive steps of landlines. In the late 1990s, a rapid increase in mobile phone usage was observed that still exceeds all expectations (ETZO/COLLENDER 2010). Due to the sale of prepaid-SIM cards, the availability of inexpensive second-hand mobile phones, falling handset prices and calling rates as well as the rapid expansion of networks, even rural areas and less affluent parts of the society have been able to participate in the success story of mobile phone usage (but still not completely; PORTER 2012).

This has led to high expectations concerning the impact of mobile phones, computers, and the internet on economic, social and political development across African countries including small producers and their integration in international markets (e.g. AKER/MBITI 2010; HEEKS 2010). Practitioners, in particular, highlighted the positive effects of ICTs including economic recovery through leapfrogging, improving business and social connectivity (ETZO/COLLENDER 2010; GRAHAM 2011; KLEINE/UNWIN 2009). The economist Jeffrey Sachs even went so far as to proclaim mobile technology as "the single most transformative technology for development" (cited in ETZO/COLLENDER 2010: 661), suggesting that phones have not only become a global good, but also a global good which will finally boost development in Africa. Telecommunication reports also concluded that particularly mobile telephony "has a positive and significant impact on economic growth, which may be twice as large in developing countries compared to developed countries" (WAVERMAN et al. 2005: 2).

These expectations have resulted in various public and private programs and projects funded by international banks and donor organizations such as USAID, FAO and the World Bank (QIANG et al. 2011; UNDP 2012; UNWIN 2009)[13]. The so-called techno-optimists tied up with the earlier approaches of development such as technological modernization in previous decades[14]. They argue that particularly African countries benefit from ICTs since they allow them to leapfrog earlier stages of development that more economically advanced countries had undergone. Some even stated that

[13] The origin of this discourse is partly related to the empirical importance of ICTs, but also to the work of scholars and practitioners and the "powerful imaginaries that corporations and mainstream media outlets have constructed regarding the potential of ICTs" (MURPHY/CARMODY 2015: 10).

[14] The modernization paradigm narrated development theories especially between 1950 and 1970. Advocates argued that technological innovation and upgrading, connected with cultural change, would help modernize economies and society (see ROSTOW 1960).

they could leapfrog directly towards a knowledge-based economy (cf. MURPHY/CARMODY 2015; THE WORLD BANK AND AFRICAN DEVELOPMENT BANK 2012). In this regard, AKER/MBITI (2010) identified five potential mechanisms through which ICTs can provide economic benefits: 1. By improving access to and use of information, 2. By improving productive efficiency by allowing businesses to better manage their supply chains, 3. By creating new jobs to address demands for ICT-related services, 4. By facilitating communication within social networks in response to shock and thereby reducing businesses´ exposure to risks, 5. By facilitating the delivery of financial, business, health, and educational services (see also CARMODY 2012).

In line with this argumentation, ICT4D projects aim to close the global digital divide – the spatially and socially uneven diffusion of ICTs. The digital divide refers to "the gap that exists between people and places with access to digital technologies and people and places that do not have this access" (GRAHAM 2008: 780). Long branded as the most unconnected region in the world, the African continent has thus come to present the world`s "black hole of informational capitalism" (CASTELLS et al. 2009: 161), where the technological gap continues to exclude Africa from "full participation in the modern world" (UNDP 2001: iv). While on a macro-scale, the wide gap between Africa and the rest of the world is being reduced, it also exists on a local scale: rural urban settings, men and women and the educated and uneducated tend to show stark differences in terms of digital connectivity (PORTER 2012). However, critics suggest moving beyond a notion of the digital divide that is only conceptualized in terms of access to infrastructure. They point to the significance of both social networks, power relations and institutional support systems as bridges to gain ICT knowledge as a pathway to technology access (GILBERT et al. 2008). Particular geographers who reconceptualised the digital divide from a geographical perspective argue that access to ICTs must be understood in relation to a wider set of political, economic and social inequalities which are spatially as well as socially constituted (e.g. GRAHAM 2008; WARF 2001).

Based on this background and on the general debate of ICT4D in Africa, a range of studies and reports have emerged that argue ICTs can help to integrate small-scale businesses into (international) value chains (e.g. AKER/MBITI 2010; FOSTER/GRAHAM 2014; THE WORLD BANK AND AFRICAN DEVELOPMENT BANK 2012). Particularly the role of ICTs as a medium of improving financial and market transactions and dissemination of information and knowledge in agricultural development has been acknowledged by several scholars and projects (e.g. MUTO/YAMANO 2009; TADESSE/BAHIIGWA 2015). Based on those results, this thesis regards especially six broad areas in which ICTs can have an effect on: 1. information and knowledge flow, 2. financial transactions, 3. market transactions, 4. structural changes, 5. power relations and 6. spatial constraints[15]*:*

[15] Although it is recognised that the issues involved are interrelated (e.g. information and knowledge flow and power relations).

1 Information and knowledge flow

Among others, the information and knowledge flow via ICTs is seen as the core function of ICTs for agricultural small-scale producers. Numerous studies (e.g. JENSEN 2007; MUTO/YAMANO 2009) stress the lower costs and increased availability of information and knowledge as the main development driver of ICTs. "The mobile phone as a platform for the dissemination of information, and in particular market prices, has become shorthand for the transformative possibilities of information in general for low-income, rural populations in the Global South" (BURRELL/OREGLIA 2015: 271).

The benefits that particularly mobile phones bring in the reduction in information search are especially important given the difficulties and dangers of African travel (PORTER 2012). In a case study on agricultural traders, OVERÅ (2006) recognizes the value of phones in a long-distance trading context in Ghana characterized by high risk, low trust and consequent heavy reliance on personal networks. Poor roads and costly, often unreliable transportation challenged trading activities and raised transaction and travel costs substantially[16]. Further, studies also reported similar benefits of phone use in long-distance trading including an increase in farmers' and traders' market participation, and price management (AKER 2008; BOATENG 2011; MUTO/YAMANO 2009). For instance, BOATENG (2011) reports how phones enhance the timely communication of information in pre-, during and post-trading stages of micro-trading. He concludes that the improved information exchange reduces the demand uncertainty and, thus, increases the frequency of transactions between actors in the value chain. According to a World Bank report (2012), market price in particular is a type of actionable information. It concluded: "Before the expansion of mobile networks, agricultural producers were often unaware of these prices and had to rely on information from traders and agents to determine whether, when, where, or for how much to sell their crops" (THE WORLD BANK 2012: 33). Especially mobile phones have a high potential to access information on prices and supply and demand information by enabling business partners to communicate directly and immediately at a distance. In his case study on fishermen in India, JENSEN (2007) showed that information translates into reduced price variability and higher profits per actor. MUTO/YAMANO (2009) also established robust results on the positive impact of mobile phone networks in remote areas on banana farmers' income. Furthermore, information asymmetries can be reduced for farmers, resulting in more accurate planning and calculating, as well as higher predictability of farming transactions and better bargaining power (cf. KRONE et al. 2014; MOLONY 2008; MUTO/YAMANO 2009). Most studies focus on the potential impact of the more efficient transmission

[16] Studies show evidence that transportation costs are much higher in Sub-Saharan Africa than in other regions (GAEL/SUPEE 2009). It has also been noted that transportation costs over short distances (e.g., from the farm to the local market) are much higher than long-distance transportation costs, presumably because the vehicles are smaller and road quality is poorer (THE WORLD BANK 2009).

of information associated with ICTs, via a reduction in search costs, on farmers' and traders' decision making and market performance (AKER/BLUMENSTOCK 2014). In theory, a reduction in search costs via ICTs allows market actors to search more quickly and over a greater geographic area and, thereby, results in better opportunities for spatial and temporal arbitrage. This reduction in search costs decreases equilibrium price dispersion and improves market efficiency. In the long run, if farmers are able to find more profitable opportunities, they can thus change the allocation of production factors or crop patterns and increase their agricultural productivity (AKER et al. 2016; NAKASONE et al. 2014).

Although most information exchange is focussed on the core processes of marketing and sales, access to relevant knowledge on cultivation practices is another important feature of ICT use. Via phones, farmers are able to connect with local organisations and extension officers, e.g. to get immediate advice on cultivation methods (DANNENBERG/LAKES 2013). Following the general consideration of (DANNENBERG/LAKES (2013); MORGAN/MURDOCH (2000)) showed that the effectiveness of ICTs for knowledge transfer in the small-scale agricultural value chains depends on the type of knowledge that is being transferred. While simple information (e.g. market prices) is easy and broadly transferred via mobile phones through voice and text messages, complex knowledge (e.g., the implementation of standards) usually requires direct personal communication. Such complex knowledge is crucial for the understanding of production processes and often involves tacit knowledge, which is difficult to communicate without face-to-face contact (POLANYI 1967). Nevertheless, access to complex knowledge is provided via phones by enabling the personal communication process. Yet, phones are limited in the knowledge exchange itself if the communication is tacit (BATHELT/HENN 2014; DANNENBERG/LAKES 2013).

However, while the use of ICTs for information and knowledge transfer is widely acknowledged, it is also critized for its uncritical use of the term information. For example, BURRELL/OREGLIA (2015) argue that the notion of phone use by farmers to check market prices has come to gain the status of an uncontested fact and a myth for pushing socio-economic development. They provided evidence on how access to market prices does not always lead to efficient use of it. They further showed how the ability to take risks (i.e. owning assets) influences the farmer to act on better information about market prices. Moreover, others concluded that obtaining more price information does not always lead automatically to higher prices received by farmers (AKER/FAFCHAMPS 2013). Access to phones also does not automatically lead to more information (TADESSE/BAHIIGWA 2015). In their study on the marketing decisions of farmers in Ethiopia, TADESSE/BAHIIGWA (2015) illustrated that only a few farmers used phones to reduce information searching costs, mainly due to the lack of information sources.

Apart from these critical results, in much of the ICT4D literature and studies, the concept of information is insufficiently problematized. It tends to be seen as something that simply exists, with

insufficient attention being paid to the interests behind its production, storage, propagation and consumption (KLEINE/UNWIN 2009). Often an implicit assumption is that "the information provided is of high quality, meaning that it meets the agent's specific information need, in a timely manner, and is provided via a reliable (and trustworthy) source" (AKER et al. 2016: 37). BURRELL/OREGLIA (2015: 272) also criticize the use of information in the ICT4D debate as it is imagined "as unproblematic and extractable, in particular, from the relationships between actors who exchange it". In their studies on agricultural markets in China and Uganda, they showed how relationships between trade partners and trade practices are essential for exchanging price information since trust in the information source is often highly valued. While there is substantial literature on trust and information provision in general, there is little literature as to how trust and relationships between interacting partners affects the way in which agricultural information provision is received and interpreted via ICTs. This thesis, therefore, aims to fill this gap by integrating the concept of relational proximity as one of several conditions influencing the effect of ICTs (see Figure 2). In this thesis, it is assumed that the use of ICTs affects the information and knowledge flow within agricultural value chains.

2 Financial transactions

ICTs cannot only facilitate access to information and knowledge, but also enable transactions that have excluded farmers from certain business activities thus far, e.g. providing access to loans and credits. Mobile payment facilitates a variety of financial transactions via mobile phone, including transmitting airtime, paying bills, allowing the user to store value in an account accessible by the handset, converting cash in and out of the stored value account, and transferring value between users by using a set of text messages. Thus, it enables people without bank accounts to have access to easy-to-use, widely accessible money transfers (cf. MBITI/WEIL 2011; MORAWCZYNSKI/MISCIONE 2008). Besides providing access to such a technology and service, the user becomes part of a wider financial network. According to MORAWCZYNSKI (2009) the main outcome through Mpesa use was the reduction in vulnerability achieved through the solicitation and accumulation of financial capital and the maintenance of social networks. It provided a platform through which funds could be instantly sent to address an urgent situation. SURI ET AL. (2012) also showed how remittances sent or received through mobile payment can reduce the impact of negative economic shocks, thus providing a form of insurance and additional income. Other studies showed that "remittances constitute an important component of rural household income and are used for different productive and consumptive purposes" (KIKULWE ET AL. 2014: 2). Due to the limited existence of formal financial services in Sub-Saharan Africa (particularly in rural areas), it is argued that mobile payment systems can resolve the

constraints farmers face in accessing finances by reducing transaction costs17 (KIRUI ET AL. 2012). Farmers do not have to incur time and travel costs to travel to banking facilities. This is of particular importance in distant locations with limited banking services. Further, mobile payment services can include the hitherto excluded farmers in banking services by reducing the costs of accessing remitted funds or depositing small savings (KIRUI ET AL. 2012). KIKULWE ET AL. (2014) and KIRUI ET AL. (2012) further analysed how mobile money contributes to more commercially-oriented farming. Their results revealed that mobile money users apply significantly more purchased inputs such as fertilizer, pesticides, and hired labour and sell a larger proportion of their harvest in the market. This is connected to lower transactions costs for receiving and paying money and to reduced liquidity problems due to receiving remittances and saving money.

In Kenya where the mobile financial service called Mpesa was introduced in 2007, 27 million Kenyans subscribed to this service in 2017 (SAFARICOM 2017). The rapid uptake and extensive reach of mobile payment applications has led many development practitioners to argue that such applications have the potential to become transformational (due to the reach of financial services to the unbanked segment of the population; e.g. THE WORLD BANK 2012). However, empirical evidence about the nature of mobile payment use is still scarce (DUNCOMBE/BOATENG 2009; one exception is MORAWCZYNSKI 2009; SEKABIRA/QAIM 2017). It is still questioned in how far mobile financial services impact the livelihoods of farmers and how those are used across different value chains. Thus, the poor availability of mobile money providers in rural areas and the costs (through using the mobile phone) challenge the financial inclusion of disadvantaged people like poor farmers. Hence, a segregation of society can be a risk since disadvantaged individuals are excluded from financial participation. Analysis showed that the likelihood of usage of mobile money services is higher among the more asset-endowed farmers than their counterparts (KIRUI et al. 2012). Further, since mobile money services are mainly used for informal money transfers between kith and kin, the promised connection between the poor and formal financial institutions is still a challenge. So far, it has not been shown how mobile payment is used in agricultural value chains and how it changes financial transactions in such chains (except of KIKULWE et al. 2014; KIRUI et al. 2012). In this thesis, it is assumed that the use of ICTs affects financial transactions within agricultural value chains.

3 Market transactions

[17] It is estimated that only 19% of the adult population can access banks (MORAWCZYNSKI 2009: 511). Formerly money was mostly transferred via informal channels including family and friends, bus and the post office. These were often risky and costly and, thus, individuals often transferred money themselves by going physically (FSD 2016).

For many small-scale producers in rural areas in the Global South, market transactions (i.e. participation in markets and coordinating marketing) are a major challenge due to market imperfections that can be attributed to a lack of market information, a lack of linkages between the actors in the value chain, the absence of output markets, high transaction costs and the high presence of trade intermediaries (FAFCHAMPS 1992). Many studies argue that ICTs can improve market efficiency by facilitating communication with buyers, the generation of market information, a reduction in logistic costs, facilitating access to markets and market research, networking, market transactions and market identification (e.g. AKER/MBITI 2010; CHOWDHURY 2006; MOLONY 2006; MUTO 2012). Consequently, ICTs are changing the way in which producer-buyer matches are made and allegedly allow for the integration of producers into the (global) market.

Particularly in Sub-Saharan Africa, where transaction costs are very high due to variegated market imperfections, ICTs can contribute to better market structures as in the reduction of transaction costs. This includes the reduction of transportation and travel costs (e.g., when meetings are substituted through calls; e.g. JAGUN et al. 2008; MOLONY 2008), coordination and control costs (e.g. the possibility to keep track of consignments in transit; MOLONY 2008; OVERÅ 2006) and market transaction costs (e.g., in accessing knowledge on markets to match rural supply and urban demand; e.g. JENSEN 2007). Particularly, the improved communication between farmers and buyers could reduce the uncertainty associated with travel delays and the demand of certain goods, thereby avoiding costly stock-outs and avoiding wasted trips (e.g. AKER/MBITI 2010; JAGUN et al. 2008). For example, AKER (2008) uses market and trader data in Niger and finds that mobile phones reduce grain price dispersion across markets and decrease intra-annual price variation. She also finds that mobile phones have a large impact on price dispersion for remote markets and for those markets that are connected with poor-quality roads. Using panel data from Uganda, MUTO/YAMANO (2009) showed furthermore that mobile phone use induces the market participation of farmers producing perishable crops such as bananas in remote areas. In a study about agro-pastoralist Maasai in northern Tanzania BAIRD/HARTTER (2017) noted that with phones, sale prices can be communicated with ease and buyers and sellers can participate remotely – giving owners greater control over the transaction. Similarly, buyers and sellers can use phones to identify price differences between markets to select the venue that best serves their interests. Further, pictures of animals taken with phone cameras can be shown widely to potential buyers. Thus, it is no longer necessary to walk an animal to market to prospect for good prices. However, most studies only provide evidence that "privileges ICTs' role in arm's-length exchange relations (e.g. basic commodity exchange or market transactions)" (MURPHY 2013: 1755). So far a lack of research can be identified regarding the effects of ICTs on market transactions within different value chains. In this thesis, it is assumed that the use of ICTs affects market transactions within agricultural value chains.

4 Structure of the value chain

It is argued that ICT use can also lead to new connections with markets and business partners and thus can expand producer´s "temporal-geographic footprint" (DONNER/ESCOBARI 2010: 650) connecting business partners who previously were out of reach (FOSTER/GRAHAM 2014; MURPHY 2013; OVERÅ 2006).

However, (MURPHY/CARMODY (2015); OVERÅ (2006)) have observed that the use of phones rather contributes to intensifying the relationships with existing local contacts rather than building new contacts from distant locations. The reasons for this can be found in the prevailing importance of personal interaction for the development of new trusted relationships (MOLONY 2008; OVERÅ 2006). MOLONY (2006) further recognizes the prevailing importance of face-to-face contacts since it is often essential at the inception of business relations. OVERÅ (2006: 1313) indicates communication by phones is not a trust-building mechanism in itself, but rather "a tool to make an already existing trust-building mechanism – the exchange of information, observation of behaviour and sanctions against dishonest action - more efficient". Another reason has been shown by MOLONY (2008) illustrating how Tanzanian farmers are tied to existing traders since they provide them with credit. Accessing new ways of transacting business could mean losing their credit source which is essential for crop production (also see BURRELL/OREGLIA 2015).

Further, the most revolutionary impact the internet is argued to have on value chains is through "disintermediation." Disintermediation was used as early as 1981 to describe the bypassing of economic intermediaries (Hawken 1981). But the term's contemporary significance generally lies in its ability to describe the potential of ICTs to threaten the existence of middlemen in any value chain and to reorganize economic spaces and relations, for example, by bringing economic benefits to both producers and consumers (GRAHAM 2008). ICTs might have the potential to restructure value chains and distribution channels, e.g. through new actors or the disintermediation of middlemen since the use of ICTs improve the ability to access increasingly direct market and sophisticated distribution channels (see e.g. JAGUN et al. 2008; MURPHY/CARMODY 2015)[18]. Particularly, the internet can reduce the use of intermediaries in the traditional supply chain by enabling producers to interact and transact directly with buyers. This is largely because producers and buyers can obtain trade information from each other and can carry out transactions at a much lower cost than in an offline supply chain with multiple intermediaries. Mobile phones can also help producers to cut out

[18] In many Sub-Saharan African countries, farmers usually have a choice between selling their products to middlemen who travel back and forth between villages and markets or transporting their products themselves to the nearest market. Due to high transportation costs, many farmers choose middlemen to pick up, despite the fact that middlemen may take advantage of their ignorance of the market price, seeking to extract a rent from them by offering very low prices for their products (FAFCHAMPS/HILL 2008).

middlemen by facilitating direct information exchange and transactions between producers and buyers. However, previous studies have also shown evidence of middlemen and traders using phones to perform their roles more effectively and not losing market power (AKER 2008; FOSTER/GRAHAM 2014; JAGUN et al. 2008; OVERÅ 2006). Middlemen perform important intermediation tasks, such as sorting and verifying quality, transportation, storage, assuming and/or pooling risk, or supplying credit, which are challenging for farmers to take on. Further, power asymmetries between buyer and intermediaries are established through the fact that many also provide loans to farmers, or pay in advance. Those asymmetries are also the result of "the inability of smallholders to produce the required volumes of larger buyers and their lack of market information" (APPEL et al. 2014: 154). According to MURPHY et al. (2014), intermediation in the case of the Tanzanian wood and tourism sector occurs both in spite of ICTs and as a result of ICTs. ICTs have had little impact on disintermediation. Instead, they have even enabled new kinds of intermediation (such as virtual intermediaries) who concentrate market power. Thus, it hinders small producers from creating and capturing value from local or international markets. In this thesis, it is assumed that the use of ICTs affects the structure of agricultural value chains.

5 Power relations

The role of mobile phones for the bargaining process between farmers and buyers is often emphasised modelling the bargaining between an informed buyer and a less informed farmer (e.g. COURTOIS/SUBERVIE 2014; NAKASONE et al. 2014). These studies rely on the assumption that buyers exert some type of market power, either due to high transaction costs, capital constraints, oligopoly arrangements and quantity restrictions (AKER et al. 2016; MITRA et al. 2015). Thus, it is often argued that improved access to information via ICTs, especially market prices, can improve the bargaining position with business partners by reducing information asymmetries (HUMPHREY 2002; NAKASONE et al. 2014). Through calling and/or texting, market prices can be accessed, which leads to an improved comparison of different markets/buyers and, thus, to a higher bargaining position. Moreover, increased connectivity through using the phone can also result in an enlarged selection of business partners and, thus, a higher bargaining position. For example, DANNENBERG/LAKES (2013) showed that farmers' access to market prices in Kenya and the possibility to connect with alternative buyers via phone lead to a better bargaining position by breaking local monopolies. Further, they showed that the improved possibility to link and organize with other farmers to buy and sell larger volumes collectively can result in increased bargaining power. COURTOIS/SUBERVIE (2014) also provide evidence on how the use of mobile phones increases farm gate prices for farmers in Ghana to reduce information asymmetries, thus indicating the improved bargaining position of farmers. However, while some studies have noted that access to ICT-based market information services actually

improves farmers' bargaining power, if traders have monopsony power, this price information will not necessary change their bargaining capacity (AKER 2008; MITRA et al. 2015). In line with this, FAFCHAMPS/MINTEN (2012) examine a context in Western India where farmers sell to buyers. They showed that providing farmers with price information had no impact on the average prices they received, though it did increase the likelihood that farmers sold at a wholesale market instead of selling to a middleman. The reasons for that were the contracting relationship between farmers and middlemen, and the middlemen's' comparative advantage in transporting produce. Further, they showed that markets are not truly anonymous and trust between the farmer and buyer is important which can lock farmers into relationships with specific traders that prevent competition. In such a situation, more accurate price information may not improve farmers' outcomes. By using examples from Tanzania, (MOLONY 2006) also argues that the ability of producers to use price information may be limited by the fact that they are tied into relationships with particular middlemen and are dependent on them for credit. All in all, MITRA ET AL. (2015: 2) concludes that the empirical evidence is mixed suggesting that the effect of price information on a farmer's bargaining position may be context-specific. "In markets where intermediaries play a relatively unimportant role, increased access to information may have relatively straightforward effects. In markets where intermediaries exist due to market imperfections (e.g. credit constraints, quality control or branding) the effects can be quite different" (MITRA et al. 2015: 2). These results suggest that the benefit of information to farmers may vary depending on what options are available to them. In this thesis, it is assumed that the use of ICTs affects the power relations within agricultural value chains.

6 Reduction of spatial barriers for information and knowledge flow

Because of spatial constraints which are typical in rural areas in Sub-Saharan Africa (e.g. remote locations, poor roads and limited logistic infrastructure and transport systems) many small-scale farmers face problems accessing external specialised knowledge (FLETSCHNER/MESBAH 2011; NAKASONE ET AL. 2014; PORTER 2015) from mostly urban areas. Hence, a spatial knowledge divide evolves leaving those behind who live in remote rural places without access to external contacts. As already mentioned in the sub-chapters before, the decoupling of information and knowledge from its physical location is one of the main advantages of ICT use (CARMODY 2013). Tightly linked to this is the debate about the role of space in the light of ICT use for economic actions (e.g. CAIRNCROSS 2001; MORGAN 2004)[19]. Several authors have pointed to the imminent 'death of distance' arguing that space and distance are of less significance for economic and cultural activities (e.g. CAIRNCROSS 2001; O'BRIEN 1992). They assert that the convergence of time and space by ICTs will reduce the geographic

[19] Since this debate has been outlined in detail in paper three/chapter six, the author only emphasises some points from this discussion to refrain from repetition.

frictions that shape spatial differences. They mainly assume that communication has a substitution relationship with transportation (i.e., more virtual interaction implies less physical movement). They further argue that with the right technology space can be bridged, transcended and shrunk and the world becomes flat for everyone who is connected. However, these arguments have been criticised by many geographers providing a more complex conceptualisation of the relationship between space and ICTs recognizing the relational links between technology, space and economic activity (E.G. GRAHAM 2008; KITCHIN 1998; ZOOK ET AL. 2004). GRAHAM (2008), for example, demonstrated that even though space may have been breached by having access to virtual marketplaces, myriad barriers (physical distance, linguistic distance, cultural distance, technical skill distance, distance from capital resources, etc.) continue to hinder efficient trade between producer and consumer. Hence, if geography is relational, technology could therefore rather supplement place-based existence instead of replacing it. In other words, ICTs can give "rise to an individual sphere of hybrid geography in which certain space-transcending activities can be performed while being simultaneously embedded in and influenced by the performer's positionality in physical space" (GRAHAM 2008: 775). All in all, there is a broad consensus that ICTs are capable of reducing space-time constraints, but disagreement exists about the extent of that relaxation (cf. SCHWANEN/KWAN 2008). In this thesis, it is assumed that the use of ICTs affects the opportunities of farmers to overcome spatial barriers regarding access to information and knowledge within agricultural value chains.

While these benefits can present the positive effects as methods of improving the existing ways of doing business, they are also discussed as initiators of new ways of doing business, meaning that ICTs can have a transformative character on economic development (e.g. AVGEROU 2010; MUKHEBI et al. 2007; UNWIN 2009). Elements of such a transformation include expanded markets and new actors (e.g., new traders or producers), a deconstruction of the value chain ("disintermediation"; GEREFFI 2001a), new learning routines, new knowledge sources and enhancement of inter-firm capabilities (MURPHY/CARMODY 2015), and new forms of organization and marketing structures in farming (MUKHEBI et al. 2007). The expected core benefit of transformation will be the producer's integration into commercial value chains connected with more value creation and value capture. Among others, the *eTransform Africa* report (2012) even postulates a transformation of Africa's economy; "Future investment programmes will be geared to the transformational use of ICTs. The outcomes will be measured not in higher penetration rates but rather in outcomes such as poverty reduction, the creation of jobs and enterprises, an increase in agricultural productivity, better access to healthcare, clean water, education and so on" (THE WORLD BANK AND AFRICAN DEVELOPMENT BANK 2012: 21).

To conceptualise the potential role of ICTs for economic transformation, MURPHY et al. (2014) differentiate between "thin" and "thick" forms of ICT integration. While thin integration "typically

involves exchanges of discrete bits of information – e.g. prices, dimensions, arrival or delivery dates/times, product colours or styles, or locations – which are vital for the everyday operations or success of the enterprise, thick forms of integration include complex and diverse kinds of information that go beyond voice and text. Thus, "the thick integration of ICTs can enable SMMEs to upgrade their products, processes and services more efficiently" (MURPHY/CARMODY 2015: 70). Transformation can be achieved through significant enhancements of intra-firm resources and intensive forms of information management leading to structural changes and generating higher value and upgrading.

Based on this differentiation of the role of ICTs for economic development by MURPHY et al. (2014), this thesis conceptualises ICT effects on value chains as low, medium and high. By effects, I understand the extent and the usability of ICT use for different activities within the value chains, e.g. information and knowledge flow. Low effects indicate minor impacts of the use of ICT or even no impact at all. Medium effects point to a mixed intensity of ICT use - ICTs are supplementary/complementary to the existing ways of doing businesses, but do not lead to substantial changes or even transformation as high effects are conceptualised. High effects entail upgrading possibilities, significantly changed power relations and structures as well as new routines of everyday activities within value chains. Although I conceptualise ICT effects on value chains as being low, medium and high or somewhere in between, it is not presumed that there is a necessary evolution from thin to thick integration as ICT diffusion progresses.

Critical perspectives of the ICT4D debate

Several authors disagree about the transformational effects of ICT use by bringing forth different arguments including limited conceptualisation, the limited evidence of an effect on economic development and the lack of integration of structural and contextual factors and conditions in the analysis of ICT effects (e.g. AVGEROU 2010; ETZO/COLLENDER 2010; MURPHY/CARMODY 2015).

First, it is argued that the positive assumptions are overestimated without sophisticated empirical proof and conceptual background (e.g. AVGEROU 2010; MURPHY/CARMODY 2015). Studies are of a descriptive nature with anecdotal features and narratives and do not differentiate between ICT use in detail (cf. CARMODY 2012). It is further argued that the developmental and transformational potential of ICTs is often taken for granted in many applied studies without differentiated perspectives. The majority of optimistic ICT4D studies are often based on anecdotes and a rather superficial enthusiasm expressed by development agencies and investors, although empirical strategy portrays a far more complex picture. The link between ICTs and development often rests more on wishful thinking than empirical findings.

Second, the overall impact of ICTs on economic development and structure is critically questioned, arguing that ICTs cannot leapfrog beyond the ordinary development problems Africans are faced

with (KLEINE 2010). Detailed data on usage, especially qualitative and ethnographic studies, remains sparse (PFAFF 2010). That certain technologies are available does not necessarily mean that they are actually used. Low literacy and education levels, difficult access to information and the lack of a steady source of electricity to charge phones were reasons for the limited use of phones (ETZO/COLLENDER 2010). For example, the recent World Development report has found that "their [ICTs] aggregate impact has fallen short and is unevenly distributed" (THE WORLD BANK 2016: 2). While several studies have shown that ICTs for agriculture initiatives have improved farmers' knowledge, this has not necessarily translated into higher yields, output prices or profits (AKER et al. 2016). Evidence even exists concerning the widening of the gap between the poor and the poorest. The most-resourced have gained through mobiles in terms of more orders, larger orders, faster turnaround and better quality of the final product. The least resourced (without access to a mobile) are losing orders (JAGUN et al. 2008). Thus, social polarization and also exclusion can be a negative outcomes of ICT use (KLEINE/UNWIN 2009).

Third, others criticise the techno-optimism in the ICT4D debate since in most cases the influence of technology itself is overestimated, bearing in mind the uneven economic structures in most case studies. It is argued that local political and institutional structures and power relations are often neglected that limit the transformative potential of ICT dissemination (ALZOUMA 2005; AVGEROU 2010; CARMODY 2012; KLEINE 2013; KUMAR 2014). For example, MURPHY/CARMODY (2015) showed in their example of small and medium enterprises in South Africa and Tanzania that ICTs may reduce production challenges, but they are limited to reconfiguring power relations and, thus, have been absorbed into existing structures instead of transforming them. In line with that, ICT4D studies often lack structural context and "geographic sensitivity" (MURPHY/CARMODY 2015: 50). KUMAR (2014) showed in his study on soybeans in India that the broader context (e.g. relationships between intermediaries and farmers, the role of distance and norms) in which a market exchange takes place determines the success of the provision of price information.

Given the controversial viewpoints on the potential effects of ICTs on development in general and on small-scale businesses in value chains in particular, I argue that those effects can depend on several conditions (see Figure 2; AKER et al. 2016; MURPHY 2013). Studies so far have already outlined some factors which influence the effects of ICTs on small-scale businesses. These include the institutional and political context (MURPHY/CARMODY 2015), the nature of the product traded (MOODLEY 2002; MUTO/YAMANO 2009), the quality of information (DUNCOMBE 2014), the type of information (DANNENBERG/LAKES 2013), the size of a farmer's social network, the quality of information (AKER et al. 2016) and the inter-firm relationships (KUMAR 2014; MOODLEY 2002). Following up on this, this thesis outlines to what extent the conditional factors determine the use of ICTs and their potential for

farmers to better participate in value chains. By analysing various conditions, it is aimed to contribute to differentiated perspective of ICT use on development and to explain why such mixed results exist. The following conditions will be the subject of the analysis that follows: the different ICT use types, types of knowledge, capabilities and characteristics of farmers, the form of value chain integration, relational proximity and the spatial distance between farms and the nearest city centre (see Figure 2).

Relational proximity

As outlined above, this thesis argues that the relationship between buyer and producer can influence the use of ICTs and their effects on small-scale based businesses (i.e. accessing information and knowledge via mobile phones). For this reason, I use the concept of relational proximity to conceptualize the various relationships. According to MURPHY (2012: 5), relational proximity is "the degree to which individuals are bound by relationships of common interest, purpose, or passion, and held together by routines and varying degrees of mutuality". Taking into account the numerous other proximity dimensions outlined by BOSCHMA (2005), I understand social, institutional and organizational proximity as parts of relational proximity (also see IBERT 2010). Since the focus of this thesis is on knowledge transfer via ICT (including the recognition of value of new information and knowledge) and not on learning and knowledge assimilation, cognitive proximity and absorptive capacity has not been part of this study.

Particularly for successful economic relationships in unstable market environments such as Sub-Saharan African rural markets and the use of new technologies, relational proximity plays an important role (HUMPHREY/SCHMITZ 1998; OVERÅ 2006). For example, the method of payment and the intensity of knowledge exchange are dependent on the level of trust and further elements of relational proximity between the actors in the chain (MORAWCZYNSKI/MISCIONE 2008; OVERÅ 2006). Particularly the issue of trust which is important in African agricultural contexts, is mostly absent in the ICT4D scholarship, but evidence exists on why it becomes especially important for the use of ICTs. Often the division between social and economic activities in agriculture are unclear, e.g. with farmers and buyers visiting their customers when passing. "Such friendship between customer and buyer can be seen to be economically functional and is based on the same information and sanctions as working relationships, but also draws on shared concepts of morality and altruism based on culturally specific norms" (MOLONY 2008). Within this context, I aim to analyse in how far the relational proximity between producer and buyer can explain the different effects of ICT use. This level of relational proximity can, therefore, also determine in how far e.g. knowledge exchange and financial transactions can be done via ICTs or whether they require personal interactions. Relational proximity will be measured using the farmer's subjective perceptions of trustworthiness (reliability

(experienced in past interactions, common interests and shared values of doing business), the quality of social performances (reputation, immediate advice and payment), and the outcomes of shared experience within their relationship with the respective actor (long-term relationships, familiar practices and routines in doing business; cf. MURPHY 2012: 5). Relational proximity might enrich the value chain approach by emphasizing the horizontal relationships between value chain stakeholder and focusing on social capital and learning as key sources of value creation. Thus, adding the dimension of relational proximity to the analytical dimensions of GVC analysis provides a more comprehensive analytical perspective to understand the usage of ICTs within value chains.

2.4 Research framework and hypotheses

As outlined in chapter one the present study focuses on the following primary research question:

To what extent and under which conditions does the use of ICTs affects small-scale based horticultural value chains and in how far can these developments provide general explanations of value chain dynamics in Sub-Saharan Africa?

On the basis of the analytical framework, this primary research question will be split into more detailed subareas, which are checked by means of the following hypotheses:

H1: The use of ICTs can affect small- scale based agricultural value chains in the Sub-Saharan Africa in different ways. This includes:

a. Information and knowledge flow
b. Financial transactions
c. Market coordination
d. Structural changes in the value chain
e. Power relations
f. Reduction of spatial barriers for information and knowledge flow[20]

H2: The ICT effects within value chains are influenced and can be explained by different conditions. These include:

a. The different types of ICT
b. The type of knowledge

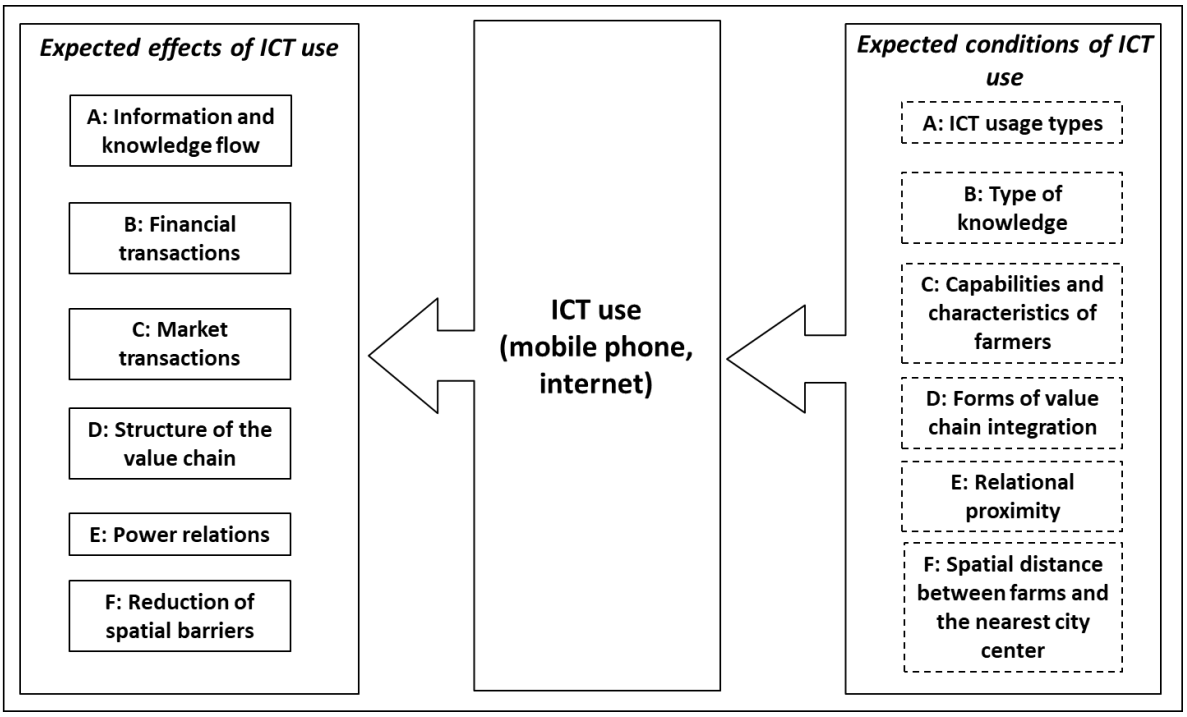
[20] As this variable will be analysed only for the Tanzanian context, no statements can be made about the effects of ICTs on the reduction of spatial barriers for the Kenyan context. The same applies for H2F.

c. Capabilities and characteristics of the farmers
d. The different types of distribution channels in the chain
e. Relational proximity
f. Spatial distance between farms and the next city centre

Based on the findings of the previous studies and conceptual thoughts, the integration of the GVC approach with ICT4D and considerations of knowledge allows the development of an own conceptual framework to analyse, categorize and explain dynamics in small-scale based horticultural value chains in Sub-Saharan Africa in the context of ICT use.

Figure 2 outlines the overall framework, which is based on the notions derived from the literature. As discussed in the chapters above, there have been calls to extend the existing discussions on ICT4D, explicitly providing an analytical and conceptual approach. Particularly the conditions and effects of ICT use on small-scale based value chains have not been given sufficient attention. In accordance with previous studies, I assume that ICTs sought to play an important role in integrating small-scale farmers by improving the information and knowledge flow, financial transactions, market coordination, structure of the chain, power relations and spatial relations. The second hypothesis of this framework is the recognition that the effects are influenced by certain conditions. Specifically, the different types of ICTs and knowledge, the capabilities and characteristics of farmers, the different forms of value chain integration, the relational proximity and the spatial distance between farms and the nearest city centre can influence the use of ICTs and, thus, also the effects. Depending on these variables, the effects of ICT use within small-scale based value chains will be different.

Figure 2. Research framework: Effects and conditions of ICT use; source: own design and illustration.



In operationalizing these ideas, the appendix 1 outlines the independent and dependent variables with the related indicators.

Summing up, the analysis of the outlined effects in relation to the different conditions will help to identify and explain under which circumstances and to what extent ICTs driven dynamics in small-scale businesses based value chains in Sub-Saharan Africa are taking place. These differences will further help to explain the emergence of different ICT uses and its influence on the users. Explanations will also be sought for the contradictory judgments (both positive and sceptical) on the influence of ICTs in the Global South (see chapter 2.3). The present framework will be used to investigate these hypotheses. Hereby chapter three describes the research settings and methodology of this thesis.

3 Research Settings and Methodology

The following chapter explains in detail the selection of the horticultural sector, the research regions and the empirical methods to provide a transparent understanding of the research framework outlined and the empirical results. While the individually published research articles all include a short section on methodology and research region, in this section, the larger methodological framework is expounded. The choice of the horticultural sector (Chapter 3.1) and research sites (Chapter 3.2) will be explained. Further, the methodology and data analysis will be elaborated on and contextualised (Chapter 3.3), and its limitations reflected on (Chapter 3.4).

3.1 The selection of the horticultural sector

Horticulture, especially with respect to high-value crops, has been identified as one of the fastest growing agricultural sub-sectors in Sub-Saharan Africa, including Tanzania and Kenya, in the past two decades (MASHINDANO et al. 2014; MURIITHI/MATZ 2015) [21]. This development is due to a rise in global demand for horticultural products due to the liberalization of international trade, but also because of urbanization and a growing middle classes in Sub-Saharan Africa (WEINBERGER/LUMPKIN 2007). Based on WEINBERGER/LUMPKIN (2007) we define horticulture produce to include fresh fruit and vegetables (FFV), but not cut flowers and processed products. In the following sections, both terms are used interchangeably. The choice of the horticultural value chain for this study has been made because of three reasons:

1. The first reason for choosing the horticultural value chain is the high perishability of the products which requires a fast transaction in the trading process since FFV products cannot be stored and have to be marketed immediately. Thus, fast delivery processes and prompt communication is needed. It is assumed that particularly phones increase the potential for a fast transaction in the trading process (MOLONY 2008; MUTO/YAMANO 2009).
2. The horticultural value chain has been the focus of research regarding the coordination and governance types in the last few years (e.g. DANNENBERG/NDURU 2013; DOLAN/HUMPHREY 2004; GOGER et al. 2014). Those results are mainly interpreted within the Global Value Chain Framework (GEREFFI et al. 2005). Furthermore, the sector is highly dynamic as more smallholder producers become integrated into horticulture GVCs (e.g. DOLAN/HUMPHREY 2004). However, none of those studies have focused on combining the value chain perspective with the use of ICTs.
3. In both regions, horticulture as an agricultural sub-sector is relevant for regional trade and for export markets (MASHINDANO et al. 2014; MURIITHI/MATZ 2015; PORTER 2010). Horticultural production is highly profitable, increases employment opportunities, and brings about increasing commercialization of the rural sector (WEINBERGER/LUMPKIN 2007).
4. Further, it has been observed that the use of ICTs has been increasing, particularly in the horticultural value chains in the last years (DANNENBERG/LAKES 2013). Thus, it can be assumed that changes in the value chain and their related activities (e.g. information and knowledge flow) will occur.

[21] Agriculture accounts for 45% of Tanzania's GDP (2013), whereby in Kenya agriculture accounts for 30% of the GDP (2013). In both countries, 80% of the total population are employed in this sector (GOK 2014; MASHINDANO et al. 2014).

3.2 Introduction of the research regions

This sub-chapter starts with a concise introduction of the horticultural sector in Kenya and Tanzania and an overview of the ICT sector and policy in both countries to provide the context for the interpretation of the changes in the horticultural value chains due to ICT proliferation. Further, the case study regions will be introduced.

The horticultural sector in Kenya and Tanzania

While Kenyan horticultural production is the most successful in the Sub-Saharan African region, the Tanzanian example is a typical case of a Sub-Saharan African region which tries to follow the Kenyan example (see table 1; GoK 2014; HODECT 2010; MURIITHI/MATZ 2015). Revenue earned as a result of horticultural activities in Kenya was US$ 1.7 billion in 2007/08, while Tanzania earned approximately 113.0 million US$ in the same year (MASHINDANO et al. 2014: 10). Particularly fruit and vegetables are one of Kenya's foremost foreign exchange earners (MINISTRY OF AGRICULTURE 2013), having contributed 33% of agricultural GDP in 2013 (THE WORLD BANK 2015) and having grown at a compound rate of 10-12% per annum from 2003-2013 (ITC 2014). In contrast, horticultural growth in Tanzania is recorded to be 8-10% per annum from 2004- 2008 (MASHINDANO et al. 2014).

In both countries the horticultural sector consists of two distinct sub-sectors: export and domestic, but in different proportions in each country (see table 1). While in Kenya, the horticultural export sector has been recognized as a success story and is analysed in various studies (ASFAW et al. 2009; DOLAN/HUMPHREY 2004; MITHÖFER et al. 2008; OUMA 2010) the share of Tanzanian horticultural export in the total export sector is rather low, since most of the horticultural produce is destined for domestic markets (CIA 2013; TANZANIAN HORTICULTURAL ASSOCIATION 2011). Kenya is by far the larger producer of the two: 180 tons of FFV produced compared with 74 tons for Tanzania in 2014 (FAO STATS 2016). Fruit, vegetable and cut flower production are the main aspects of Kenya's and Tanzania´s horticultural production. In both countries, the sub-sector has undoubtedly contributed to increased rural incomes and reduced rural poverty, through both direct production effects and linkage effects, as horticultural incomes are re-spent in rural areas.

While the majority of horticultural growers (about 80%) in both countries are small-scale farmers, the average farm sizes differ. Most of the fruit and vegetables produced in Tanzania come from small-scale farmers with plot sizes of 0.1 to 2.0 ha (TAHA) and in Kenya with farm sizes between 0.2-4 ha, depending on the location and rainfall patterns (MINOT/NGIGI 2004: 23).

As a result, in both countries horticultural production and trade is seen by farmers, traders, politicians and donors as a strategy to increase income and development. Many regions have tried to adapt/adopt? this strategy, including Tanzania (PORTER 2010). The understanding of the success factors and challenges of this sector is, therefore, of great relevance.

Table 1. Horticultural sector in Kenya and Tanzania; source: own calculations based on CIA (2013); (FAO STATS 2016).

Horticulture	Kenya 2014	Tanzania 2014
Production FFV (t/a)	4.738	5.839
Average size of farm	0,1-2 ha (2013)	0,2-4 ha (2013)
Exports of FFV (t/a)	180	74
FFV share of total exports	5%	0.48%

ICT dissemination and use in Kenya and Tanzania

While landline telephone networks were not pursued due to high costs, mobile phone networks in Tanzania and Kenya provide access in rural areas and are affordable for most villagers and internet connections are rapidly increasing (see Figure 3; DANNENBERG/LAKES 2013; ITU 2016). Figure 3 shows clearly that the rapid increase of mobile phone subscriptions in Kenya and Tanzania is commensurate with the rise of subscriptions in the whole Sub-Saharan Africa region. Kenya has a leading role regarding ICT use in the region. In 2003, 4.7% of the population in Kenya and 3.9% of Tanzania´s population were subscribed to mobile phones. Already in 2009, almost half of the population in Kenya (49.3%) where subscribed compared to 29.7% of the population in Tanzania. In 2016, 72% of all Tanzanians where subscribed to mobile phones (ITU 2016). In the same year, in Kenya 84% of the total population where subscribed to mobile phones (ITU 2016)[22]. Of the subscribers, 99% are prepaid, likely because of the high deposit required by operators for customers to qualify for post-paid services and the prevalence of low-denomination prepaid calling cards and, therefore, affordable for a majority of Kenyans and Tanzanians (ESSELAAR/ADAM 2013; WAEMA/NDUNG'U 2012).

However, subscription rates and mobile phone coverage were not evenly distributed within the countries. Urbanity is an important factor for mobile phone diffusion, accordingly Nairobi and Dar es

[22] As already mentioned, subscription rates only provide a general indication of mobile phone access in a country. The GSMA believes unique subscriptions rates, e.g. in Kenya to be considerably lower than total subscription rates at around 31% in 2013 (GSMA 2014). Nevertheless, access to mobile phones is common in Kenya and Tanzania through sharing of phones. One nationally representative survey for Kenya observes that 85% of respondents used a mobile phone, although only 44% owned a phone in 2009 (WESOLOWSKI et al. 2012).

Salaam show the highest country rates. The rural penetration rate in Tanzania is approx. 25% (ESSELAAR/ADAM 2013).

The expanding mobile network also plays a critical role in facilitating access to the internet among users. The vast majority of Kenyan and Tanzanian internet subscribers (99%) access the web through mobile devices, including internet-enabled mobile phones and PCs with cellular (CA 2016; ESSELAAR/ADAM 2013). While 13% of Kenyan`s used the internet in 2011, only 8% used it in Tanzania in the same year (see Figure 3). In 2016, already 57% of the population in Kenya used the Internet compared to 33% Tanzanians (ITU 2016). Similar to the spatial distribution pattern of mobile phone subscribers, internet access is mainly exclusively confined to larger urban settings that provide the complex infrastructure. Thus, in both countries rural areas lag far behind in terms of the reach and quality of the telephone and internet networks and related services. The main challenges include high operational costs due to limited access to electricity, roads and infrastructure security, low population densities and high licence and spectrum fees coupled with unclear spectrum policies in these areas (COMMUNICATIONS COMMISSION OF KENYA 2011; ESSELAAR/ADAM 2013).

The use of mobile technology to provide money transfer services has spread widely across both countries and is offered by several mobile networks. Safaricom's M-Pesa, introduced in March 2007, is the largest, accounting for 82% of mobile money transfer service subscriptions in 2011 in Kenya. In general, 60% of Kenyans use mobile money services (WAEMA/NDUNG'U 2012). After Kenya, the next most successful mobile money market among East African countries is in Tanzania. Tanzania's mobile money use stands at 14.1% (ESSELAAR/ADAM 2013).

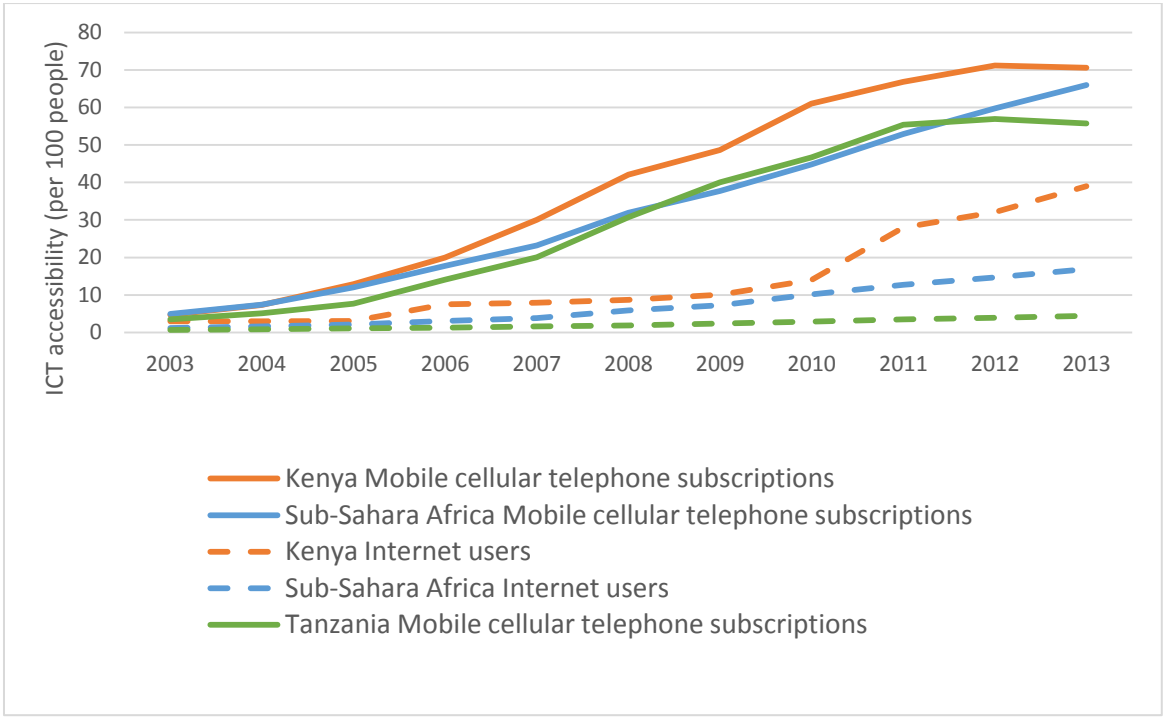
In both countries, the formulation of policies and laws in the ICT sector has facilitated market entry, cost reduction and the increased productivity of telecommunication and other ICT services. For example, Kenya liberalized its telecommunications sector in the late 1990s and created the Kenya Internet exchange point[23] in 2002, which led to a dramatic fall in providers' operating costs and retail prices and an increase in local content (KENDE/HURPY 2012). This had led to an enormous increase in internet use. Further, the government adopted a national ICT policy in 2006 and set up an ICT Board in 2007. Measures included investments in submarine and terrestrial fibre optic cables, the removal of a value added tax for mobile handsets, support for the development of the internet exchange point in Nairobi, sharing of the state-owned electricity company's infrastructure and reduction in the cost of calling between different mobile networks. These measures have played an important role in attracting private sector investment, increasing competition, improving the quality of the network and reducing the cost of mobile access. The government also adopted a National Broadband Strategy to establish faster and more reliable broadband connections around the country (BAUMÜLLER 2012).

[23] Internet exchange points (IXPs) enable internet players (including internet service providers, backbone providers and content providers) to exchange Internet traffic between their networks (KENDE/HURPY 2012).

Market players in the mobile services sector are Safaricom Kenya, Airtel Networks Kenya, Telkom Kenya (Orange) and Essar Telcom Kenya (Yu).

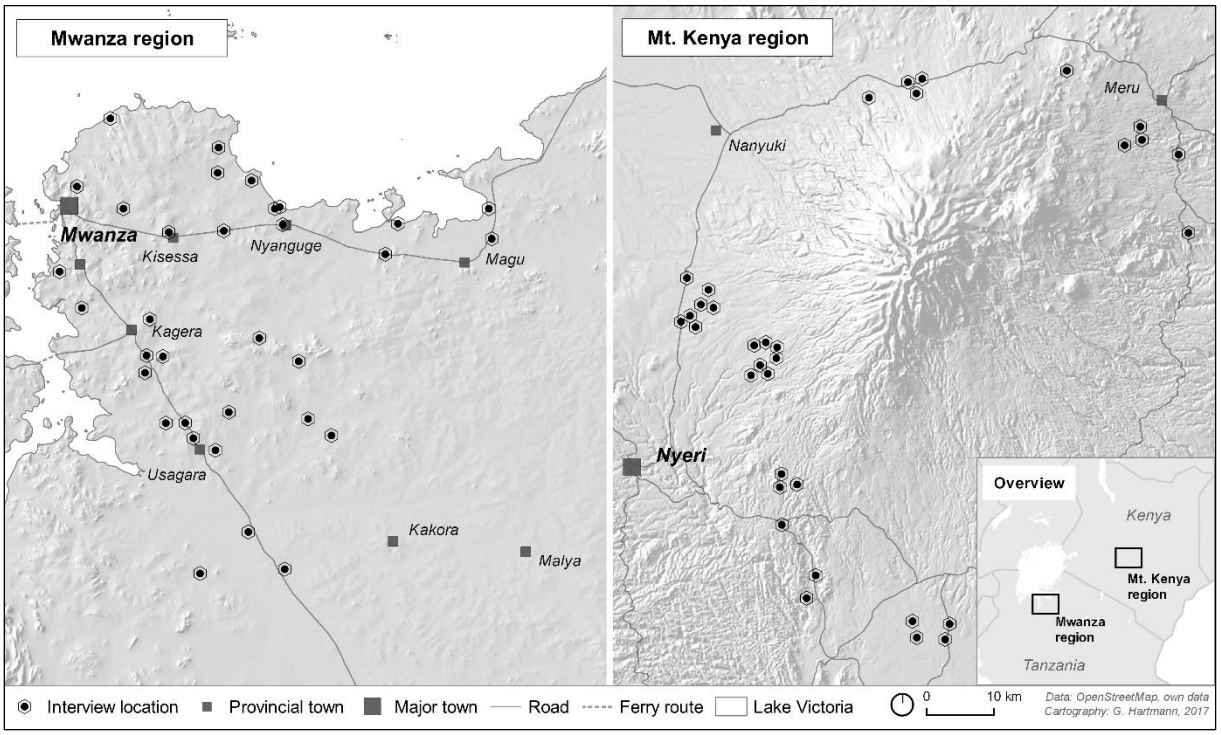
Parallel to this, in Tanzania the government created a conducive environment for more investments in the ICT industry. Two critical events have had an enormous effect on the Tanzanian ICT sector: linking to the SEACOM and the Eastern Africa Submarine Cable System (EASSy) networks in 2009-10; and the launch of the National ICT Broadband Backbone (NICTBB), in two phases (2010 and 2012). These events have reduced voice and data prices, leading to increased use and penetration, as well as supporting the dramatic improvement of mobile money use. More efforts are concentrated on ensuring speedy integration of cost-effective ICTs into the economy by expediting implementation of the National ICT Policy under a PPP approach. The government also implemented various programs, including local content development, e-government, e-procurement, e-business, e-education, e-agriculture and e-health. Since its liberalization, this sector has been growing tremendously, particularly in ICT infrastructure and applications services (ESSELAAR/ADAM 2013). The mobile telephone market has become fully competitive in Tanzania. Private operators provide mobile phone services, data services, paging and internet services. The currently mobile phone providers are: Vodacom, Airtel, Tigo, Zantel, Zain, TTCL.

Figure 3. ICT accessibility (per 100 people) in Sub-Saharan Africa, Tanzania and Kenya form 2003 till 2013; source: calculations based on ITU (2016), own design.



Within these two countries, two research sites have been selected aiming at the maximal variation of commercial small-scale farmers in the sample and due to pragmatic considerations[24] (see table 2; also see for selection of case study regions FLICK 2009; LAUDEL/GLÄSER 2004). Maximal variation is aimed to integrate cases which are different "to disclose the range of variation and differentiation in the field" (FLICK 2009: 122). However, while it is important that the central variable differs (different distribution channels, capabilities and degree of professionalization of small-scale farmers), it should be ensured that the influencing factors (ICT distribution and use) are preferably homogenous to compare the effect of the influencing factors (LAUDEL/GLÄSER 2004). To do this, with the two case regions representing a range of Sub-Saharan small-scale producers, the aim was to cover a broad spectrum of production systems (e.g. local market, export market) in the horticultural sector. While Mwanza is *a more typical example* of a commercial producing region in the Global South which is more representative of other regions in Sub-Saharan Africa and other developing countries, Mt. Kenya is an *outstanding example* of successful horticultural production area with high commercialisation of small-scale farmers. Notable differences and similarities regarding the relevant aspects (horticultural production and export, trading system and road infrastructure and ICT infrastructure) will be discussed in the following sub-chapter and are compiled in Table 2.

Figure 4. Overview of interview sites in the research regions.



[24] As outlined in chapter three, the author has experience in the analysis of the selected sector and the regions and worked together with various experts and actors in the regions as well as international scientists on these topic areas. Further, this study is part of the Mobility Measure Program in 2013 with partner universities in Kenya and Mwanza. Within these partnerships, the research regions were selected.

Mt. Kenya region

The Mt. Kenya Region is located in the north of Nairobi directly on the Equator and is endowed with a generally favourable climate for horticultural production but differs in the intensity and type of vegetable crops produced, accessibility and agro-ecological conditions (DANNENBERG 2012; MURIITHI/MATZ 2015). Here, we can find the major horticultural export production area in Kenya with polarizing farm structures (HCD 2013). Large farms exist, but regarding the pure number of farms, commercial horticulture is still dominated by small-scale family farming with typically less than 5ha (80-85% of the farms; MITHÖFER et al. 2008). These small-scale farmers produce mainly vegetables and fruit for the EU market and are, thus, integrated in often highly coordinated value chains. Commercial domestic value chains (in particular for domestic supermarkets, hotels and restaurants) are also important sales markets. The most important products are French beans, snow peas, avocados and mangoes for export and tomatoes for national markets (DANNENBERG 2012; OUMA 2010).

The capability (e.g. concerning the qualifications, financial resources and equipment) of the farmers is low in comparison to EU producers, but high in comparison to other Sub-Saharan African farmers. Large numbers of the small- scale farmers are integrated via outgrower schemes in quality management systems (QMS) in which they are controlled but also receive significant assistance, knowledge and often also financial support from the exporter who runs the scheme (OUMA 2010). However, large numbers of farmers both in export production to the EU and in commercial production for domestic markets are not integrated in coordinated schemes or directly linked to an exporter, but distribute their produce via independent middlemen.

The region is also characterized by good road infrastructure to Nairobi and the airport which is important for the fast transport of the FFV products for export. However, only unpaved roads lead to remote farmers (see Figure 4).

While the rural regions of Mt. Kenya generally lack a land line telephone connection, the infrastructure and access to mobile phone networks in the study area are good and mobile phones are commonly used. The whole area is connected to a network, e.g. by Essar, Safaricom, Orange and Vodafone. However, the internet and smartphones are rarely used for their farming business.

Mwanza region

The Mwanza region, being part of the wider Lake Region, is an emerging production area for horticultural crops for the region. It is located in the northern part of Tanzania, south of Lake Victoria. The region has a tropical climate, with a rather even temperature distribution throughout the year.

Because of the high altitude, average temperatures are not as high as in the lowlands of Tanzania. The climate of the region is characterized as semi-arid with seasonal rain falls (EVERAARTS et al. 2014).
A total of 24,809 households were involved in the production of different types of vegetables (GOT 2012: 40). Even though Mwanza is known for cotton cultivation, horticulture has become important for the cash income for the rural population as it is largely produced for the market and not for household consumption. Mwanza is one out of six main horticultural production regions in Tanzania (GOT 2012). The majority of farmers are small-scale farmers with an average of one ha (EVERAARTS et al. 2014). There are only very few large-scale farms. Thus, contract farming and quality managements systems among farmers in vegetable chains in Tanzania are limited to the areas surrounding these large farmers.
Even though there is no accessible statistical data of the share of farmers who produce commercially, farmers produce for domestic and further East African markets including Uganda and Kenya (KÖNIG et al. 2011). Domestic products are mainly marketed close to the farm at the local village and nearby small town markets and at the larger markets in Musoma (population 178,000), Mwanza city (population 707,000) and Bukoba town (population 129,000). Most produce is distributed by independent traders and middlemen without a higher degree of coordination involved. Exporting horticultural produce is rarely the case with the exception of trading tomatoes and onions with Kenya and Uganda. Major crops are tomatoes, onions, cucumbers, cabbages and watermelons (EVERAARTS et al. 2014).
The capabilities of small farmers in Mwanza are lower than in Mt. Kenya and farmers have little experience with international standards. The low degree of professionalization goes in line with the few support services they access and their low financial capacities. Farmers mainly transfer knowledge only within their community, even though some national and international programs provide support (e.g. Agriculture First and USAID). Little assistance from buyers exists and quality management systems such as those found in Kenya do not play any significant role (EVERAARTS et al. 2014; KÖNIG et al. 2011).
The roads in the Mwanza Region are in very poor shape and only a few paved main roads exist (Figure 4). Farmers who are located far from the main road are marginalized, not only because they have difficulty in reaching the market, but even more so because traders avoid farms in areas off the main road where transport costs are too high.
Similar to the Mt. Kenya region, the infrastructure and access to mobile phone networks in the study area are very good and mobile phones are commonly used. However, the internet and smartphones are rarely used for their farming business.

Table 2. Characteristics of the two study regions Mt. Kenya and Mwanza.

Characteristic	Mt. Kenya	Mwanza
	Similar Characteristics	
Climate	Diversified and seasonal climate; generally favourable for horticulture, different climate zones; irrigation often needed	Diversified and seasonal climate; generally favourable for horticultural production, irrigation mostly needed
Farm structure	Mainly small farming (80-85%)	Mainly small farming (ca. 85%)
Products	Vegetable and fruit production (French beans, snow peas, tomatoes and mangoes)	Vegetable and fruit production (tomatoes, onions, cabbage and watermelons)
Education	Mainly primary school level	Mainly primary school level
ICT	Mobile phones commonly spread; internet and smart phones rarely available	Mobile phones broadly spread and accessible, internet and smart phones rarely available
	Differentiating Characteristics	
Capability of	Low compared to Western standards but	Low compared to Western standards,

businesses	high compared to other Sub-Saharan regions concerning farming experience and financial capacities	average compared to other Sub-Saharan regions concerning farming experience and financial capacities
Distribution channels	Often highly integrated exporter based systems, but also loose market based distribution systems (via middlemen).	Mainly loose spot market based distribution systems via middlemen and traders
Professionalization in the value chains	Integration in professional domestic and export value chains with advanced technologies including ICT (especially in the EU)	Integration in commercial domestic and export value (but mostly limited to East Africa)

(DANNENBERG 2012; DANNENBERG/LAKES 2013; EVERAARTS et al. 2014; GOT 2012; OUMA 2010)

3.3 Methodology and data analysis

Multi-site case study

The study is based on a multi-site case study[25] with a mixed method approach[26] including 59 semi-structured qualitative interviews with small-scale farmers and 28 buyers in each research region, nine expert interviews with professionals working in this field and a quantitative survey with 368 small-scale farmers. While single case studies usually only include one individual case, multi-site case studies contain several cases of analysis. In this study, the focus is on horticultural small-scale farmers who produce commercially in two sites: the Mt. Kenya region and the Mwanza region. This multi-site approach augments external validity and helps guard against observer biases (SHARP et al. 2012).

[25] A case study is: "An empirical inquiry about a contemporary phenomenon (e.g., a "case"), set within its real-world context, especially when the boundaries between phenomenon and context are not clearly evident (YIN 2013: 18). The case study approach is preferable in situations when "how" or "why" questions are asked, when the investigator has little control over the events, when the focus is on a contemporary social phenomenon and when the researcher seeks to understand complex phenomena while retaining the holistic and meaningful characteristics of real-life events (Yin, 2009).

[26] Mixed methods research "is a research design (or methodology) in which the researcher collects, analyses, and mixes (integrates or connects) both quantitative and qualitative data in a single study or a multiphase program of inquiry" (CRESWELL/CLARK 2007).

Instead of focussing on a comparison between these two regions, this study used data from the two regions to have a diverse statistical population with varying types of different value chain integration and different characteristics of small-scale producers[27]. The numerous structural similarities between the regions facilitate the analysis of cross- country and cross-sectoral structural elements of value chains. Hereby, a cross-case analysis will be applied. This gives a more differentiated picture of the varying types of commercial small-scale farms and their use of ICTs (FLICK 2009). In this way, for example it can be measure if ICT use by small-scale farmers differs within different value chain types. However, in chapter six only the Tanzanian example will be used for empirical analysis.

Mixed Methods

According to HAMMOND/WELLINGTON (2012), mixed methods research "has clear benefits in that it provides confirming, complementary and contrasting sources of data, very often as part of a strategy of triangulation" (ibid., p. 108). Combining the quantitative and qualitative methods allows the researcher to generate complementary databases that include information that has both depth and breadth regarding the phenomenon under study.

Because of the quantitative survey, it is possible to collect statistical data to categorize and summarize it in a sufficient manner. The survey is used to provide descriptive and bivariate statistics about the extent of ICT use within the different horticultural value chains, structural characteristics of producers, practices of ICT use and value chain integration (type of chain and buyer). It also aims to characterize the respondents regarding farming, distribution channels and skills. Furthermore, it mutually validates the findings of both methods (triangulation; see FLICK 2009) and adds scope and depth to this study and, thus, puts the findings on a more solid foundation. Due to its limitations regarding insufficient options to answer an interpretative analysis of the survey, data is restricted (PFAFFENBACH/REUBER 2005). Therefore, the qualitative data is used to fill that gap. It offers the opportunity to give contextual explanations of the quantitative data. Particularly, the measurement of relational proximity requires a high level of contextual knowledge that is limited within a quantitative approach. While the use of semi-structured interviews with small-scale farmers and buyers provides subjective knowledge of each value chain actor regarding ICT use and value chain activities, interviews with experts supply the study with professional expert knowledge (see FLICK 2009).

The mixing occurs either concurrently or after some time passes. During the data analysis stage, quantitative data facilitated the quantification of the qualitative data and shed new light on qualitative findings. Alternatively, during the data analysis stage, qualitative data played an

[27] For pragmatic reasons, a comparative case study has not been conducted since cross-cultural research by a single researcher can be difficult due to limitations in time, resources and access (BRYMAN 2008).

important role by interpreting, clarifying, describing, and validating quantitative results (JOHNSON et al. 2007).

The sampling strategy applied of this mixed method study involves the selection of cases using both probability sampling (to increase external validity) and purposive sampling strategies (to increase transferability). Such a sampling technique is particularly appropriate for mixed methods studies since it incorporates both goals of the generalizability of the research findings and an in-depth understanding of the research context (SHARP et al. 2012).

Field work periods

Instead of choosing one long consecutive fieldwork stay, several shorter periods were chosen (see Table 3). Visiting the research sites more than once enabled me to analyse and discuss data at my home university before entering the next field work period. This allowed me to reflect during the gaps in the data-collection process.

Table 3. Overview of fieldwork periods.

Date	**Location**	**Data Collection**
August 2013	Mt. Kenya	Surveys and semi-structured interviews with small-scale farmers, buyers
August till October 2013	Mwanza	Surveys and semi-structured interviews with small-scale farmers, buyers
January till February 2015	Mwanza	Semi-structured interviews with small-scale farmers, buyers and expert interviews
February till April 2015	Mt. Kenya	Semi-structured interviews with small-scale farmers, buyers and expert interviews

The first field trip in 2013 was part of a BMBF mobility program "Changing gender roles in Sub-Saharan horticultural family farming", a joint research project with the University of Cologne (Professor Peter Dannenberg), the University of Vechta (Professor Schumacher), Saint Augustine University of Tanzania (Dr. Bandiho and Dr. George Masanja), and Karatina University, Kenya

(Professor Nduru). During this project, the first empirical data was collected and various contacts with farmers, buyers and further stakeholders established. Furthermore, a survey was constructed for the project as a team, whereby the author essentially contributed to the further development of the conceptual framework, construction of the survey, and conducting pre-tests and the survey. This survey is also used for this study (see appendix 1).

Fortunately, for the next field trips these existing contacts and partnerships with local partner universities were very useful. The Saint Augustine University of Tanzania (Dr. George Masanja), and Karatina University, Kenya (Professor Nduru) welcomed me during my fieldwork periods and provided me with great support and assistance. These partners were of great help in resolving the practical issues of conducting fieldwork in foreign environments, choosing interview sites, organizing transport and translating the interviews (from Kiswahili to English). Particularly the introduction of research assistants for the whole research project was essential for the success of this thesis. The field assistants (one in each country) were staff members from each partner university. They were selected by each partner (Professor Gilbert Nduru and Dr. George Masanja) according to their scientific background as well as their expertise in the research area. Their tasks were mainly translating the semi-structured interviews and conducting the surveys as well as acting as guides in the local communities[28]. Moreover, they also provided insight on local community dynamics and guidance on cultural and safety issues, and negotiated access to local gatekeepers. Before starting the data collection, they were introduced to the research design and methods. Their knowledge of the research area was very useful, particularly when triangulating the data collected. Nevertheless, their role as translators also needs to be critically discussed (see chapter 3.4). Moreover, the cooperation went beyond the field periods and further assistance was given even while back in Germany (joint publication, collecting data and data cleansing).

3.3.1 The quantitative approach

In order to collect the quantitative data, a survey was created in a research team within the BMBF Mobility Measure Program which was carried out in both research regions between August and October 2013. The pre-test and subsequent adjustment of the survey were part of the BMBF Mobility Measure Program in 2013.

Horticultural small-scale farmers who produce commercially were the focus of the survey. The total target population of the present analysis consist of all horticultural small-scale farmers in both

[28] In general, quantitative as well as qualitative data collection in developing countries is constrained by several factors, especially in rural areas. Among those are access to remote areas, informal structures and language barriers (see DANNENBERG 2012; CAESAR ET AL. 2006).

regions, who produce for commercial markets (domestic and internal). To quantify this total population is challenging due to several reasons; first, the available statistical data in both regions is limited and its reference frame is not clear (e.g. different geographical boundaries and definition of small-scale farmers). Secondly, the number of farmers varies significantly according to seasonality and demand (cf. DANNENBERG 2012; MITHÖFER et al. 2008).

The interview sites (farms) were selected based on interviews with experts (e.g. the Ministry of Agriculture in Kenya and in Tanzania) and the local partner Universities[29]. It was ensured that diverse locations with different characteristics were selected (e.g. distance to main road or next market place, access to water) to reduce the influence of site-specific factors (e.g. special physical conditions). Thus, attention was paid to include farmers from remote places and central places (depending on the distance to the nearest main street or nearest urban centre as a market place). A remote location can lead to poor access to knowledge and markets which reduces competition and profit margins. Within the villages, the respondents were selected randomly by informal local leaders or village chiefs (gatekeeper; CRESWELL 2013). Only farmers who produce commercially horticultural crops and are small-scale were asked to participate in the survey.

The survey was conducted partly by the project participants of the BMBF Mobility Measure Program (including the author) during the field trip and partly by the author and by briefed field assistants from SAUT University and Karatina University. To design and pre-test the survey within the research group of the BMBF Mobility Measure Program offered the advantage of being able to refer to expert knowledge from local scientists. Thus, questions were formulated, constructed and arranged together according to the local settings. Altogether 368 small-scale farmers were interviewed in the Mt. Kenya and Mwanza regions from August to October 2013.

The survey contained standardised and partially standardised questions that were oriented to particular aspects of the research questions and hypotheses. As this survey was designed by the research team participating in the BMBF Mobility Measure Program different thematic blocks were included, which were not all used for this thesis (for the full version, see appendix 1). The survey was divided into nine parts with questions regarding business relationship (Part C; e.g. integration in quality management systems and target customers), questions on ICTs (Part D; e.g. types of ICT and usage), specific questions on phone users (Part E) and specific questions for internet users (Part F)[30]. The general blocks on farm characteristics (Part A; the size of the farm, educational level, turnover rates) and final questions on future expectations (Part I) were also analysed in this thesis. This is especially meaningful to measure the different degrees of the farmers' capabilities. It is assumed that

[29] The selection of the research sites and respondents with the support of local assistance will be critically discussed in chapter 3.4.

[30] Furthermore, questions on gender roles (Part B) were also included in the survey, but are not of interest for this thesis.

the use of ICTs differs regarding the various distribution channels and characteristics and capabilities of the farmers (see chapter 2). As it is assumed that mobile phones are used more frequently than the internet, more questions are related to phone use (see Part D and E). Additionally, subjective assessments of access to the different types of information and knowledge related to their use of ICT were also asked (Questions D3 and 4). This is particularly important to analyse the effects of ICT use on producers. However, because of the fuzziness of the concept of information and knowledge, quantitative surveys can only provide a first orientation and have to be combined with qualitative analysis. Power relations between the individual actors and buyers and suppliers were also asked about (Questions C4 and 5) to analyse another effect of ICT use on producers. Most of the questions on business relationships are used to describe the context and analyse the conditions under which ICTs are used. Particularly with the help of this block, significant differences in ICT use regarding various characteristics of the producers were identified. All in all, the survey made it possible to achieve reliable information on the integration of small-scale farmers in the horticultural sector as well as general tendencies in ICT use in the region.

After the collection of the data, the questionnaires were entered into SPSS for a statistical analysis and overview. The results were analysed mainly using descriptive analyses. Statistical testing procedures (Chi^2) were applied to prove the significance of the results. The results were, hereby, differentiated according to ICT usage types or distribution channels and the significant differences regarding farming or ICT characteristics were tested with Chi^2-tests (see BAHRENBERG et al. 2013). Additionally, bivariate regression analysis was used to identify the associations between the indicators for the expected dimensions of ICT-driven effects and the indicators for the different characteristics of the outlined variables (BACKHAUS et al. 2013).

Table 4. Profile of the survey respondents.

Characteristics of interviewees (n=368)	**%**
Residence in Mt. Kenya	52
Residence in Mwanza	48
ICT user	91
Non-ICT user	9
≤ 30 years	20
30-50 years	63
≥ 50 years	17
Primary educational level	69
Higher than primary education	31
Female	31
Male	69

3.3.2 The qualitative approach

The qualitative data collection consists of semi-structured interviews with value chain actors (producers, buyers), and experts (e.g. representatives from NGOs, associations; scientists; see Table 5). Semi-structured interviews have some degree of predominated order, but still ensure flexibility in the way issues are addressed by the interviewees. This approach was used to gain an in-depth understanding of the dynamics between agricultural value chains and the use of ICTs through the examination of the example of horticultural small-scale producers in Tanzania and Kenya.

The selection of the respondents for the semi-structured interviews was aimed at relevance for the study not for representativeness. The aim of the analysis is, rather, to capture characteristic features of the cases and then carry out a typologisation.

Two sampling strategies were applied. First, the respondents were sampled purposively in order to select typical cases of horticultural commercial small-scale producers in both research regions. That means that each research region is well characterized by the chosen respondents. In Mt. Kenya mainly export-oriented farmers were interviewed, while in Mwanza the farmers interviewed were mainly domestic-oriented. As a result of this, the detection of causal connections between the effects of ICT use and value chains are facilitated. Second, within those typical small-scale farmers` respondents were chosen to show contrasting cases (FLICK 2009). Horticultural farmers within different distribution channels were subdivided according to ICT use and non ICT use. Thus, it is not only possible to compare small-scale farmers within different value chain types (respectively different distribution channels), but also within different ICT usage patterns (e.g. using ICT and farmers not using ICT).

Similar to the selection of the survey respondents, those respondents were selected with the support of local partners. Particularly, for the identification of typical and contrasting cases, the local context knowledge of the research partners was very helpful and indispensable. With the help of gatekeepers, contacts in the villages were built and interviewees were accessed according to the sampling strategy explained. In some cases, the farmers interviewed for the survey had also been interviewed for the semi-structured interviews. The extension officers from the Ministry of Agriculture (MoA) in Tanzania and in Kenya played a special role. Due to their daily work with farmers, they have access to many contacts which they passed on to the researcher. In contrast to the survey, the qualitative interviews were conducted by the author herself (with the support of the research assistant to translate)[31].

[31] Hereby, the participants of the BMBF Mobility Measure Program were not involved (neither in constructing the questions, nor in conducting the interviews).

The interviews were carried out in a flexible and adjustable way allowing a dialogue between the interviewer (respectively the research assistant) and interviewees. However, guidelines were formulated beforehand to improve the interview structure. The uniform empirical assessment allowed a comparability of the results which are the basis for an interpretative typologisation and theory generation. For each value chain actor, a different guideline was developed (see appendix 1). The guidelines are based on the research questions and are aimed at identifying the different aspects how of ICTs are used for value chain activities and how value chain integration is configured and coordinated. Particular focus was laid on obtaining information about how value chain actors interact, collaborate and use ICTs (see appendix 1 for full version of guideline). The guidelines were tested and refined after a pre-test. The interviews were held face-to-face and lasted between 30 minutes and 1.5 hours. In most cases, the interviews were digitally recorded. When it was not possible (e.g. if a respondent did not agree to recording the interview), field notes were taken. The interviews were mainly done in Swahili and immediately translated into English by a research assistant. The survey was continued until a theoretical saturation of the sample was achieved.

Complementary interviews with experts were carried out to gain insights on the previous development of ICTs in general and in the horticultural sector to understand the structure and development of the horticultural sub-sector in each country and to discuss the meaning of preliminary results to enhance the interpretation and understanding of the results in their regional context. Experts are people who have specific knowledge of the research subject and its social and local context (LAUDEL/GLÄSER 2004). In this thesis experts are 1. stakeholders that are not included in the horticultural value chain, but with valuable knowledge about it due to their direct involvement (e.g. extension officers, staff from MoA); 2. people from institutions working with ICT related topics (e.g. GSMA staff). To conduct such interviews, semi-structured interviews were applied (see appendix 1).

The field notes and interview recordings were transcribed and grouped according to categories, with the help of qualitative data software (MAXQDA). Structural content analysis was used to structure the material for the process of coding (MAYRING 2004). Coding "is a process labelling and categorizing data as a first step in the analysis" (FLICK 2009: 373). Thus, codes are text passages that symbolize mutually exclusive categories. They have been either derived from the theoretical frameworks (e.g. value chain types) or have been derived from the material itself (e.g. importance of social relations) (CRESWELL 2013).

Table 5 provides an overview of the qualitative interviews conducted. To preserve confidentiality, the names of interview partners were anonymised when citing them directly or indirectly. Each interview was given a number (e.g. Farmer#1).

Table 5. Overview of semi-structured interviews per research region and respondent type.

	Tanzania	Kenya	Total
Farmers	32	27	59
Buyers[32]	13	10	28
Experts	11	22	33

3.4 Limitations of the methodology

Concerning the methods and research process applied, it is crucial to acknowledge several limiting factors when interpreting the data.

First of all, a critical point refers to the challenging data situation regarding Tanzanian and Kenyan horticultural production (such as the number of farmers, size of farms). A secure data situation and the representative nature of the sample are not ensured, because of the yearly and seasonal fluctuations of producers and the limited statistical material for each country. The sample only includes a limited proportion of all small-scale horticultural farmers in both regions. Further, a bias might exist in the selection of the respondents as only those who are confident are willing to answer the survey and semi-structured interviews. These respondents might also be those who are more successful in farming or using ICTs due to their open attitude.

The second point refers to empirical research in the Global South in general and relating thereto its access to respondents. Particularly in rural areas, access to informants and respondents is challenging due to limited access to villages, informal structures and language barriers. Moreover, postal addresses are missing and, thus, the identification of respondents can be very problematic.

Another critical point concerns the uncertainty regarding some questions in the survey. Particularly, the question about access to information and knowledge in the survey contains some challenges for the interpretation of the data. Asking people about issues concerning their knowledge access has problems as people are not always aware of what they know. Besides, knowledge may be articulated in many ways, not only via verbalizing. Thus, in some instances, explanations for practices may be incompletely articulated, e.g. the access to tacit knowledge. Altogether, the triangulation of the quantitative and qualitative data together with the literature review provides the reliability of the statements described.

Another critical point concerns the role of the researcher. FLICK (2009) points out that for the assessment of the validity of the data, the "researcher has to critically reflect himself" (ibid., p. 22). That means that the authenticity of the interviews conducted has to be questioned and especially the role and positionality of the researcher. Aspects like gender, age and hierarchy can have a

[32] This include exporters, middlemen and retailers.

significant influence on the responses of the interviewees. Certainly it was an advantage that the researcher is female and younger than most of the respondents and plays no role in the local hierarchy. But these advantages may lose their importance as "otherness" (FLICK 2009: 93) observable by different skin colours and origin influences the interview situation. "Race, ethnicity, class, gender, religion, marital status and other non-demographic characteristics often define the position and identity of the researcher in relation to the researched community" (APENTIIK/PARPART 2006: 35). Accordingly, these factors can influence the interview situation and also the quality of the data as the researcher might not access all the relevant information of the respondent. Particularly, in the case of our research regions, people do not have much contact with researchers from other countries and, thus, might be to answer all the questions. However, since the interviews were always conducted together with a local research assistant and the respondents were introduced by a local gatekeeper, these concerns might be reduced. Additionally, the researcher visited some villages and market places several times to build a trustful relationship which might also reduce the challenge of being foreign to the local situation. Moreover, a large part of the survey was conducted by local research assistants from the partner universities who are familiar with the research sites and the people.

Both in the conduct of the research as well as in the analysis, cultural misunderstandings may exist. Cross-cultural research design bears the risk of misleading the interpretation of the answers given. The statements of the interviewees and interactions between the respondent and the interviewer cannot be similarly interpreted by cultures that are outside one´s own society. "One of the main criticisms of outsiders 'research is its tendency to produce knowledge or interpret societies from a position or location of power and privilege, and in most cases without sufficient input from the local people" (DESAI/POTTER 2006: 34). Thus, it is necessary for the researcher to reflect the statements of an interviewee and re-evaluate the previous understanding of the research practices and interpretation. Again, cooperation with a local research assistant might have minimized these challenges. As mentioned before, they were selected by the director of the departments of each university according to their scientific background as well as their expertise in the research area. They were not only translator, but also "ethnographic informants" (BUJRA 2006: 177). Their knowledge of the research area turned out to be very useful, particularly when triangulating the data collected.

Moreover, their role as a translator has also to be critically reflected. During the interviews, each question was translated from Swahili to English. The translator was briefed beforehand and all the questions clarified. However, it cannot completely guarantee if the translator and the respondents correctly understood the questions in all cases. Even though the research assistant can capture the statements of the respondents more precisely than the researcher, the assistant is not a professional

translator and English is a foreign language for both the researcher and the assistant (BUJRA 2006). To avoid misunderstandings, each question of the semi-structured interview and the survey was clarified before the interviews. Besides, it is not clear if all the information given by the respondents was translated accurately or only summarized or "filtering out what they consider unimportant, even though this might be precisely what the researcher needs and wishes to know" (BUJRA 2006: 176). Therefore, the translation of the data material can contain potential sources of inaccuracy which can lead to misunderstandings regarding the meaning of interviewees' statements. However, due to the briefing and debriefing of the research assistant the researcher assumes that no great loss of knowledge in this study occurred and the data collected by the assistant is valid.

4 The Use of Modern Information and Communication Technologies in Smallholder Agriculture: Examples from Kenya and Tanzania

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Abstract

Through examining the example of commercial small-scale horticultural farmers in Mt. Kenya region and Mwanza region, this empirical study aims to provide an explanation for why different perspectives on the impact of information and communication technologies (ICT) in the Global South exist. A mixed methods approach was used to show that ICT usage can lead to significant

improvements, including access to simple and complex knowledge and the development of business linkages. However, the influence of ICT depends on the different ICT usage types and the capabilities of farmers to use them. This paper gives a differentiated view on factors influencing the effects of ICT on small-scale farming. It provides a typology of ICT that helps to explains some of the potential effects of ICT usage in the Global South. The results contribute to the current applied and conceptual debate on market access for smallholders and Information and Communication Technologies for Development.

Keywords: information and communication technologies, horticulture, smallholders, markets, agricultural value chains, knowledge exchange, East Africa.

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Introduction

In the Global South, and especially in Sub-Saharan Africa, agricultural small-scale production is often the most important sector for employment and income. Subsistence production is gradually being replaced by market-oriented production and agricultural producers are being integrated into supraregional commodity chains. The Kenyan fresh fruit and vegetable production (FFV) sector is a forerunner in the integration of small-scale famers and traders into international value chains in the European Union (DANNENBERG/NDURU 2013), a trend which Tanzanian businesses are trying to follow. In Tanzania, such export orientation has not taken place yet but they are also increasingly supplying professional commercial retailers for domestic and African export markets (KÖNIG et al. 2011; KRONE et al. 2014). Thus, Kenyan and Tanzanian FFV value chains are examples of different types of commercial

small-scale farming and integration into different distribution systems.

In order to connect with commercial markets, an increasing number of small-scale businesses in the Global South are using information and communication technologies (ICT), including mobile phones and the Internet (DONNER/ESCOBARI 2010). This can also be observed in the Kenyan and Tanzanian FFV production, although Kenya is ahead of Tanzania in this development.

Based on a general debate surrounding the benefits and disadvantages of the application of information and communication technology for development (ICT4D), a range of applied studies have emerged (e.g. OKELLO et al. 2013b). At the moment, there are already large programs and activities on the applied side, e.g. by private companies who develop new markets for mobile phone companies and by donors who support small businesses. These projects are generally based on the assumption that the outputs of ICT-usage are only or mainly positive. Without a clear conceptual

basis and given the fact that the mid- and long-term effects of these developments are hardly predictable, this assumption can be misleading and some studies on the use of mobile phones even indicate negative effects (CARMODY 2012).

Generally, a deeper understanding of how ICT can affect small-scale farming in the Global South is missing (see also the critique by DONNER/ESCOBARI 2010). Most studies (e.g. MOLONY 2008) also only analyse the use of mobile phones without a deeper analysis of the internet. However, preliminary results suggest that the influence of ICT on farming businesses is dependent on the different types of ICT usage (DANNENBERG/LAKES 2013; KRONE et al. 2014). Those different types of ICT usage and the underlying causalities could assist in explaining the potential effects of ICT on development.

This paper aims to close this research gap by providing a differentiated quantitative and qualitative study of FFV farmers in the Mt. Kenya region (Kenya) and Mwanza region (Tanzania). By using data from dissimilar types of farmers, this study provides a broad and differentiated picture on ICT usage. Firstly, we identify and explain different causalities and factors which influence the usage of ICT by developing ICT usage types including the internet. Secondly, we analyse the effects ICT can have on these farmers based on the different ICT usage types. Further, this paper aims to enrich the current conceptual and applied debate on ICT4D by arguing that the effect of ICT on development depends on the different usage types.

ICT for development and its relevance for small-scale farming

The organization and coordination of business activities today is largely supported by ICT-based solutions like E-trade and Web-enabled management tools on complex logistics systems. Particularly in developing countries, the rise of ICT – often on a simpler level – has dramatically increased the access to, the volume, and the richness of available knowledge even in peripheral regions (QIANG et al. 2011; UNWIN 2009). This has also led to positive expectations concerning the impact of ICT on economic, social and political development in the Global South, including agricultural production systems and their integration in professional and international markets. These expectations have resulted in the realization of various public and private programs and projects funded by international organizations such as USAID, the FAO and the World Bank under the term ICT4D (see QIANG et al. 2011).

Practitioners, in particular, highlight the positive effects of ICT4D including economic recovery through leapfrogging (by skipping the stage of landline telephones) and improving business as well as social connectivity (GRAHAM 2011). Regarding the spread of business to business (B2B) e-commerce in the Global South, HUMPHREY (2002) suggests transaction costs could be reduced and become less sensitive to distance by shifting transaction- and information-oriented exchange to ICT-based solutions (e.g. e-commerce). AKER/MBITI (2010) identify five potential mechanisms through which ICT

can provide economic benefits: 1. by improving access to and use of information, 2. by improving productive efficiency, allowing for businesses to better manage their supply chains, 3. by creating new jobs to address demands for ICT-related services, 4. by facilitating communication within social networks in response to shock and, thereby, reducing businesses´ exposure to risks, and 5. by facilitating the delivery of financial, business, health, and educational services (see CARMODY 2012).

Small-scale farming in Africa

Especially access to commercial markets is a great challenge for small-scale farming in Africa and for small-scale resource-based businesses in the Global South in general. Applied studies (e.g. QIANG et al. 2011) argue that access, e.g. to text messaging services or websites bears the potential to fundamentally increase small-scale farmers' access to market links and distribution channels, finance services and extension services previously unavailable to them. DANNENBERG/LAKES (2013) show that the usage of mobile phones can support farmers in linking up with local organisations and extension officers in order to access knowledge and fulfil the process requirements of their respective buyers. They further indicate simple information (e.g. simple facts on weather or prices) can be exchanged easily via ICT while this is much more difficult or limited in the case of complex knowledge exchange (e.g. production techniques). According to MURPHY ET AL. (2014) the type of information can be crucial for the potential benefits derived through the use of ICT. HUMPHREY (2002) argues that the use of ICT can help small agricultural producers to reduce information asymmetries (e.g. regarding export market prices) with their buyers and, therefore, strengthens their bargaining position. Furthermore, ICT solutions may increase the number of options for business partners, which can lead to a better selection of partners. OKELLO ET AL. (2013) even see a transformation potential as a result of internet and mobile phone-related innovations which may result in new forms of organization and marketing in farming.

Critical perspectives on ICT in farming

While the positive achievements and potentials of ICT have been highlighted, there are also more critical notions on ICT for farming in developing countries which indicate ICT might be overestimated and/or lead to negative developments.

Both, the disintermediation potential as well as the transformative potential of ICT are discussed controversially: DONNER/ESCOBARI (2010) more likely see a consolidation of middlemen (who themselves use ICT, especially mobile phones). They generally predict an increase in the use of ICT in the Global South which will impact the production and distribution systems, but not necessarily change the underlying mechanisms and structures.

HUMPHREY (2002) argues that the potential positive effects of ICT may be accompanied by problems and negative impacts. Since the usage of ICT is dependent on the openness of necessary physical infrastructure and software this can create entry barriers– not only to ICT usage, but also to knowledge flows and additional transactions, initially not based on ICT, which are shifted to ICT usage. For small-scale enterprises, the proliferation of technology such as mobile phones may also increase inequalities between wealthier enterprises, that are able to afford mobile phones, and poorer enterprises, that are not (the digital divide), and, therefore, are at risk of being excluded from new possibilities (HEEKS 2014). This suggests the influence of ICT on farming is dependent on the different capabilities of the farmers (financial capability, education). CARMODY (2012) further pointed out that while the use of mobile phones helps to connect to international markets, it also leads to increasing worldwide competition in which enterprises of developing countries often struggle to compete against strong international competitors.

Research questions

Based on the different and partly contradictory opinions on the use of ICT in farming, we argue that ICT has an influence on farming, especially on knowledge access, in terms of providing the possibility to use different distribution channels, and on the bargaining position of the farm. However, we also argue that the influence of ICT on farming is dependent on different variables, including at a minimum the type of ICT usage and the different capabilities of the farmers (i.e. education, financial resources).

To test these assumptions, we posit two research questions:

1. What are the different ICT usage types of farmers for business purposes in relation to the capabilities of the farmers?
2. In how far does the usage of ICT influence the farmers regarding knowledge access, distribution channels and bargaining positions?

This paper focuses on commercial small-scale fresh fruit and vegetable farmers. The data source of this paper is drawn from qualitative and quantitative field studies in the Mt. Kenya region and Mwanza region (autumn 2013 and spring 2015). The regions were selected because of their high numbers of commercial small-scale horticultural farmers with different capabilities and distribution systems. Within those regions, we identified typical villages based on expert interviews with local scientists and the Ministry of Agriculture. Hereby, we aimed at a maximal variation to disclose a range of differentiation in the field (FLICK 2009). The interviewees in the villages were selected randomly by key informants. Once contacts with selected farmers had been established, snowball sampling followed (FLICK 2009). In order to measure the effect of ICT use on agriculture, both farmers using ICT and non-users were interviewed.

In 2013, we conducted a pretest and a survey with 368 smallholders in both regions and 21 explorative interviews with agricultural smallholders and experts in both regions[33]. The survey questionnaire contained pre-categorized and partially categorized questions oriented on particular aspects of the research questions. These included questions concerning ICT (e.g. types of ICT) and a section covering the capabilities of farmers (e.g. educational level) and questions on their subjective assessment of access to knowledge as well as on power relations between the individual actors and stakeholders (e.g. bargaining position). Moreover, the different distribution channels were evaluated. Following the preliminary data analysis, a further 61 semi-structured interviews were conducted in spring 2015 with farmers, stakeholders across the value chain, and experts.

Instead of focussing on a comparison between the two regions in question, we used data from these two regions as a broad statistical population. This gives a more differentiated picture of the varying types of commercial small-scale farms and their integration into different distribution systems.

Following the primary survey, the data was analysed with SPSS. Correlation analysis was used to identify the associations between the indicators for the expected dimensions of ICT-driven effects and the indicators for the different characteristics (or combinations of characteristics) of the outlined variables. Statistical testing procedures (Chi^2) and bivariate regression analysis were applied to prove the significance of the results. In addition to the general question of whether a significant correlation exists, the strength and the form of the correlation were also of interest. The analysis of the interviews was based on the principles of qualitative content analysis (MAYRING 2004) and were mainly used to interpret the quantitative results.

Different ICT usage types in relation to capabilities

As Table 6 shows, the majority of the respondents were ICT users (91%). The mean age of the respondents ranged between 31 and 50 years. Most respondents were male. The majority of respondents attended primary school (69%), while 30% had a higher educational level. The median monthly turnover was US$101.

Table 6. Overview of quantitative interviews.

Region of residence (n=368)	*In %*	*Educational level*	*In %*
Mt. Kenya	52	primary	69
Mwanza region	48	higher than primary	30
ICT use	*In %*	*Gender*	*In %*
ICT user	91	male	68
Non ICT user	9	female	31

[33] The interviews were held in English and in Swahili (by local research assistants supervised by the principal researchers).

Age	*In %*	*Monthly turnover (n=299)*	*Median value*
< 30 years	19		10.000 KSH ($101)
31- 50 years	63	< 10.000 KSH ($101)	52 %
> 51 years	16	> 10.001 KSH ($101)	48 %

Different prerequisites and capabilities need to be met so that farmers can use technologies in various ways. In order to use a phone to make a call, farmers do not need to have a primary education level. However, in order to use a phone to send text messages, it is necessary to be literate. Furthermore, in order to use the internet, a device with internet connectivity (computer, smart phone or a feature phone) or access to an internet kiosk has to be available and the farmer has to have sufficient command of the English language. Based on these different prerequisites and the varying levels of complexity, we ordered the identified types of usage into: 1. only voice user, 2. voice - text user and 3. voice - text - internet user (Table 7).

The least complex ICT usage type was comprised of farmers using their phone for calls only (13%). Calling was used to immediately access information on a particular topic, e.g. market prices. Amidst the different ICT usage types, the combination of text and voice was the most dominant (67%). Texting was often used to confirm business deals that had been negotiated before. Mobile payment also takes place via text messaging and was used by 64% of all respondents[34]. Texting for crucial knowledge transfer was often regarded as not reliable as an immediate means for communication.

The picture is divergent for the usage of the internet with a share of only 11% (Table 7). This can be related to the lack of awareness about connectivity availability, limited knowledge about how to use the internet and the complexity of using the internet (cf. DANNENBERG/LAKES 2013). Further barriers for using the internet were related to connection costs, purchasing costs (e.g. smartphones or computers), and the lack of public access to the internet. Nevertheless, the internet was used to access detailed knowledge, e.g. on specific pesticides and their usage and also on prices outside the region.

Only a small group of farmers (9%) did not use mobile phones or the internet for farming business[35]. This indicates that while in general some parts of the population in East Africa are still not using ICT[36] due to a lack of awareness (MTEGA/MSUNGU 2013), the vast majority of the commercial farmers in the research areas uses it.

Table 7. Overview of ICT usage types (n=368; 32 farmers did not use ICT, in % and total n).

Only voice user	**Voice - text user**	**Voice - text - internet user**

[34] However, for export production, mainly bank checks were used due to the formalised contract system and higher security.

[35] We only asked about the use of ICT for farming business and not about ICT use in general.

[36] In total, 71% of all Kenyans and 56% of all Tanzanians use mobile phones (ITU 2016).

13% (45)	67% (243)	10% % (41)

A regression analysis was run to determine the significance of determinant factors for using ICT types that included level of education and income (Table 8). As expected, a high educational level tends to be especially important for the use of the internet as it requires comprehensive reading and writing skills in English. Mainly farmers with a college degree had access to the internet. Hence, the majority of farmers did not use such complex ICT usage types such as the internet (Table 7).

Unexpectedly, we could not prove that high financial resources are an important variable regarding access to the internet or any other ICT type. However, the qualitative interviews reveal that high costs of internet connection and hardware are still barriers to using the internet. Due to decreasing costs in both regions, the use of phones and, thus, simple ICT functions are non-problematic.

Table 8. Effects of education and monthly turnover on ICT usage types.

Odd Ratios	**Only voice user**	**Voice-text user**	**Voice-text-internet user**
Educational level (> primary school=1)	-0,035^{ns}	-0,761**	1,339***
Monthly income (> 20.000KSH= 1)	0,356^{ns}	-0,631*	0,646^{ns}
Pseudo R^2	0,138	0,051	0,054
Prob>chi²	0,007	0,001	0,010

Note: *p<0,1; **p<0,05; ***p<0,01; ns=non-significant

Generally, ICT was used by a broad variety of different farmers of various capabilities, nevertheless differences emerged. Particularly the more complex usage types tended to be higher among well-educated users. However, while internet usage seemed to be higher among more highly educated users, education did not necessarily seem to be a significant barrier to access simple ICT types as has been stated in a study by MTEGA/MSUNGU (2013). Hence, it seems that particularly simple ICT functions (voice and texting) were used by nearly everybody. In contrast, the majority of farmers were not using complex ICT usage types such as internet (Table 7).

Dimensions of knowledge access

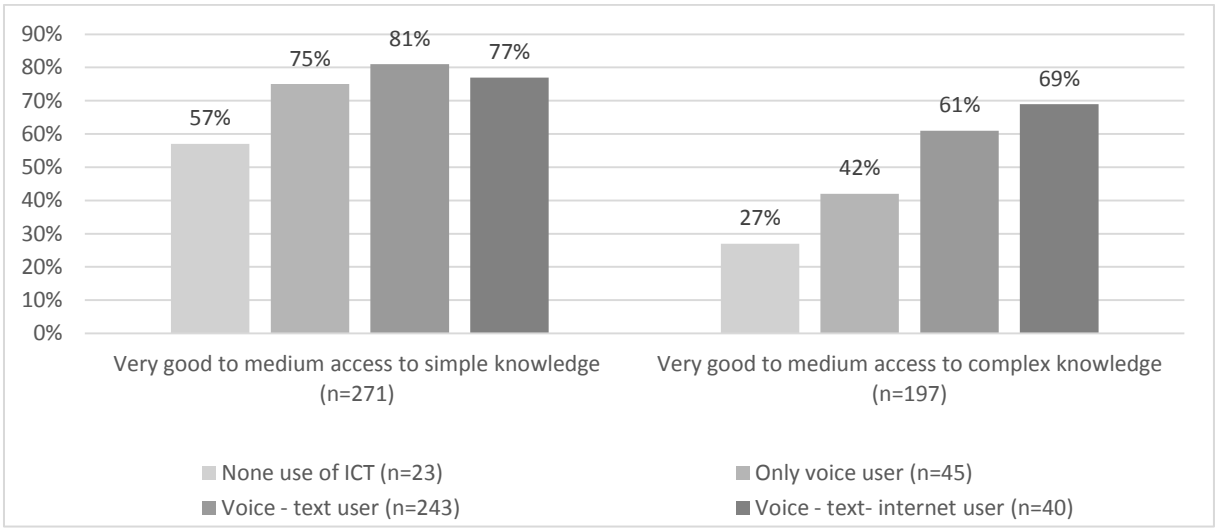
Various studies have already demonstrated mobile phones can help with providing quick access to relevant knowledge, leading to improved agricultural productivity (e.g. AKER/MBITI 2010; OKELLO et al. 2013). The use of ICT, in general, plays a significant role when it comes to the accessibility of information and knowledge (Figure 5). Regarding simple knowledge, particularly, the benefits through the increased ability to access timely price information were highly valued as a farmer exemplifies:

> "Previously, I took the product to the market without knowing the supply, the prices and traders. Now I just call somebody at the market to get the information. With that knowledge, I am able to prepare my farm to get the harvest and sell the products" (farmer 5, 2013).

Nevertheless, the fact that half of the farmers (57%) who did not use ICT had good access to simple information reveals that ICT usage is not necessarily a precondition for good information access. Face-to-face interactions were still essential for transferring especially sensitive knowledge (see also MOLONY 2008). However, ICT helps to maintain these contacts and organises face-to-face meetings.

The advantage of using ICT is greater when it comes to accessing complex knowledge. A significant statistical correlation between access to complex knowledge and a larger combination of ICT usage types has been observed (Figure 5). Notably the use of the internet tends to facilitate good access to complex knowledge. Through the use of the internet, complex codified knowledge was transferred in written form (e.g. documents about standards).

Figure 5. Dimensions of knowledge access according to different ICT usage types; source: own data and illustration.



As mentioned above, calling and texting also enabled farmers to access complex and even tacit knowledge. Mobile phones provided farmers with the opportunity to access complex knowledge by enabling the personal communication process needed but also codified complex knowledge, e.g. the application of fertilizer, was exchanged via calling.

Only 27% of farmers who did not use ICT had very good to medium access to complex knowledge. Farmers without ICT had great difficulties in accessing complex knowledge as it is costly to access since physical travel is often required. Complex knowledge was particularly important for high-value markets as certain requirements (e.g. process standards) have to be met (see also DANNENBERG/NDURU 2013; OUMA 2010).

Small-scale farmers did not only use ICT to transfer simple information, but also complex knowledge is exchanged via ICT. However, the transfer of complex knowledge via ICT was still connected with difficulties. First detailed insights are given in how far different types of knowledge are exchanged in the context of African commercial small-scale farming in relation to the different types of usage.

Distribution channels

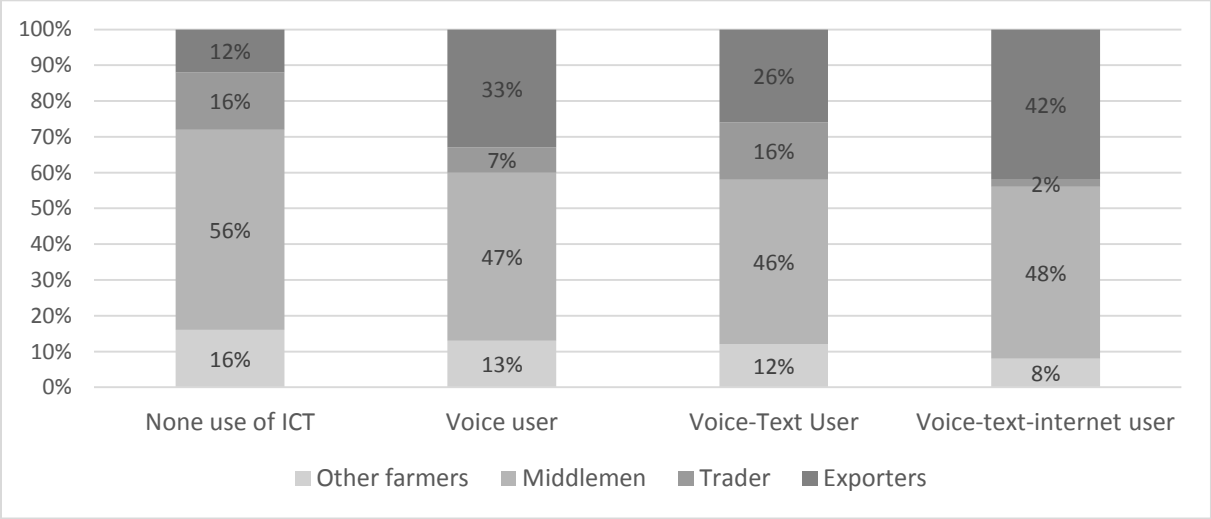
Different distribution channels were accessed by the farmers interviewed according to their different levels of complexity and the level of formalisation needed to enter them, as well as the geographical distance to the buyer. Selling to other farmers is the easiest channel due to the informal nature of the deal and close proximity. As shown in Figure 6, the need to use ICT to contact business partners was limited as they do not have to deal with external buyers (see also DANNENBERG/NDURU 2013). The most dominant type of buyers accessed by the farmers interviewed were regional middlemen who buy the products without formal contracts in smaller volumes[37] (Figure 6). Phones become especially necessary if farmers wanted to access different middlemen for price comparisons. In Tanzania, farmers also sold to traders who are more formalized regional buyers and either come to the farm or can be met at a wholesale market to buy large volumes (ESKOLA 2005). Phones were mainly used to coordinate with them. The most sophisticated and formal channel was selling directly to an exporter[38.] Exporters generally operate from larger cities. The standards farmers are required to meet are high, in part due to the fact that exporters prefer to enter into long-term partnerships with farmers (OUMA 2010). Here, the use of ICT has become important to coordinate activities and track the quality of produce. As demonstrated in Figure 6, farmers who use the internet more often sold to exporters (42%) compared to those who only used the phone (33%; 26%) and, in particular, compared to those who did not use ICT (12%). This is also supported by qualitative interviews stating that exporters require an intense communication process as they do not come to the farm regularly.

[37] Middlemen are often trusted by farmers due to their shared cultural background and long relationships.

[38] Exporters operating in Mt. Kenya mainly focus on the EU market.

Calling and texting became necessary as coordinating activities have to be done over greater spatial distances. The internet, in particular, provides access to specific knowledge on how to produce and how to fulfil the complex exporter standards. Selling direct to exporters usually includes higher margins. Additionally, exporters often provide farmers with complex knowledge on production methods for high-value production (DANNENBERG/NDURU 2013).

Figure 6. The usage of distribution channels of non ICT users and different ICT usage types; source: own data and illustration.



While these results outlined the potential benefits of ICT usage, the problematic side of this development is that the usage of ICT is increasingly becoming compulsory to do business with exporters and also with middlemen and traders. In this way, the risk of exclusion appears to rise as well and farmers who do not use certain ICT devices are in danger of becoming marginalized and losing access to commercial markets in the long term (see also CARMODY 2012). However, this problem is reduced in two ways: 1. Most farmers had the chance to sell via another farmer or a farmer's group/cooperative. 2. The interviews as well as HEEKS (2014) suggest that by 2016 almost all commercial farmers in Tanzania and Kenya will use mobile phones (at least for calling).

As stated in the literature, ICT might have the potential to restructure value chains and distribution channels, e.g. through new actors or the disintermediation of middlemen (cf. DONNER/ESCOBARI 2010). The use of ICT improved the ability to access increasingly complex and sophisticated distribution channels. A farmer confirmed this by saying:

> "We have a larger variety of buyers and even places for selling our products. We exchange the contacts of traders among ourselves" (Farmer#6, 2013).

On the one hand, farmers experienced advantages in accessing market information from different sources. On the other hand, the rising number of options for buyers lead to a better selection of partners and, thus, to an improved ability to market their produce. However, a restructuring of distribution channels did not occur due to the use of ICT. So far, no real new actors could be identified and middlemen are still common buyers.

Even though the use of ICT can bridge the spatial barriers to establishing contact with exporters, the exporters themselves were often not interested in maintaining such direct contact, preferring to conduct business via middlemen who collect larger volumes for them. Besides farmers were usually not able to provide a continuous supply of bulk produce which also hinders them in doing business with exporters. Further, due to the use of phones middlemen were now able to make cartel agreements aimed at hindering farmers who would otherwise prefer to sell directly to traders and buyers to manifest or even increase their bargaining position.

Bargaining positions

In the literature (e.g. BAUMÜLLER 2012), it is argued that improved access to information, especially information concerning market prices, can improve the bargaining position with business partners by reducing information asymmetries. As shown in Table four, the statistical analyses could only partly support this observation39, because the majority of the results are not significant. However, a trend can be observed showing that ICT users more often achieve a better bargaining position (Table 9). Especially through calling and/or texting, market prices can be accessed which leads to an improved comparison of different markets and buyers and, thus, to a higher bargaining position. Moreover, increased connectivity through using the phone can also result in an enlarged selection of business partners and, thus, a higher bargaining position. This is exemplified by the following farmer's response:

> "I have the final power when it comes to bargaining about the price. Some buyers may just come and they want to give you a low price and I don't agree. If we reach that point, then I call other buyers. So I have the power in that" (Farmer#7, 2015).

According to Table 9, only 6% of farmers who do not use ICT have a superior bargaining position. In short, farmers using ICT devices have a better bargaining position compared to those who do not use ICT.

[39] As power relations are difficult to measure, we asked the farmers for a subjective assessment of their bargaining position related to their buyer.

Internet usage does not appear to be as much a priority as calling and texting as it is mainly used to access complex knowledge. To cross-check market prices, the internet has no importance. A farmer confirmed this by saying:

> "I use the internet sometimes. I can see market prices there, but nothing has been changed due to the usage of the internet. Especially regarding the price - using the internet for me has not affected any changes in bargaining" (Farmer#2, 2015).

This lack of "change through the internet" can be connected to the localized market structures as these prices cannot be found in the internet, with the exception of farmers who use the internet to sell to exporters and, thus, are contracted farmers. While this has several advantages, it also leads to a lower bargaining position (cf. OUMA 2010). 78% of those farmers who sell directly to exporters have an inferior bargaining position. This is also confirmed by this respondent:

> "The contractor gets his price from the company where he takes his produce to. So he actually changes the price depending on where he's taking the goods to. So in fact, we are not powerful like him. We cannot bargain" (Farmer#
> 24, 2015).

Further, we could observe that belonging to a group (e.g. a self-help group) also affects the bargaining position. More than half of those who are in a group (56%) see themselves in a superior bargaining position (see also DANNENBERG/NDURU 2013). As various farmers stated, with the use of phones they can now organize themselves better internally (integrating more and remote farmers, coordinating meetings more effectively) and externally (getting in contact with various buyers and suppliers) and, therefore, improve their bargaining position.

All in all, it conveys the impression that an increase in information and the possibility to contact different buyers alone does not necessarily lead to an improved bargaining position (see JAGUN et al. 2008), but it helps to belong to a group. Further, we can conclude that it is useful to differentiate not only between simple and complex ICT types but also between the types of knowledge when it comes to analysing bargaining positions.

Table 9. Effects of ICT usage types on bargaining position (superior, equal to inferior).

	None use of ICT (n=32)	**Only voice user** (n=44)	**Voice - text- user** (n=240)	**Voice - text - internet user** (n=41)
Superior	6% (2) **	18% (8) [ns]	18% (42) [ns]	12% (5) [ns]

bargaining position				
Equal to inferior				
bargaining position	94% (30) **	82% (36) [ns]	83% (198) [ns]	88% (36) [ns]

Note: *p<0,1; **p<0,05; ***p<0,01; ns=non-significant

Conclusion and outlook

In this paper, we took a differentiated look on the effects of ICT types on farming businesses by identifying three types of ICT usage (voice; text-voice; text-voice and internet).

We indicated that ICT positively influences access to simple and complex knowledge and presents an opportunity to overcome spatial barriers to build up and maintain linkages to a larger variety of buyers in order to access commercial markets. While we could identify smaller structural changes in the distribution systems and selling opportunities of the farmers, we could not observe transformational changes at the farm-gate level (such as new business channels or processes) as discussed in the ICT4D debate. Despite increased access to information, an improvement in simple information-related bargaining positions with buyers and suppliers is only partly observed. Based on our typology analysis, the results indicate: the more sophisticated the ICT use, the higher the chances of gaining access to complex knowledge and sophisticated markets.

The risk of becoming marginalized and to potentially lose access to commercial markets in the long term is a given. Yet it is not clear to what extent farmers will be affected by potential exclusion and how the organisation of value chains will be affected in the future (e.g. by increased internet usage which is more restricted to users with a higher education).

For practitioners and policy makers dealing with ICT4D approaches, we were able to give a more differentiated view on how ICT with different complexity can influence different farming businesses. For smallholders who are integrated in simple chains, simple phones can so far already lead to improvements in different areas, while the usage of complex ICT devices seems to be more important for farmers who need to access complex knowledge (e.g. on standards in export farming). In total, the results support the view of ICT4D as a useful development approach but also outlined limitations. While the spread of simple phone usage has nearly reached all farmers, the spread of the internet is more challenging as the internet demands higher capabilities. ICT4D strategies which do not take these different capabilities into account are likely to increase existing disparities to the disadvantage of those who already have lower capabilities.

5 Analysing the Effects of Information and Communication Technologies (ICTs) on the Integration of East African Farmers in a Value Chain Context

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Abstract

Insufficient access to markets, limited financial transactions, and a lack of information and knowledge often restrict opportunities for small-scale farmers to link up with commercial value chains in Sub-Saharan Africa. Advances in Information and Communication Technologies (ICTs), especially mobile phones and the internet, have expanded the possibility to communicate across geographical distances and to integrate into commercial value chains.

By using a novel combination of conceptual considerations on ICTs, value chains, and relational proximity, this paper assesses: 1. How the use of ICTs affects the integration of small-scale farmers into the value chains (by analysing the information and knowledge flow, the financial and market transactions) and 2. to what extent the use of ICTs is on the other side influenced by the value chain context (i.e. the structure and coordination of the chain and the relational proximity between farmer and buyer). Our findings showed that even simple ICTs (phones) can lead to improvements for farmers to integrate into the chain as they facilitate simple information and complex knowledge flow, financial transactions, and market access, even though a greater structural transformation was absent. However, our results showed that the extent of the effects depends on the context in the value chains, in particular their structure, coordination, and the relational proximity between the actors. In this way, this paper contributes to the conceptual discussions on information and communication for development (ICT4D) and the dynamics in value chains.

Keywords: Africa, ICT4D, mobile phones, relational proximity, value chains

Introduction

The integration of small- scale businesses into global value chains and the proliferation of Information and Communication Technologies (ICTs) is seen as major factors for the economic

development in the Global South (e.g. AKER/MBITI 2010; BARRETT 2008). In East Africa, fresh fruit and vegetable (FFV) production for export is growing and many small-scale farmers are successfully integrated into global value chains (e.g. DOLAN/HUMPHREY 2004; OUMA 2010). Generally, it is assumed that a better integration of small- scale farmers into commercial chains can lead to growth and development through increased income opportunities (e.g. DOLAN/HUMPHREY 2004; THE WORLD BANK 2007; WEINBERGER/LUMPKIN 2007). While it is so far barely understood how such an integration can be fostered, studies on information and communication technology for development (ICT4D) suggest that ICTs can significantly support such an integration (e.g. MUKHEBI et al. 2007).

Even so there is a controversial debate about if and to what extent ICTs are contributing to socioeconomic development and value chain integration (e.g. ETZO/COLLENDER 2010; FOSTER/GRAHAM 2014; MURPHY/CARMODY 2015), detailed case studies that explain why different opinions on the effects of ICTs exist are rare thus far (exceptins are e.g. FOSTER/GRAHAM 2017; KUMAR 2014; MURPHY/CARMODY 2015). Furthermore, it is barely understood how different value chain contexts might influence these effects of ICTs on small-scale farmers and their value chain integration. Such knowledge is however crucial as it could explain the controversial opinions on the effects on ICT integration and inform practitioners in which value chain context ICT4D strategies might work or not.

To fill this research gap, this paper combines ICT4D and Global Value Chain approaches by looking at the example of small-scale farmers in Kenya and Tanzania.

On the one hand, it examines in detail in how far the use of ICTs affects the integration of small-scale farmers into value chains by looking in particular on the effects of ICTs on the access to simple information and complex knowledge flow, the opportunities for financial transactions and market transactions.

On the other hand, this study outlines to what extent the specific context within value chains - in particular their structure, coordination, and the relational proximity between the value chain actors - determine the use of ICTs and their potential for farmers to integrate into these chains. As a result, this paper follows the general research question:

To what extent and under which conditions does the use of ICTs affects the integration of small-scale farmers?

Effects of ICT use on small-scale producer in agricultural value chains in Sub-Saharan Africa

Discussed effects of ICTs and its transformative potential

In Africa, the percentage of the population subscribed to mobile phones increased from 9% in 2005 to 63% in 2016 (ITU 2016). Even in rural areas, a large number of people own and use mobile phones due to improved accessibility, coverage, and affordability. Additionally, internet use increased from 1% in 2010 to 23% in 2016 (ITU 2016).

Based on this background and on the general debate on the role of ICT4D in Africa, a range of studies and reports have emerged that show how ICTs can help to integrate small-scale businesses into (international) agricultural value chains (e.g. AKER/MBITI 2010; FOSTER/GRAHAM 2014; THE WORLD BANK AND AFRICAN DEVELOPMENT BANK 2012). They mainly analyse ICTs' impact on simple information flows, complex knowledge flows, financial transactions and market transactions.

Numerous studies (e.g. JENSEN 2007; MUTO/YAMANO 2009) stressed already the lower costs and increased availability of information and knowledge as the main development driver of ICTs for small businesses in low-income countries. They argue that mobile phones have a high potential for small producers to access simple information on prices and supply and demand by enabling business partners to communicate directly and immediately at a distance. This can lead to a reduced price variability, disintermediation (the bypassing of economic intermediaries) and higher profits per actor (JAGUN et al. 2008; JENSEN 2007). Further, for small producers, information asymmetries can be reduced, resulting in more accurate calculations, higher predictability of transactions, and a better bargaining position (cf. KRONE et al. 2014; MOLONY 2008; MUTO/YAMANO 2009). Further, via phones farmers are able to connect with local organisations and extension officers, e.g. to get immediate advice on cultivation methods (DANNENBERG/LAKES 2013).

DANNENBERG AND LAKES (2013) however also showed that the effectiveness of ICTs for knowledge transfer in small-scale agricultural value chains depends on the type of knowledge that is being transferred. While *simple information* (e.g. market prices) is easy and broadly transferred via mobile phones through voice and text messages, *complex knowledge* (e.g. the implementation of standards) usually involves tacit knowledge and, therefore, requires face-to-face communication (POLANYI 1967). Nevertheless, ICTs can support personal communication processes (e.g. organizing meetings and maintaining or intensifying personal contacts; BATHELT/HENN 2014; DANNENBERG/LAKES 2013).

Moreover, mobile payment systems (e.g. Mpesa in Kenya) especially are seen as a solution to overcome the lack of formal financial services in rural areas (cf. MBITI/WEIL 2011; MORAWCZYNSKI/MISCIONE 2008). They facilitate a variety of financial transactions via mobile phone, including paying bills, allowing the user to store value in an account, converting cash in and out of the stored value account, and transferring value between users by using a set of text messages. Due to the limited existence of formal financial services in Sub Saharan Africa (particular in rural areas) it is argued that mobile payment systems can resolve the constraints farmers face in accessing finances by reducing transaction costs (KIRUI ET AL. 2012). Farmers do not have to incur time and travel costs to travel to banking facilities. This is particular of importance in distant locations with limited banking services. Further, mobile payment services can include the hitherto excluded farmers into the banking services by reducing the costs of accessing remitted funds or depositing small savings (KIRUI ET AL. 2012). KIKULWE ET AL. (2014) AND KIRUI ET AL. (2012) analysed how mobile money contributes to

more commercially-oriented farming. Their results revealed that mobile money users apply significantly more purchased inputs such as fertilizer, pesticides, and hired labour and sell a larger proportion of their harvest in the market. This is connected to lower transactions costs for receiving and paying money and to reduced liquidity problems due to receiving remittances and saving money. However, empirical evidence about the nature of mobile payment use are still scarce (DUNCOMBE/BOATENG 2009; ONE EXCEPTION IS MORAWCZYNSKI 2009; SEKABIRA/QAIM 2017). It is still questioned in how far mobile financial services impact the livelihoods of farmers and how those are used across different value chains contexts.

Furthermore, it is argued that ICT use can also improve *market transactions* as it leads to new connections with markets, business partners, and financial partners who were previously out of reach (FOSTER/GRAHAM 2014; MURPHY 2013; OVERÅ 2006). Many studies argue that ICTs can improve market efficiency by facilitating communication with buyers, generation of market information, reduction in logistic costs, facilitating access to markets, facilitating market research, networking, market transactions and market identification (e.g. AKER/MBITI 2010; CHOWDHURY 2006; MOLONY 2006; MUTO 2012). Consequently, ICTs are changing the way in which producer-buyer matches are made and allegedly allow for the integration of producers into the (global) market.

The potential of ICTs and the first empirical evidence for such developments have led various development practitioners to argue that such applications have the potential to become transformational (e.g. AVGEROU 2010; THE WORLD BANK AND AFRICAN DEVELOPMENT BANK 2012). Such a transformation not only includes expanded markets and new business actors (e.g., new buyers), but also a reconfiguration of value chains (disintermediation; GEREFFI 2001a), new knowledge sources, and the enhancement of inter-firm capabilties (MURPHY 2013) and, as a result, an overall increase in value creation and value capture.

However, so far this *transformational potential* has been barely identified for African businesses, including farming. As a result, some critics (AVGEROU 2010; MURPHY/CARMODY 2015) argue that many of the optimistic works on ICT4D lack sophisticated empirical proof, differentiation of ICT use in detail, and a substantial conceptual background. Also the recent report from the THE WORLD BANK (2016: 4) on ICTs argues that "yet their aggregate impact has fallen short and is unevenly distributed". They concluded that the better educated, well connected, and more capable have received most of the benefits of the proliferation of ICTs. Furthermore, critics argued that the existing studies which outline the transformative potential of ICTs underestimate the local political and institutional structures and power relationships that limit the transformative potential of ICT dissemination (e.g. KUMAR 2014). For example, MURPHY/CARMODY (2015) showed in their example of small and medium enterprises in South Africa and Tanzania that ICTs reduced production challenges

but were limited in reconfiguring power relationships and, thus, were even absorbed into existing structures (and to control suppliers) instead of transforming them.

Moreover, studies further outlined contextual factors that influence the effects of ICT on businesses. These include the institutional and political context (MURPHY/CARMODY 2015), the different capabilities of the users (e.g. KRONE et al. 2016), the nature of the product traded (MOODLEY 2002; MUTO/YAMANO 2009), the quality of information (DUNCOMBE 2014), the type of information (DANNENBERG/LAKES 2013), and the inter-firm relationships (MOODLEY 2002).

Given the controversial viewpoints on the potential effects of ICTs on development in general and on small-scale businesses in agricultural value chains in particular, we argue that the effects also depend on the *value chain context* (MURPHY 2013). This study outlines to what extent the specific context within value chains (in particular their structure, coordination, and the relational proximity between) determine the use of ICTs and their potential for farmers to better integrate into these chains.

The value chain context and the role of relational proximity

To analyse the value chain context, we use the Global Value Chain (GVC) approach (see in particular GEREFFI et al. 2005). This approach examines value chains according to their constituting elements, which include the exchange of products, the exchange of crucial knowledge and information, the governance and the coordination of trading activities, and financial transactions. As outlined above, it is likely that in a value chain, the *type of knowledge* exchanged and the terms and conditions of the *financial transactions* affect the potential of ICT usage. However, the GVC analysis reveals further important contextual factors.

In comparison to other related concepts of value chains (e.g. the Global Commodity Chains or Global Production Networks; GEREFFI 1996; HENDERSON et al. 2002), the GVC approach provides an analytical framework for a deeper understanding of the different variations of governance and coordination. GVC analysis shows how power can actively shape the distribution of profits and risk in an industry, and the actors who exercise such power through their activities. In the GVC framework, GEREFFI ET AL. (2005) have developed a typology of governance which is based on different degrees of coordination and power asymmetries. The type of each chain (1. markets, 2. modular chains, 3. relational chains, 4. captive chains, and 5. hierarchical chains) depends on three factors (GEREFFI et al. 2005: 85):

1. The complexity of information and knowledge transfer required to sustain a particular transaction.
2. The extent to which this information and knowledge can be codified and therefore, transmitted.
3. The capabilities (finances and competences) of actual and potential suppliers in relation to the requirements of the transaction.

Market coordination is, for example, characterized by the low complexity of transactions and high capabilities of the suppliers, while hierarchical chains are marked by the high complexity and low capabilities of the suppliers. The typology of the concept has been critiqued as being highly stylized (see e.g. COE et al. 2008; NADVI 2008). However, the three factors identified have been proven as useful in explaining the relationships in commercial value chains and the success of companies participating in these chains. In this context, the GVC has also proved to be of use to analyse agriculture based value chains in Africa and other regions of the Global South (e.g. STRASSER et al. 2013), including studies in Kenya (e.g. DANNENBERG/NDURU 2013; OUMA 2010).

Based on (PONTE/GIBBON (2005); and PONTE/STURGEON (2014)) we argue that the forms of coordination can be analysed separately from overall modes of governance of global value chains. "A GVC may be characterized by different forms of co-ordination in various segments, yet a single and relatively coherent mode of overall governance" (PONTE/GIBBON 2005: 3). Following this perspective, we focus on the micro-level of a value chain (determinants and dynamics of exchange at individual value chain segments) and its coordination forms (PONTE/STURGEON 2014: 2). We regard coordination in chains as the mechanism of economic processes between the actors at each part of the value chain with a specific focus on the direct linkages of the farmers (without neglecting the general value chain context along the chain; see below).

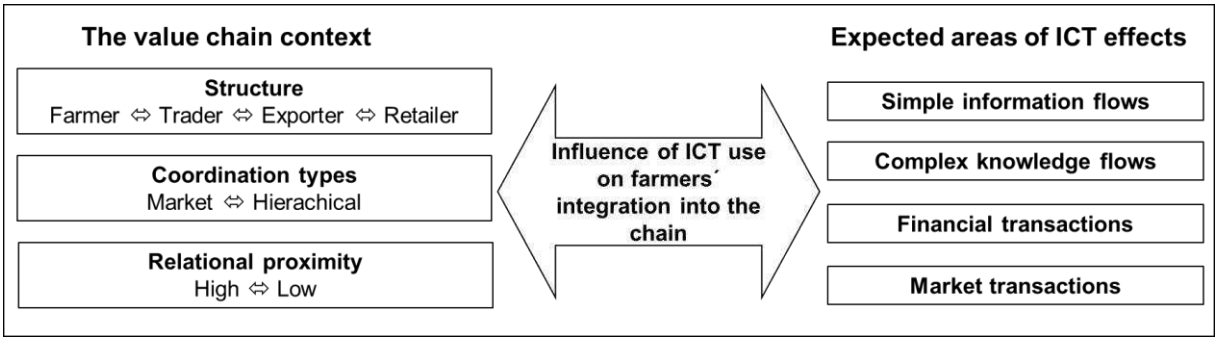
The coordination type of the chain goes usually hand in hand with the typical *structure* of the chain. For example, Sub-Saharan African small-scale farmers are sometimes directly linked to commercial large-scale traders and exporters but also often use intermediaries (DANNENBERG/NDURU 2013; OUMA 2010). Here, it can be expected that the potential effects of ICT usage also depend on the structure of the chain, e.g. what type of buyer the farmers are selling to and what ways of communication and financial transaction modalities this buyer requires.

The GVC approach emphasizes the importance new information and technologies systems can have on the organization and governance structure of the chain, which can include new power relationships. In this context, GEREFFI, already in 2001, outlined the possible transformative power of ICT for value chains using the example of the internet which could "deconstruct" (GEREFFI 2001a) large professional chains. However, GEREFFI'S ICT considerations focused on large scale e-commerce in the North, but not on the ICT use of small farmer-based value chains in the Global South. Such chains, however, differ in their organizational and structural characteristics which often not only include small-scale producers and middlemen, but also informal distribution channels (e.g. STRASSER et al. 2013). Apart from FOSTER/GRAHAM (2014), there are to our knowledge no case studies detailing how ICTs reconfigure GVCs in the Global South.

Additionally, we argue that a further contextual factor influencing the potential effects of ICTs is the *relational proximity* (AVGEROU 2010; IBERT 2010; MURPHY 2012) between the actors in the chain. According to MURPHY (2012: 5), relational proximity is "the degree to which individuals are bound by relationships of common interest, purpose, or passion, and held together by routines and varying degrees of mutuality". While local factors can influence relational proximity (e.g. language barriers, local norms), spatial proximity is not a requirement (IBERT 2010) but can be supportive to develop a high degree of relational proximity. Particularly for successful economic relationships in unstable market environments (such as Sub-Saharan African rural markets) and the use of new technologies, relational proximity plays an important role (HUMPHREY/SCHMITZ 1998; OVERÅ 2006). For example, the method of payment, the intensity of knowledge exchange, and the necessary level of control are dependent on the level of trust and further elements of relational proximity between the actors in the chain (MORAWCZYNSKI/MISCIONE 2008; OVERÅ 2006). The level of relational proximity can, therefore, also determine in how far e.g. knowledge exchange and financial transactions can be done via ICT solutions or whether they require personal meetings. Thus, within this context, we aim to analyse in how far relational proximity between producer and buyer can explain the different effects of ICT use in a value chain. Adding the dimension of relational proximity to the analytical dimensions of GVC analysis provides a more comprehensive analytical perspective to understand the usage of ICTs within value chains.

In summary, we argue that the different value chain forms are marked by different value chain structures, coordination types and relational proximities and that these differences influence the effects of ICTs on value chain integration. Based on this conceptual perspective, Figure 7 illustrates the research framework and structure of the following analysis.

Figure 7. Research framework: The value chain context and effects of Information and Communication Technologies (ICT) use on farmer's integration in the chain; source: own design and illustration.



Consequently, the research questions include the following:

1. How are ICTs affecting the integration (simple information and complex knowledge flows, financial transactions and market access) of farmers into the value chain?

2. To what extent does the value chain context (structures, coordination types, relational proximity) influence these effects?

By answering these questions, this study generally argues that the extent to which ICTs affect small business in the Global South can significantly depend on the context in the value chains they are linked to.

Research methods, data collection, and case study regions

We used a mixed method approach (CRESWELL 2013) based on qualitative interviews with actors along the value chain, a quantitative survey with farmers, and expert interviews with professionals working in the field. The data was collected in 2013 (quantitative survey and qualitative interviews) and 2015 (qualitative and expert interviews) in the Mt. Kenya region in Kenya and the Mwanza region in Tanzania (Figure 8). Instead of comparing both regions, we used data from these two regions to identify different forms of value chain coordination and integration (including commercial domestic and export value chains).

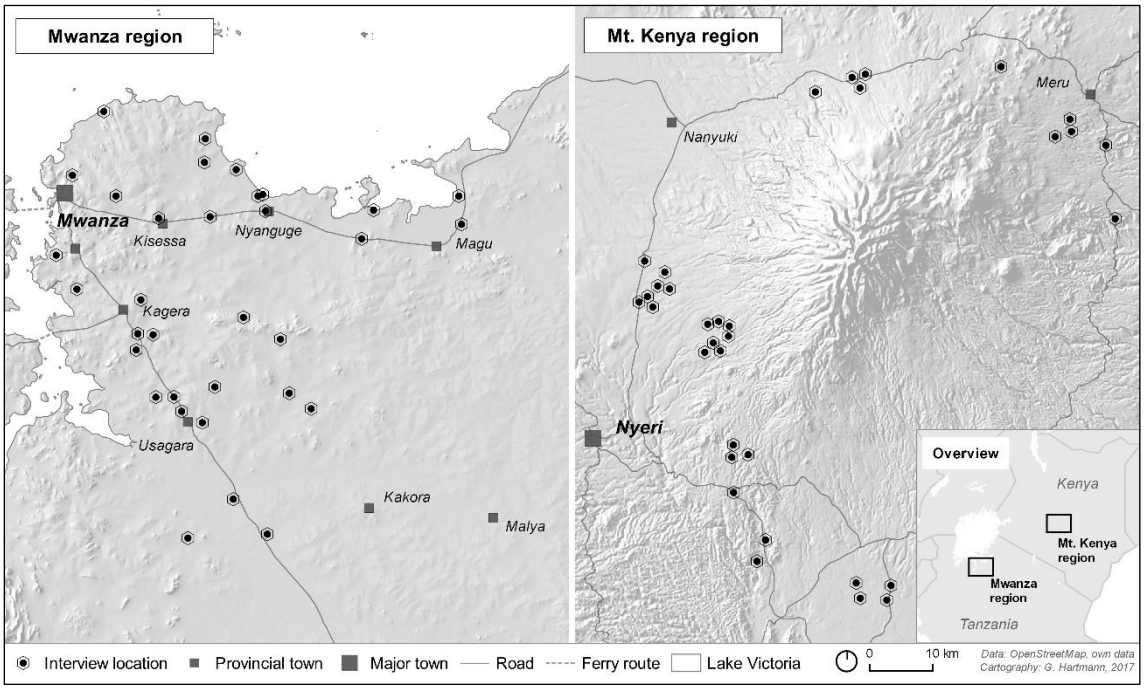


Figure 8. Overview of interview sites in the research regions.

We selected the horticultural sector due to its economic significance for the rural population and due to the high perishability of the products (WEINBERGER/LUMPKIN 2007). It is assumed that particular phones increase hereby the potential of a fast transaction of the trading process (MOLONY 2008).

Further, we selected a sector with contrasting value chains to generate a more generalized conclusion.

The horticultural value chain includes mainly small-scale farmers, but also some middle and large scale professionalised farmers who sell to exporters or directly to importers from the EU (often large retail companies). In contrast, the small-scale farmers often sell to middlemen who either sell to domestic wholesalers or also to exporters. In some cases, small-scale farmers sell directly to regional traders who sell to wholesalers in major cities (cf. DANNENBERG/NDURU 2013; ESKOLA 2005). Important horticultural crops are tomatoes, snow peas, French beans and cabbage. While Kenya can be characterised as a forerunner of commercialisation of small-scale farming with a high export rate, Tanzanian small- scale FFV farmers are also increasingly supplying professional commercial retailers for domestic and African export markets (see Table 10; EVERAARTS et al. 2014; KÖNIG et al. 2011).

Table 10. Horticultural sector in Kenya and Tanzania; Own calculations based on (FAO STATS 2016).

Horticulture	Kenya 2014	Tanzania 2014
Production FFV (t/a)	4,738	5,839
Exports of FFV (t/a)	180	74
FFV share of total exports	5%	0.48%

In both countries landline telephone networks barely exist, but current mobile phone networks provide access in rural areas and are affordable for most villagers (DANNENBERG/LAKES 2013; MWAKAJE 2010). In 2016, 84% of all Kenyans and 72% of all Tanzanians used mobile phones. While 57% of Kenyans used the internet, 33% of Tanzanians used it in 2016. Mobile money transfer was used by 30% of Tanzania`s population and by 56% of Kenyans. (ITU 2016).

The quantitative data is composed of a survey with 368 small-scale farmers (see table 11). The sampling was stratified (SÄRNDAL et al. 2003) including preselected villages as subgroups (in order to get a broad variety of different farmers in different regional environments) and randomly selected farmers in the villages. The survey included questions concerning ICT usage (e.g. types of ICT), the capabilities of farmers (e.g. educational level), their access to knowledge, and their different distribution channels (e.g. type of buyer). Only commercial small-scale farmers were selected (less than 5 acres; see also OUMA 2010).

Table 11. Overview of respondents according to the research region.

Residence in Mt. Kenya region	Residence in Mwanza region	Total
52% (n=192)	48% (n=176)	100% (n=368)

We measured the ICT effects at the four different analytical stages with different related indicators (see Figure 7). Since information and knowledge dimensions are difficult to measure, we asked the farmers for a subjective assessment of their access to each type of information and knowledge in the survey on a scale ranging from poor to very good. While financial transactions were measured with the variable "use of mobile payments", market access was derived from respondents´ qualitative references to changes in their marketing strategies including access to buyers and markets. Further, the value chain structure was operationalized by the direct buyer each farmer sells their products. By using expert and farmers interviews we could map the dominant value chains (see Figure 3). The coordination types were derived from respondent's references to the three governance factors by GEREFFI et al. (2005); see above. Relational proximity was measured qualitatively using the farmer's subjective perceptions of trustworthiness (experienced reliability in past interactions, common interests and shared values of doing business), the quality of social performances (reputation, immediate advice and payment), and the outcomes of shared experience within their relationship to their direct buyer (long-term relationships, familiar practices and routines in doing buisness; cf. MURPHY 2012: 5).

A logistic binary regression analysis was used to identify the associations between the ICT-driven effects (mobile payments, access to simple information and complex knowledge) and the value chain forms. However, due to the limited n of value chain form IV it was not possible to do the regression analysis with it. We included dummy variables like gender, educational level, monthly turnover, age, access to agricultural training, and group membership in the regression analysis (see table four). We calculated three regression models: one to estimate the effects of the independent variables on the use of mobile payment of small-scale farmers, another to estimate the effects of the independent variables on the access to simple information and the third to estimate the effects of the independent variables on the access to complex knowledge. The underlying equation of the resulting three-level proportional hazards mixed effects model is: $logit(p)=log(p/(1-p))=в0+ в1x1+ вqxq+y$. According to this equation the probability (p) that y is a 1 depends on the constant β0, the coefficient β1 on the variable x1, and the error term y. Further, we used descriptive statistics and ran t-tests to test if there are significant differences across categories. An overview of the used variables is attached in the ppendix.

Moreover, 61 qualitative interviews with producers, buyers, and external agents (e.g., extension officers) and nine expert interviews with experts (including members of the Ministries of Agriculture, NGOs and local scientists) complement the mixed-methods data set used in this paper. The respondents for the semi-structured farm interviews were sampled purposively in order to select typical cases of FFV commercial small-scale producers. The producers interviewed varied in type of production system (local market, export market), value chain type, the use of ICT (no use, mobile

phone use, internet use), and their capabilities (e.g. high, basic, or no education). The analysis of the interviews was based on the principles of qualitative content analysis (cf. MAYRING 2004) with the help of qualitative data analysis program (MAXQDA). The appendix provides an overview of qualitative interviews used in this paper.

Results

The value chain context in different value chain forms

Our qualitative data analysis along the chain revealed, that so far, horticultural value chains in Kenya and Tanzania has not been affected by larger chain-wide ICT solutions like tracking or barcoding which would influence the farmer in a value chain. Therefore, it was possible to mainly focus on the farmers and their direct chain partners in our primary data analysis. We identified four major value chain forms which differed according to structure, coordination type, and relational proximity between farmers and buyers (Figure 9; while hybrid forms also exist, these forms were the most common). Sometimes famers were integrated in more than one form, but mostly had one main buyer. We focused on those.

Figure 9. Value chain forms of Kenyan and Tanzanian small-scale farmers; source: own findings and illustration.

Value chain forms	**I Export direct**	**II Export via middlemen**	**III Domestic via middlemen**	**IV Domestic direct**
Value chain structure	Farmer → Exporter → European Importer	Farmer → Middleman → Exporter → European Importer	Farmer → Middleman → Trader → Domestic Wholesaler	Farmer → Trader → Domestic Wholesaler
Coordination type	Captive	Market-based	Market-based	Market-based
Relational proximity	High	Low	High	Low
Share (total number)	32% (n=114)	21% (n=74)	41% (n=148)	7% (n=24)

Form I: Export direct: 32% of the farmers interviewed fall into the category form I. They are linked to an exporter through contractual agreements that are marked by a direct, exclusive purchase with a long-term perspective (exclusively found in Kenya). Due to the high-quality and complex production requirements of the export market, a high degree of coordination and monitoring is required (cf. DOLAN/HUMPHREY 2004). The exporters, who are mainly Kenyan and based in Nairobi, organise and support the farmers indirectly but regularly through technical advisors (TAs). TAs are hired by exporters and support the farmers with face-to-face consulting and on-the-job training (complex tacit knowledge transfer) and coordinate the trading activities (simple information). The direct personal interaction between the exporter and the small-scale producer is low, but characterised by a high relational proximity due to experienced reliability in past interactions, shared values of doing business and the quality of social performances (reputation, immediate advice and payment). Once a year, exporters and buyers meet each other personally at the farm to negotiate a new contract. In the meantime, they use mobile phones to communicate with each other and the TA provides trainings and daily interaction which also increases the relational proximity. Since the exporters invest in supplying the farmers on a credit basis, the farmers are dependent on the exporter but also acknowledge their support and the reliability of contract farming (DANNENBERG/NDURU 2015). The relationship between the producer and the exporter can be characterised as captive. The exporter controls and organises the chain with an integrated quality management system that is based on international standards.

Form II: Export via middlemen: Value chain form II consists of farmers selling to export markets via individual middlemen (21%) who buy small volumes of produce and are characterised by low capabilities (poor transportation equipment, low financial capital, and low educational level). There are no commitments between middlemen and farmers; instead, loose short-term spot-market relationships are dominant (cf. DANNENBERG/NDURU 2013; OUMA 2010). Working with middlemen is common for peripherally located farmers for whom these buyers are often the only connection to export markets (DANNENBERG/NDURU 2015). Often, a low level of trust and relational proximity exists due to opportunistic behaviour and unreliable transactions. Hence, the informality of business interactions formulates a high-risk environment in which agreements (e.g. about payment modes) are difficult to enforce. The middlemen do not provide complex knowledge due to their own limited knowledge. Thus, only simple information on the trading transaction is exchanged.

Form III: Domestic via middlemen: Selling to middlemen for domestic markets is the most common form (41%) due to its relatively low entry barriers. These middlemen operate similarly to those in form II (informal market relationships and simple information exchange). However, domestic market-

oriented middlemen and farmers usually share the same local background (social and ethnicity) and the products are sold within the region the producers are located in. As a result, their relational proximity is usually high due to common values and interpretation schemes, familiar business practices and routines and immediate advice and payment. Such relational proximity further increases when middlemen successfully demonstrate their reliability with respect to timely transport and payments (cf. ESKOLA 2005), often resulting in trust. Since these farmers are producing for local markets, the need for complex knowledge is low.

Form IV: Domestic direct: This includes farmers selling to so-called "traders" (which are large-scale buyers sellingt to national wholesalers; cf. ESKOLA 2005) for the domestic market (7%). Similar to the domestic-oriented middlemen, such traders operate in informal market-based structures with simple transactions. However, in contrast to the domestic-oriented middlemen, traders operate on a larger geographical scale with large trucks for product volumes. Usually they specialize on one certain produce and sell it to wholesalers or to retailers in urban centres (e.g. Mwanza city). Since traders operate over larger distances, they usually do not know most farmers personally, but buy from the easiest accessible farmers (e.g. close to main streets; MOLONY 2008). Traders fluctuate in each region and, thus, their relationship with farmers is short-term. Low relational proximity between farmers and traders describes the relationship as a result of limited shared experiences, trustworthiness and different socio-cultural background.
Middleman and trader are common terms used in the business according to the statements of the interviewees.

Use of ICTs related to value chain forms

The identified chain forms differed significantly regarding the use of ICTs (Table 12). The majority of small-scale farmers used ICTs for business (91%, n = 288). While all of them used mobile phones, 11% also frequently used the internet (n= 40; mainly via smartphones or internet kiosks in the villages), while 9% (n = 32) did not use ICTs at all (limited financial resources and a lack of awareness). The main reasons for not using the internet included high connection and hardware costs, the lack of awareness, and language difficulties. According to our interviews with farmers, other chain actors and local actors the main reason for farmers starting to use the phone were aim to improve their business and in particular knowledge and information access and the linkages to other business partners.

Table 12. Value chain forms and their use of simple phone, phone and internet and none; source: own data and calculations.

	Phone and internet	Simple phone	No use of ICT
I Export direct	16% (18)*	81% (90)*	3% (3)*
II Export via middlemen	24% (17)**	76% (55)**	0% (0)**
III Domestic via middlemen	3% (4)*	84% (124)**	13% (19)**
IV Domestic direct	4% (1)**	54% (13)	42% (10)**
Total	11% (40)	80% (282)	9% (32)

Note: *P<0.1; **P<0.05

Farmers integrated in domestic chains (forms III and IV) used ICTs much less than those in the export chains (forms I and II). Especially, farmers with direct relationships to traders (form IV) tended to use fewer ICTs. This can be explained by their low relational proximity:

"*I communicate […] only with those [buyers] who live within this area. I don't communicate with the customers [buyers] who live far away because I don't know them. I only sell to them when they reach a collection point or when they visit my farm.*" (Farmer#4, 2015)

Other farmers confirmed that they rarely used their phones to communicate with traders, as they show up spontaneously at the farms or at the collection points. In accordance with findings by MOLONY (2008) reputation and "being known" is crucial for getting a trustworthy relationship and this is in turn important for using phones. Since traders very rarely appear it is a challenge to establish and maintain relational proximity for which repeated interaction and communication are required. Hereby, it becomes clear that ICT use is embedded in a social context (cf. AVGEROU 2010; OVERÅ 2006).

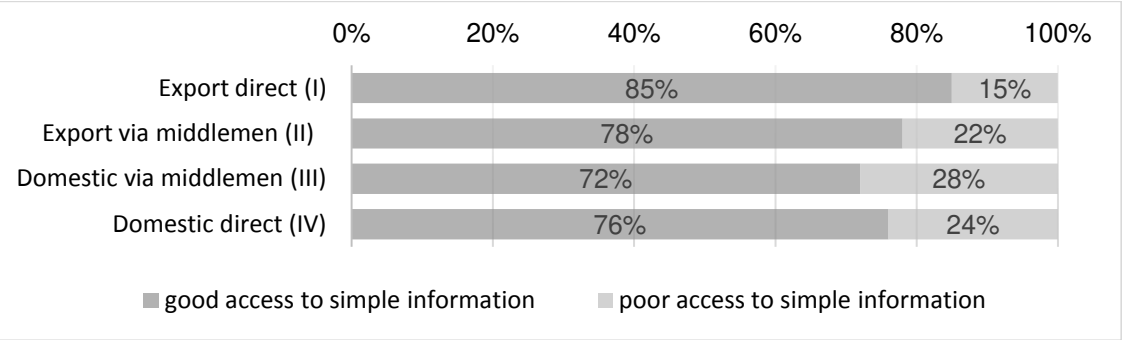
Export-oriented producers (forms I and II) also used the internet more than domestic-oriented farmers (forms III, IV) due to the high requirements of the export market (e.g. process standards for production). Typical usage included accessing certain topics (e.g. pesticide use or international food standards) via Google search or using social media to exchange experiences on farming (e.g. Facebook groups). However, a crucial prerequisite for using the internet is good English skills which were a challenge especially in Tanzania.

Effects and context of ICT use

Simple information flows: The percentage of farmers with good access to simple information who used ICTs (80%) was significantly higher than those farmers who did not use ICTs (57%). Simple information (e.g. market prices) can be transferred easily via text messages and phone calls (cf.

KRONE et al. 2016; MUTO/YAMANO 2009). In the captive coordinated form I, almost all farmers had good access to simple information (Figure 10). TAs used phones (text messages) to access a high number of farmers regarding specific information (e.g., time to spray pesticides). In this case, farmers used their phones passively for receiving information, while exporters/TAs simplified their coordination.

Figure 10. Comparison of value chain forms and access to simple information through use of ICTs; source: own data and calculations.



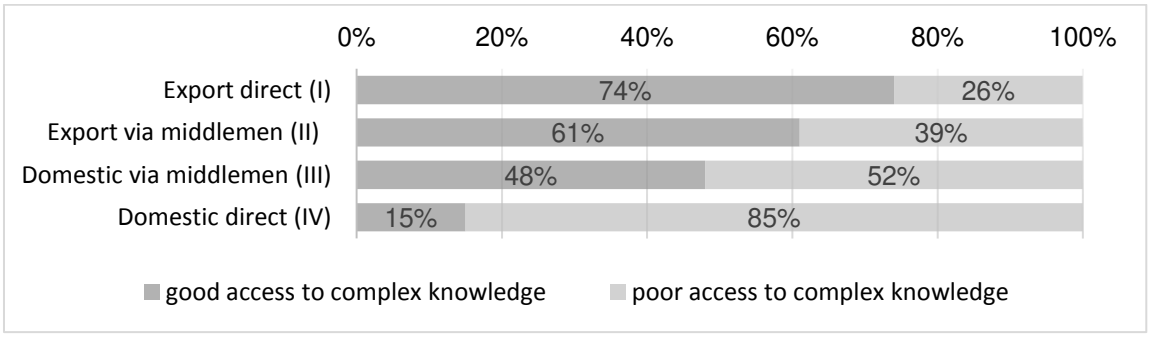
In the market-based chains (forms II, III and IV), producers used their phones to cross-check information on prices at different buyers. This reduces information asymmetries with buyers and increases the chances of getting a higher price (value capture). As shown in the regression analysis participating on trainings and being a member in a farmers group significantly influences the chance to have good access to simple information via ICTs. In contrast, being an old farmer (over 55 years) reduces the chance to access simple information (see Table 13). In sum, the use of ICTs by small-scale farmers was effective for accessing simple information from the buyers independent of the coordination type, the value chain structure or relational proximity.

Complex knowledge flows: As expected, the direct transfer of complex knowledge via ICTs was more challenging than transferring simple information. Even though the internet facilitated good access to complex knowledge in written form (DANNENBERG/LAKES 2013), due to the limited use of the internet in general, these effects were low. Tacit complex knowledge was mainly transferred face-to-face in meetings by buyers, other farmers or extension officers. Nevertheless, phones indirectly supported farmers in accessing complex knowledge by facilitating personal communication as outlined, for example, in the following statement:

"I use my phone when I need short and simple information, but sometimes I have more complex problems on my farm, like unexpected problems with my new fertiliser. Then I call a technical advisor and arrange a meeting." (Farmer#1, 2013)

The opportunities for farmers to access complex knowledge through ICTs differed according to their related value chain form and potential knowledge sources (Figure 11), but was significantly a challenge for all (Table 13). Farmers who were integrated in form I could access complex knowledge more often than in other forms as the TAs regularly provided it (e.g. via calls and also personally) and the exporter has interests in providing them with valuable knowledge about production requirements to achieve high profits[40].

Figure 11. Comparison of value chain forms and access to complex knowledge through use of ICTs; source: own data and calculations.



In contrast to TAs, most traders and middlemen only have limited capabilities and knowledge of horticultural production. Hence, the access to complex knowledge for the producers integrated in forms II-III was limited which is also shown in the regression analysis (Table 13).

The difference between these domestic market-based chains can be explained by the limited relational proximity between the traders and the farmers. Particularly successful tacit knowledge transfer is related to relational proximity as the knowledge transfer also depends on the trustworthiness of the sender (cf. BATHELT/HENN 2014). Furthermore, in domestic chains the need for complex knowledge was less pronounced, which is related to the wider governance of the chain.

Although phones were used to access complex knowledge, face-to-face communication was still the main method to transfer complex knowledge. However, both forms of communication are interdependent as personal communication induces trust, which is crucial for the use of ICTs (cf. BATHELT/HENN 2014; MOLONY 2008).

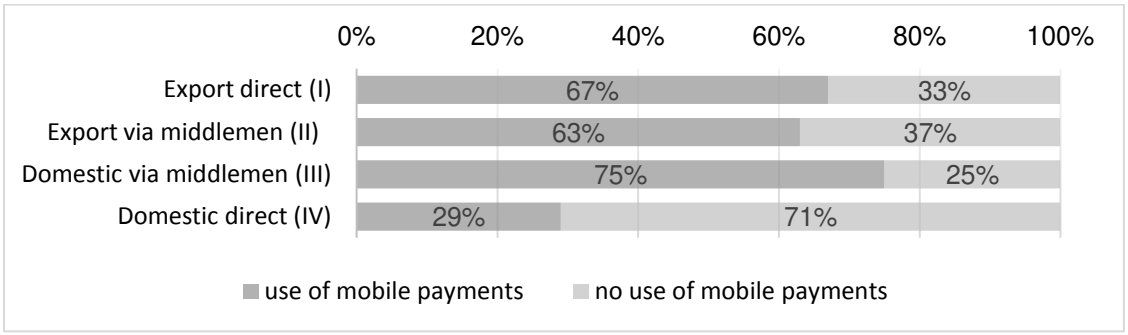
While the use of phones has intensified the already existing simple information and complex knowledge flows and improved the way of communication with the known actors (cf. OVERÅ 2006), very few new information and knowledge sources (e.g. external sources from outside the region)

[40] However, the regression analysis revealed that to be directly linked with an exporter reduces the chances to access complex knowledge via ICTs which points to the fact that the direct transfer via ICTs is limited (Table 13).

have been accessed. The challenge for farmers is to gain face-to-face access (for tacit knowledge transfer and inducing trust) to external new knowledge sources that can support them with knowledge about production and marketing. So far, ICTs have not helped farmers to really upgrade their products or processes or enhance their capabilities e.g. to enter new markets. This challenge is a typical one of small businesses in the Global South (cf. MURPHY 2013).

Financial transactions: 68% of the farmers interviewed used mobile payments appreciating its convenience. This usage included storing and transferring money in a mobile account (cf. MBITI/WEIL 2011). However, the regression analysis revealed that the integration in any of the value chain forms reduces the chance to use mobile payments (Table 13). Additionally, mobile payment is significant used differently depending on the value chain form (Figure 12). Accordingly, mobile payments were most often used by those selling to middlemen in a domestic chain, followed by the export-oriented farmers and then the farmers selling to the traders (Figure 12). Both results can partly be explained by the different levels of relational proximity, but also by structural problems of the mobile payment system and the preference of farmers to use cash.

Figure 12. Comparison of value chain forms and use of mobile payments; source: own data and calculations.



Our interviews revealed that different relationships were the main reasons why so few farmers in form IV used mobile payments. In contrast, farmers in in form III regularly used mobile payment due to a higher relational proximity with their buyer:

"*Yes, I'm also using Mpesa. After he [the middleman] has sold the products at the market, he sends the money to me through Mpesa. This is only for the buyers who we know very well."* (Farmer#17, form III, 2015)

Since it is possible with Mpesa to reverse the money transactions after receiving the produce, trust (interpersonal trust) is of importance.

Lack of trust in the mobile payment system (institutional trust; cf. MORAWCZYNSKI/MISCIONE 2008) is another challenge for using mobile phones for financial transactions. Further, our qualitative data revealed that exporters did not use mobile payment to pay the producers due to safety and transparency issues, as well as high fees and the limited possibility to transfer larger amounts of money (the maximum transaction per day is 592€). Thus, the money transfer between producers and exporters was usually operated through a formal bank account[41]:

"Mpesa [mobile payment system in Kenya] is only used for the local markets. We have a bank account where the exporter puts the money. Mpesa is too risky for the transactions." (Farmer#26, form I, 2015)

This is in contrast to the findings of MORAWCZYNSKI/MISCIONE (2008) who concluded that mobile payment systems were trusted due to its affiliation to the well-known phone company (institutional trust) but supports general findings (e.g. MBITI/WEIL 2011) that mobile payment usage is limited due to high fees and risky transactions.

In sum, formal bank accounts were used within formal trading relationships (form I) while mobile payments were used by informal business relationships (form II, III) if relational proximity exists. In the case of missing formal trading relationships and relational proximity, cash is still the most important payment in order to avoid opportunistic behaviour and risky financial transactions. In short, financial transactions via phones either rely on relational proximities or on trust in the system itself. So far, mobile payments seem to be rather supplementary to formal bank accounts and cash than substitutional (see also MURPHY 2013).

Market transactions: Our study revealed different advantages for farmers using ICTs, e.g. to get in contact with different buyers in the chain and to access commercial markets. Especially terms and conditions, like the time and the place for the transaction, can be settled via phone, as the following quote exemplifies:

"I do not need to travel to address the buyers physically. When I have the products, I'm sure that I can call different buyers, and one of them just comes and buys the product." (Farmer#14, form III, 2015)

[41] This was the only case in which our quantitative results (Figure 12, export direct (I)) were not backed by the triangulation with our qualitative interviews. Given the clear statements of both various farmers and exporters we followed the results of our qualitative analyses and concluded that the farmers indeed mostly use bank accounts instead of mobile payment (and that they mainly use mobile payment for private concerns).

Placing orders via phone reduces transaction costs (e.g. avoiding long travels; cf. MOLONY 2008) and enhances the flexibility of marketing and distribution, which is especially important for perishable FFV products.

In general, the use of phones for market access and its potential effects again depend on the chain form. For producers selling to middlemen and traders (forms II, III, IV), the mobile phone was an essential tool to organise with buyers, because the producers did not have a buying agreement (oral or written contracts). They also used the phone to expand their marketing network. For example, one Tanzanian farmer stated, referring to the advantage of using the phone*:*

"With the phone, we have a larger variety of buyers and even places to sell our products. We exchange the contact details of buyers among ourselves" (Farmer#6, form IV, 2013).

Phones made it possible to get in contact with, and compare, a large number of buyers, which led to a better selection of partners and improved the chances of higher margins.

In contrast, producers who are organised by exporters (form I) used ICT less for market transactions. This is mainly due to the high degree of coordination and monitoring in the captive chain (mostly face-to-face). Since TAs coordinate the timing of harvesting and marketing, often at the farm, phones were rarely needed:

"The use of a phone is limited for the farmers linked with the exporters. Unless they communicate with the TAs and other farmers about the meetings and the production schedules, they do not use the phone as a marketing tool, as they are not allowed to sell to others." (Expert#21, 2015)

Again, the extent of phone use for market transactions depends on the relational proximity. As outlined above, a buyer's reputation and recognition are not only important for a successful business relationship, but also for the decision if the exchange with this buyer is done via phone.

Further, face-to-face communication is still essential for trading due to its tacit nature of negotiation and, thus, limits the role of ICTs as the following quote exemplifies:

"We usually begin the bargaining via phone, at least to know the starting price in terms of the quantity required. But to fix the final price is when I have visited the farm and have seen the products in the farm. So we start with the phone and then finally physically to set the price (Middlemen#7, 2015).

While our results support other scholars' findings that phones may be important for market access and transactions (cf. JENSEN 2007; MUTO/YAMANO 2009), our results indicate that this is not generally

the case. The exceptions are cases where market relationships and relational proximity exist. In short, phones mainly supplement face-to-face communication (also see JAGUN et al. 2008; MURPHY 2013).

Furthermore, our empirical analysis provided new results and explanations to the question why ICTs cannot lead to a disintermediation of middlemen. First of all, middlemen and traders used phones more widely and early (early mover advantage) than farmers, thus they could partly establish cartel agreements:

"We [buyer] can go to a certain farmer and discuss with him or her the price. Then the farmer can refuse. If I'm the first buyer to arrive at that farm, I will inform my colleagues that this farmer is selling at this certain price. So when they [other buyers] go there, they bargain to get a lower price. Then the farmer could refuse. He will tell another buyer to give him a higher price. Then the buyer will go there and give the farmer a lower price. And you know these products are perishable, so the farmer will get worried about the product. So he will automatically sell and lose profit" (Middleman#9, 2015).

This example is in line with other cases where buyers used phones to perform their roles more effectively (FOSTER/GRAHAM 2014; JAGUN et al. 2008; OVERÅ 2006). The strong position of many middlemen in our cases was built on different characteristics and functions. Their role rests on their access to small peripheral farmers who are, because of their low volumes and their remote location, of low interest for larger traders like exporters. Hence, middlemen also had an important logistic and bundling function (through collecting, delivering, and selling the products of different farmers) which could not be done by small-scale farmers due to limited resources and capabilities, even with ICT support. Finally, some middlemen even fulfil financial services for the farmers (cf. MOLONY 2008). As a result, while reducing information asymmetries the use of phones did not lead to disintermediation of middlemen, but even led to a stronger intermediation of middlemen which hindered small producers from creating and capturing more value from local or international markets.

All in all, our study could not identify a larger transformation of the chain or the production system. So far, no genuinely new actors or platforms, no disintermediation, and no shift in bargaining power could be identified. Furthermore, a shift from less sophisticated domestic value chains (form I, II) to export chains (farmers III, IV) is still a challenge. Even though ICTs could bridge the spatial barriers for many farmers to enable contact with exporters, which was not available to them before, the main barriers are still the insufficient capabilities of most farmers to meet the exporters' requirements (i.e. provide a continuous supply of bulk highly valuable produce). Further, often exporters were not

interested in such direct contact with individual farmers, but preferred intermediaries who collect larger volumes for them. In both contexts, ICTs did not help domestic-oriented farmers to integrate into export markets and, thus, higher value creation was absent. Simliar challenges have been identified for small producers in the wood sector in Tanzania by MURPHY (2013).

Table 13. Effects of diverse factors on use of mobile payments, access to simple information, and access to complex knowledge; source: own data and calculations.

Odd Ratios	**Mobile payment**	**Access to simple information via ICT**	**Access to complex knowledge via ICT**
Export direct (yes=1)	-1,121	-0,068	-1,304*
Export via middlemen (yes=1)	-1,214*	0,222	-1,288*
Domestic via middlemen (yes=1)	-2,095**	0,368	-1,722**
Domestic direct (yes=1)	N/A	N/A	N/A
Participating on trainings (yes=1)	0,013	0,639*	-0,306
Gender (female=1)	-0,173	-0,176	-0,393
Educational level (higher education=1)	-0,078	-0,092	0,339
Monthly turnover in €	0,000	0,000	0,000
Group membership (yes=1)	0,822**	1,317**	1,445***
Age (>55years=1)	0,174	-0,817**	-0,158
Size of farm in acre	0,081	0,057	0,046
Observations	292	309	307
Constant	0,777***	1,265***	0,255**
Pseudo R^2	0,087	0,120	0,237

Note: *p<0,1; **p<0,05; ***p<0,01.

Summary and conclusion

In this paper, we assessed the extent to which ICTs affect farmers' value chain integration and in how far these effects are influenced by the value chain context.

First of all, our case studies showed how ICT use can improve simple information and complex knowledge flows and financial transactions as well as market access and, in this way, facilitate farmers' commercial market integration. However, while ICTs lead to some improvements (efficiency gains), so far they have not been able to replace or reconfigure extant transactions, market access, and information and knowledge flows. Furthermore, we could not identify a changing value chain context. The structures, coordination forms, and relationships we observed were similar to those of previous studies. In this way, ICT usage has so far resulted in a 'thin integration' (MURPHY/CARMODY 2015) with no real transformative or substantial upgrading effects.

Secondly, based on the novel combination of conceptual considerations on ICTs, value chains, and relational proximity, our results showed that the effects of ICTs highly depend on the coordination, the structure, and the relational proximity within the value chain forms. Table 14 summarises the

extent of ICT effects on information and knowledge flows, financial transactions, and market access depending on the context within the different value chain forms.

Table 14. Effects of ICT use on small-scale farmers' integration within different value chain forms and their context (stylised); source: own results and illustration.

Value chain form	**I Export direct**	**II Export via middlemen**	**III Domestic via middlemen**	**IV Domestic direct**
Context				
Structure	Relatively direct with highly capable buyers	Mediated with less capable buyers	Mediated with less capable buyers	Direct with less capable buyers
Coordination type	Captive	Market-based	Market-based	Market-based
Relational proximity	High	Low	High	Low
Effects				
Simple information	High	High	High	High
Complex knowledge	High	Low	Low	Low
Financial transaction	Low	Low	High	Low
Market access	Low	High	High	High

While studies exist which outline the importance of contextual factors and the capabilities of the users for the effectiveness of ICTs in low-income countries, this study firstly specifically outlined and explained the effects of the value chain context and their combination in different value chains. While, for example, a high relational proximity in a chain is generally favourable for less expensive transactions, the level to which ICT use can further improve the transactions in such chains depends on further contextual factors in the chain (as shown in the comparison of form I and III). Particularly, adding the dimension of relational proximity to the analytical dimensions of the GVC analysis provided a more comprehensive analytical perspective and also added a deeper understanding to the concept of coordination within GVCs and the relations particularly between producers and buyers.

The results point to a new digital divide that presents differences between actors under a favourable value chain context who can gain more benefits from using ICTs (e.g. reducing of transaction costs

and access to simple and complex knowledge) than those who lag behind due to an unfavourable context.

While these findings are specific to the East African context and the branch concerning the detailed identified characteristic attributes, we argue that analysing the influence of the outlined value chain context (structure, coordination, and relational proximity) is of general relevance for understanding the effects of ICTs on the integration of small businesses in low-income countries into commercial value chains. This can also help policy makers and practitioners to decide in which cases ICT solutions can be used effectively to support farmers.

Any underlying research materials related to our paper can be accessed via the authors.

APPENDIX.

Table 15. Overview of quantitative interviews; source: own findings.

Characteristics of interviewees (n=368)	%
Residence in Mt. Kenya	52*
Residence in Mwanza	48*
ICT user	91**
Non-ICT user	9**
≤ 30 years	20**
30-50 years	63**
≥ 50 years	17**
Primary educational level	69**
Higher than primary	31**
Female	31**
Male	69**
Group membership	48
Participating in trainings	50*
Farm size in acre (median)	1 acre
Monthly turnover in € (median)	10,000 KSH ($101)
Good access to simple information	78**
Good access to complex knowledge	57**
Use of mobile payment	67**

Note: *$P<0.1$; **$P<0.05$

Table 16. Overview of qualitative interviews used in this paper, sorted according to appearance in the text.

Number of interviewed farmer	**Region**	**Year of the interview**
F4	Mwanza	2015
F1	Kenya	2013
F17	Mwanza	2015

F26	Kenya	2015
F14	Mwanza	2015
F6	Mwanza	2013
Number of interviewed expert	**Institution**	**Year of the interview**
E21	Ministry of Agriculture and Food Security, Nyeri County, Kieni East District	2015
Number of the interviewed middlemen	**Region**	**Year**
M9	Mwanza	2015
M7	Mwanza	2015

6 A Spatial Perspective on Access to Knowledge and Mobile Phone Use – Examples from Tanzanian Farmers

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This is an author's original manuscript of the submitted article.

Abstract

Small-scale farmers in rural areas in the Global South often lack access to crucial business knowledge due to, among others, spatial constraints, e.g. peripheral locations and poor transport infrastructure. Studies on information and communication technology for development (ICT4D) argue that the use of ICTs like mobile phones supports farmers by overcoming these constraints. Combining concepts about knowledge with relational and spatial proximity, this paper aims to contribute to the current debate on ICT4D studies. Based on a survey and qualitative interviews with horticultural small-scale farmers in Mwanza region, Tanzania, we analyse the potential and limitations of mobile phone use to reduce spatial constraints in order to access different types of knowledge. Our results show the benefits of phone use to access particularly external knowledge can only fully take place if the users already possess external contacts that are, however, usually based on personal relationships in close spatial proximity.

Keywords: Africa, Mobile phone, Knowledge, Agriculture, ICT4D

INTRODUCTION

In Sub-Saharan Africa agricultural small-scale production provides employment and income for approximately 70% of the population (THE WORLD BANK 2014). Many of them, who used to sell to local consumers, are shifting their sales to high commercial value chains (MCCULLOUGH et al. 2008). To

adapt to these chains, farmers usually need external knowledge from outside their local community such as on how to use modern chemical inputs or book-keeping (LWOGA 2010; NAKASONE et al. 2014). While general knowledge on farming practice can be exchanged between farmers locally, specific and more complex knowledge is often only accessible through input suppliers, extension officers and other professionals. However, farmers from remote rural areas often do not have these contacts, as these actors concentrate mainly in urban centers or provincial towns. Poor transport infrastructure in remote areas further make it difficult for small-scale farmers to meet extension officers and input suppliers face-to-face to access such knowledge (NAKASONE et al. 2014; PORTER 2015). Thus, it is assumed that a spatial knowledge divide evolves, leaving behind those small-scale farmers who live in remote rural places.

Studies on Information and Communication Technologies for Development (ICT4D; e.g. FOSTER/BRICEÑO-GARMENDIA 2011; THE WORLD BANK 2016) argue that ICTs like mobile phones can support small businesses in Sub-Saharan Africa to overcome this spatial knowledge divide by expanding and establishing contacts. This has led to positive expectations and assumptions among practitioners and development organizations that ICTs can improve the agricultural sector in Sub-Saharan Africa by providing access to information and knowledge across space (e.g. AKER/MBITI 2010; FOSTER/BRICEÑO-GARMENDIA 2011; LWOGA 2010).

However, ICTs' "effects cannot be separated from the contexts in which they are situated" (SCHWANEN et al. 2008: 520) and most of the positive assumptions refer to perspectives from the Global North. Thus, these assumptions do not take into account the different contextual conditions within the Global South and its rural areas (cf. PORTER 2015). Rural areas in Africa significantly differ from northern and urban contexts because of their lack of infrastructure, sparse population, low accumulation of external knowledge and preference for personal communication (cf. PORTER 2015). Therefore, it is barely understood how far such a spatial knowledge divide can be bridged by mobile phones and how small-scale farmers in rural areas of the Global South can better access external knowledge using ICTs like mobile phones. To fill this research gap, this paper combines concepts about knowledge and its spatial and relational implication with ICT4D studies by looking at the example of horticultural small-scale farmers in Tanzania. This includes the question to what extent ICTs can really support access to new knowledge outside the region or just improve the exchange with already existing contacts. We aim to analyse the potential and limitations of mobile phone use to reduce spatial constraints in order to access different types of knowledge.

The paper examines the following questions:

1. What types of knowledge do farmers access from whom?
2. To what extent does a spatial knowledge divide regarding access to local and external knowledge exist?

3. In how far can the use of mobile phones reduce such a spatial knowledge divide?

The results are derived from a field study in the Mwanza Region in Tanzania in 2013-2015, including qualitative interviews with and surveys of small-scale farmers.

The paper is divided into five parts. After this introduction, the conceptual framework is presented by giving an overview of different types of knowledge and its spatial implications. Further, we discuss the knowledge benefits through mobile phone use and its potential to reduce spatial constraints as well as the limitations and critiques of ICT use. The fourth part includes the regional context and methods. In chapter five, the empirical results are presented and discussed, analysing the use of phones for access to different types of knowledge. This paper shows that despite the use of phones, spatial proximity remains essential for tacit knowledge transfer and to establish contacts. Finally, the conclusion reviews the potential and limitations of mobile phone use for knowledge access.

CONCEPTUAL FRAMEWORK

Knowledge access in relation to spatial and relational proximity - Concepts of knowledge have been subject to extensive research in the past decades and most of the economic geography literature considers knowledge as key for long-term economic development due to the growing complexity and uncertainty in social and economic interactions (cf. BATHELT et al. 2004; FUCHS 2014). While an increasing flow of knowledge over distance has been observed in the context of globalization, there is an ongoing debate on the role of proximities for knowledge transfer.

This paper includes spatial and relational proximity for the analysis of knowledge transfer via mobile phones. According to TORRE/RALLET (2005), we define spatial proximity as the kilometric distance that separates two units (e.g. individuals, farms) in geographical space. In rural areas in Sub-Saharan Africa, spatial proximity is often very important for knowledge transfer since most people own bicycles rather than cars and are disadvantaged by poor transport and road infrastructure (PORTER 2015). Thus, the lack of spatial proximity is often connected with time requirements and expenses. By relational proximity we understand perceptions of trustworthiness, the quality of social performance, and the outcomes of shared experience (cf. MURPHY 2012: 5). While local factors can influence relational proximity (e.g. local norms), spatial proximity is not a requirement (IBERT 2010), but can be supportive to develop a high degree of relational proximity (cf. BOSCHMA 2005). Taking into account the numerous other proximity dimensions outlined by BOSCHMA (2005), we understand social, institutional and organizational proximity as parts of relational proximity (also see IBERT 2010). Since we focus on knowledge transfer via phones and not on learning and knowledge assimilation, cognitive proximity and absorptive capacity are not part of this study.

With regard to NONAKA (1994), who distinguishes between tacit and codified knowledge, and MORGAN/MURDOCH (2000: 160), who applied existing ideas on knowledge distribution to agricultural networks, we distinguish between different types of knowledge: simple and complex knowledge, tacit and codified knowledge, local and external knowledge. In some cases, the pairs of knowledge types are interrelated and, thus, overlap.

First, knowledge is differentiated according to complexity:

a) **Simple knowledge** is understood as codified information in terms of facts or data ("know-what", LUNDVALL/JOHNSON 1994). In the agricultural context, it contains mostly market prices and transaction information which are easy to transfer over distance via ICTs.

b) **Complex knowledge** includes knowledge that goes beyond factual information, such as "know-why", "know-who" and "know-how" (LUNDVALL/JOHNSON 1994). "Know-why" includes the understanding of certain rules and applications and is mainly codified in nature, e.g. the correlation of the rainy season and the increase in supply of certain crops. Further, it is easy to transfer over distance with ICTs. "Know-who" is tacit and relates to the interconnection of people and the quality of their relationship. The essential value of know-who is that it enhances knowledge access opportunities, thus contacts. Especially in agricultural communities of practice, contacts play a crucial role regarding the transfer of knowledge as most agricultural information and knowledge are diffused through interconnected actors rather than being freely available in the community (LWOGA 2010). However, it is often distance-sensitive and the frequency of interaction is likely to be higher in networks where people are within spatial distance such as urban areas. Hence, we assume that most farmers access their knowledge from spatially close contacts and lack access to external contacts. "Know-how" compromises practical knowledge and skills. It is important for the understanding of production processes and involves e.g. trained skills, which are often tacit and therefore difficult to communicate (POLANYI 1967). Often "know-how" is directly linked to experiences and can only be observed through application and acquired through practice and experiences, for example, the identification of pests and the right treatment (cf. GERTLER 2003).

Second, knowledge is further divided regarding to codifiability:

c) **Tacit knowledge** is directly connected to ideas, perceptions and experience and can only be observed through application and acquired through practice and experiences (NONAKA 1994). The distinction between tacit and codified knowledge can best be explained by the famous phrase by POLANYI (1967: 4) "we can know more than we can tell". In farming, for example, many farmers may know the best time to sow a particular crop, but they cannot always explain the underlying principles. According to HOWELLS (2002), tacit knowledge is referred to as "know-how" and "know-who" and, thus, it is transferred via face-to-face communication through demonstrations

and practice often linked with a learning process (BATHELT et al. 2004; GERTLER 2003). Hence, it can be difficult to access and transfer tacit knowledge since "it exists in the background of our consciousness and the inadequacies of language in expressing certain forms of knowledge" (GERTLER 2003: 77). It is also often shared through codes of common practice and through social interactions (NONAKA 1994; POLANYI 1967). Relational proximity between interacting individuals is necessary for its transfer.

d) **Codified knowledge** is standardized and not bonded to subjects; it comprises rules, facts and documented experiences (NONAKA 1994). This is, for example, knowledge of agricultural production standards. Codified knowledge can be recorded, transmitted in the form of symbols or embodied in tangible form. Hence, it can easily be transferred over distances via ICTs (BATHELT/TURI 2011).

Third, in the context of the increasing commercial production, farmers require external knowledge which goes beyond the scope of the local networks and communities they are involved in. Thus, we further differentiate between local and external knowledge referring to the geographical boundaries of knowledge transfer (cf. YANOW 2004: ; see Figure 1):

e) **Local knowledge** is developed within a community of practitioners, it is specific to a regional context and to a group of people acting together (YANOW 2004). It can be simple, complex, codified or tacit and contains mainly basic farming "everyday" knowledge such as how to produce local crops or how to fight against common pests as well as local market structures. Furthermore, local knowledge is tied to the local socio-economic system and does not extend beyond the respective community (in this case the local farming community; cf. MORGAN/MURDOCH 2000). However, in contrast to the conventional development discourse where local knowledge is viewed as backward (NYGREN 1999), we understand local knowledge as specialised knowledge linked to spatially-specific practices.

   LWOGA (2010) illustrated for Tanzanian rural communities that interpersonal sources such as friends, family members and neighbours are the main providers of agricultural knowledge due to their credibility, reliability and, most of all, they are trusted by the rural community. We assume that local knowledge is ubiquitous and easily accessible for all farmers who are surrounded by other farmers within the same community of practice – no matter if remote or close to urban centres as long as they are relationally proximate to each other. We assume depending on its tacitness, it can be accessed and transferred by ICTs. In relation to that, authors describe the advantage of close relationships for knowledge transfer through spatial proximity by using different wordings, e.g. buzz (BATHELT et al. 2004). The idea behind it is that certain contexts can stimulate competitiveness due to frequent and ongoing knowledge transfer on a local scale based on co-presence. Knowledge transfer often occurs spontaneously and automatically

without high investments of time and travel costs (BATHELT et al. 2004). However, geographically close networks also tend to be limited in their scope of information transmissions and lock-in effects can occur. Empirical examples have illustrated that regional agrarian systems benefit from an intensive buzz, but also from trans- local or even international linkages through which external knowledge can be accessed (e.g. DANNENBERG/KULKE 2005).

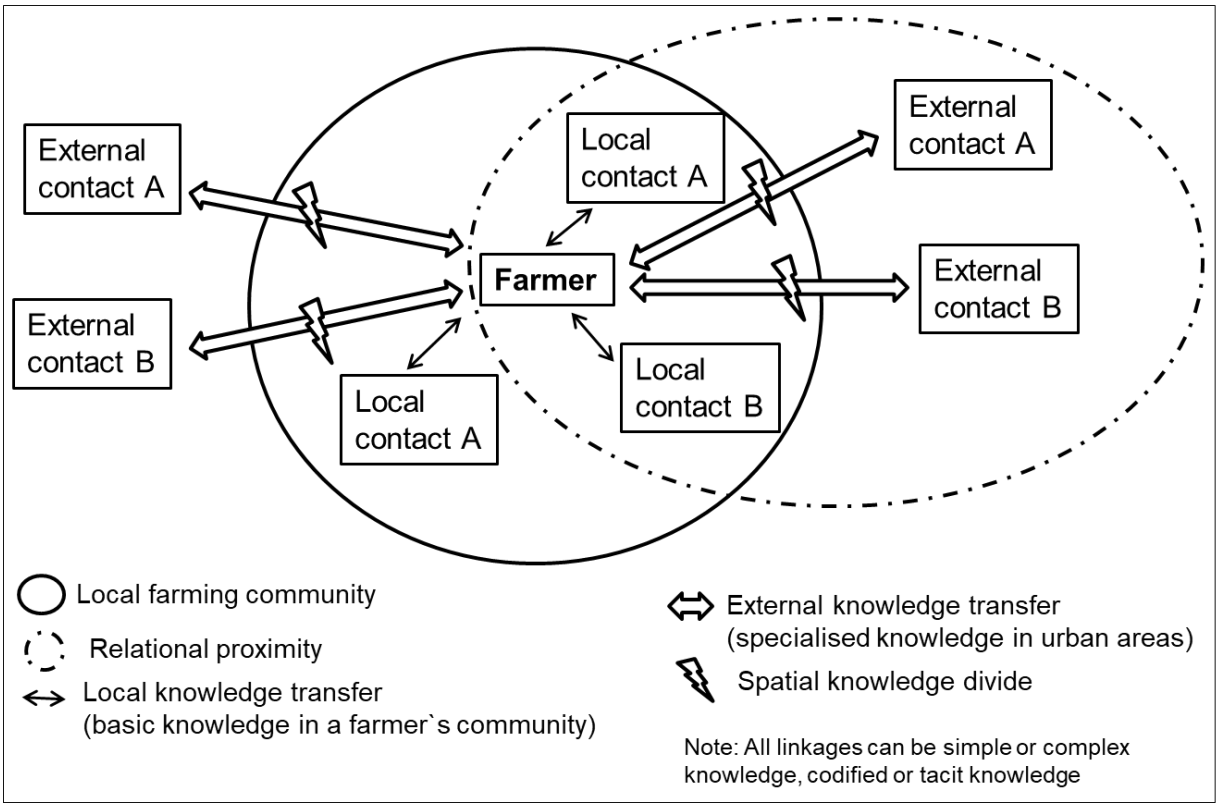
f) **External knowledge** exceeds the usual knowledge circulation in a local network. According to YANOW (2004), external knowledge can include expert knowledge which is scientifically constructed. It is of particular importance for farmers since it is mostly specialised, e.g. focusing on new commercial inputs, new cultivation practices, standards and also information about new markets and buyer requirements.

   Similarly to local knowledge, it can also be simple, complex, codified or tacit. In contrast to local knowledge, external knowledge is accessed within trans-local interactions, which do not occur automatically and do not result from spontaneous meetings of actors. Its access is planned in advance and often requires certain investments like time and travel costs. Based on the concept of a regional agrarian system, we assume that farmers can access external knowledge from preliminary units (e.g. input supplier), downstream units (e.g. buyer) and from a variety of different service providers (e.g. extension services, banks, cf. DANNENBERG/KULKE 2005).

   However, access to such knowledge is often challenging for farmers due to inadequate means of transportation and poor road infrastructure that make transactions risky and increase the cost to gather knowledge - which is mostly the case in Sub-Saharan Africa (OVERÅ 2006; PORTER 2015). Hence, we assume a spatial knowledge divide exists between urban areas with good access to external and local knowledge and remote rural areas with predominantly access to local knowledge. Therefore, it is crucial to understand how far such external knowledge can be better accessed through the use of mobile phones.

These types of knowledge should not be understood as substitutes, but rather as complements to one other and as a continuum since a piece of knowledge can be located somewhere in a range between the completely tacit and completely codified, between simple and complex and between local and external (see Figure 13). Based on this, the knowledge types are used in the empirical analysis that follows to refine the analysis of benefits and limitations of phone use regarding knowledge access and transfer over distance. It is assumed that some knowledge types can be transferred via phone without challenges and some cannot be.

Figure 13. Stylized model of local and external knowledge; source: own design and illustration.



The potential of mobile phones to reduce spatial constraints regarding knowledge access - Following several authors who have contributed to the ICT4D debate (e.g. AKER/MBITI 2010; MUTO/YAMANO 2009; THE WORLD BANK 2016), it is argued that mobile phones provide quick access to external knowledge that may improve businesses by enhancing productivity and income. The main argument behind this is that the costs of searching and accessing information and knowledge are reduced as the initial fixed costs required to buy a mobile phone are lower than personal travel costs and other transaction costs. PURCELL/TOLAND (2004: 241) claim: "ICT[s] offer the opportunity to reduce the barriers of distance". Linked to this, several authors (e.g. CAIRNCROSS 2001; O'BRIEN 1992) have pointed to the imminent "death of distance" arguing that space and distance are of less significance for economic activities. They asserted that the convergence of time and space by ICTs will reduce the geographic frictions that shape spatial differences and that ICTs enable codified knowledge to be made available more quickly and more cheaply and, thus, reduces knowledge to a universally accessible form of information (cf. MORGAN 2004).

However, those arguments have been criticised by some authors (e.g. GRAHAM 1998; KITCHIN 1998) providing a more complex conceptualisation of the relationship between space and ICTs recognizing the relational links between technology, space and economic activity. In line with this, SCHWANEN et al. (2008) argued that the potential of ICTs to overcome spatial constraints depends on certain conditions, such as the type of activity and social relationships in which people are embedded. A major critique refers to the point that spatial reach is conflated with social depth, neglecting the

importance of relational proximity. BURRELL/OREGLIA (2015: 272) also emphasise the relationship between social relationships and mobile phone use by criticising the use of information in the ICT4D debate as it is imagined "as unproblematically extractable, in particular, from the relationships between actors who exchange it". In their study on agricultural markets in China and Uganda, they showed how good relationships between trade partners and trade practices are essential for exchanging price information and knowledge since trust in the information source is often highly valued (BURRELL/OREGLIA 2015). This is why we integrate relational proximity within our research framework, assuming that it influences not only access to knowledge but also the use of mobile phones.

However, most of the assumptions and perspectives on ICT use and spatial implications refer to the context of urban areas in the Global North and/or more complex ICT types like the Internet (e.g. CAIRNCROSS 2001; SCHWANEN et al. 2008). The implications of phone use for daily mobility practices in the context of rural Sub-Saharan Africa are very different from the illustrated perspectives; irregular and sometimes even dangerous transport infrastructure, on the one hand, and a high valuation of face-to-face interaction characterizes most rural places (cf. OVERÅ 2006; PORTER 2015). So far, studies taking this different context into account are rare.

Nevertheless, existing studies illustrate the benefits that mobile phones bring in the reduction in information search for the agricultural context in Sub-Saharan Africa (e.g. BUYS et al. 2009; OVERÅ 2006; PORTER 2015). For example, in a case study on agricultural traders in Ghana, OVERÅ (2006) recognizes the value of phones in a long-distance trading context characterized by high risk, low trust and consequent heavy reliance on personal networks. Although most studies on knowledge access within the agricultural context in Sub-Saharan Africa focus on the core processes of marketing and sales at a local scale, access to relevant external knowledge on cultivation practices is also an important feature of ICT use (DANNENBERG/LAKES 2013; KRONE/DANNENBERG 2018). In this context, COLE/FERNANDO (2012) argued that ICTs can facilitate more access to extension services by reducing the cost of extension visits, enabling more frequent two-way communication between farmers and agents outside the local community. Thus, a spatial knowledge divide can be bridged with the support of phones.

Accordingly, we aim to analyse the potential and limitations of mobile phone use to overcome these spatial constraints of remote farmers to access local and external knowledge. Hereby, we also aim to analyse the different types of knowledge and their access via mobile phone and the influence of relational proximity and spatial proximity between farms and the nearest city centre. We argue that the role of mobile phones for knowledge access differs according to the relational proximity between individuals and the type of knowledge accessed and the spatial proximity between farms and the nearest city.

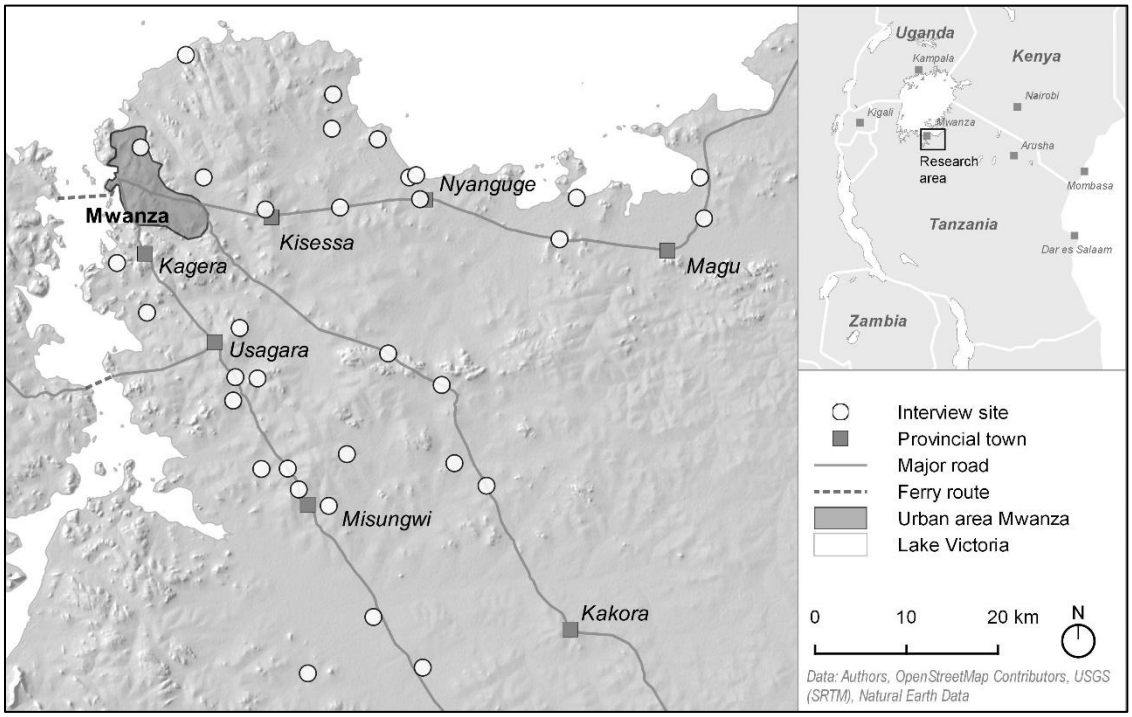
REGIONAL CONTEXT AND METHODS

The increasing popularity of mobile phones and the Internet, as well as regulatory reforms, falling tariffs and hardware costs have fostered the increasing use of ICTs in Tanzania. While landline telephone networks barely exist, current mobile phone networks in Tanzania provide access in rural areas and are affordable for most villagers. In 2016, 72% of all Tanzanians used mobile phones and 33% of Tanzanians used the Internet in 2016 (ITU 2016).

The Mwanza Region is part of the Victoria Lake Region (see Figure 14) which is an emerging production area for horticultural crops due to its tropical climate, with a rather even temperature distribution throughout the year (EVERAARTS et al. 2014). The horticultural sector is mainly characterized by small-scale farmers with plot sizes between 0.1 to 2 ha producing mainly tomatoes and cabbage for the domestic market (EVERAARTS et al. 2014). We selected the horticultural sector due to its economic significance for the rural population and due to the high perishability of the products. Horticultural production is highly profitable, increases employment opportunities, and brings about increasing commercialization of the rural sector (WEINBERGER/LUMPKIN 2007). In this context, it is assumed that phones in particular increase the potential of fast transaction of the trading process and fast communication (MOLONY 2008).

Within the research region, Mwanza City is the largest city providing essential access to agricultural upstream and downstream value chain services including domestic wholesale markets. Transport services in the research region differ between extremely poor (bicycle taxis), modest (motorcycle taxis) and good (public bus) depending on the remoteness (which can be measured as the distance from farms to Mwanza city).

Figure 14. Overview of research area with interview sites.



Our research is based on a mixed method study- qualitative interviews and quantitative surveys with horticultural commercial small-scale farmers - and was conducted in autumn 2013 and spring 2015. Combining the quantitative and qualitative methods allowed us to generate complementary databases that include information that has both depth and breadth regarding the phenomenon under study.

For the survey, we preselected villages in order to get a broad variety of different farmers in different regional environments and different locations. Within these we randomly selected farmers together with a local research partner. Altogether, we have a variation of remote rural farmers and farmers close to Mwanza City (see Figure 14). In order to measure the effects of mobile phone use on knowledge access, both farmers using mobile phones for farming and non-users were interviewed for the survey and the qualitative interviews.

The quantitative data comprises of a survey with 169 small-scale farmers. The survey questions focused on particular aspects of the use of ICT (mobile phones and the Internet) and access to knowledge. Further, questions were asked about from whom they access what kind of knowledge in order to identify and distinguish local and external, and simple and complex knowledge (see Figure 13). Since knowledge dimensions are difficult to measure, we asked the farmers for a subjective assessment of their access to each type of information and knowledge in the survey on a scale ranging from poor to very good. However, because of the fuzziness of the concept of information and knowledge, quantitative surveys can only provide a first orientation and have to be combined with

qualitative methods. Additionally, GPS data from each respondent was captured to extract the spatial variable for to map the distribution of phone users within the research area. For the data analysis, descriptive statistics (cross-table calculations and chi^2 tests) were used to identify the associations between the mobile phone-driven effects and knowledge types as well spatial proximity. We classified the location of farmers into two classes following the logic of local and external knowledge; close farmers <35km to Mwanza and remote farmers >35 km to Mwanza. The classification was used to analyse the effect of spatial proximity to Mwanza on knowledge access. Further, the classification of the location of farmers was used to identify the use of ICTs in relation to spatial proximity to Mwanza. Here, we used four classes.

Moreover, 21 semi-structured interviews with producers, buyers and external agents (e.g. extension officers) and four expert interviews complement the data set. The respondents were sampled purposively in order to select typical cases of commercial small-scale horticulture producers. Within those typical small-scale farmers, respondents were chosen to show contrasting cases (FLICK 2009). These interviews were particularly important to gain an understanding of the everyday use of ICTs and the relational proximity between agents as well as the farmers´ access to knowledge and general knowledge of the local road and transport infrastructure. Relational proximity was measured using the farmer's subjective perceptions of trustworthiness (experienced reliability in past interactions, common interests and shared values of doing business), the quality of social performance (reputation, immediate advice and payment), and the outcomes of shared experience within their relationship with the respective actor (long-term relationships, familiar practices and routines in doing business; MURPHY 2012: 5). The field notes and interview recordings were transcribed and grouped according to categories, with the help of qualitative data software (MAXQDA). Structural content analysis was used to structure the material for the process of coding (MAYRING 2004).

RESULTS

Types of knowledge accessed and a spatial knowledge divide - The farmers interviewed indicated that they needed different kinds of knowledge such as how to plant, store, market and sell, which is provided by different actors at different spatial scales, e.g. input suppliers in urban centres (see Figure 15; cf. MTEGA/MSUNGU 2013).

49% of the farmers interviewed rely solely on local contacts (other farmers and family members) for their access to knowledge. The transferred local knowledge included the four analysed knowledge types (simple or complex, tacit or codified). Regarding simple codified knowledge farmers asked mainly local contacts regarding marketing information, e.g. price information and contacts to buyers. Complex knowledge that was either codified or tacit often includes basic farming practices, e.g. how to harvest and store local crops. It was mainly ubiquitous and, thus, not place-based as local

agricultural communities of practices exist in nearly all areas of the regions observed. It was accessible for all farmers who were surrounded by other farmers to whom they have a high relational proximity, since it is accessed peer-to-peer:

> *"Farmers ask other farmers always at first when they have problems with their farm. Only if other farmers from nearby cannot help me, I would think of other possibilities to get support" (Farmer with a phone#2, 2013).*

Often they shared the same farming experiences, the same problems and also mutual trust which simplified access to local knowledge (cf. LWOGA 2010). The majority of the farmers draw upon social capital embedded within the local scale to facilitate knowledge transfer (cf. GERTLER 2003). Thus, relational proximity as well as spatial proximity can explain the importance of local contacts as a knowledge source. The identified structure of local knowledge transfer was similar to a buzz consisting of continuous knowledge spill-overs due to co-location with a community of practice (cf. BATHELT et al. 2004).

However, farmers emphasised the need for external knowledge and criticized the fact that the available local knowledge often does not include knowledge on new production techniques and pest handling. As shown in Figure 15, 51% of farmers accessed external knowledge from trans-local contacts additionally to their local knowledge sources. Farmers indicated that external contacts were important to overcome the shortcomings of the local contact base since they often come from outside the local farming community and provide specialised expert knowledge such as requirements of the international markets, new seed varieties and pest management.

External knowledge can be either simple or complex, tacit or codified and was mainly provided by input suppliers (e.g. pesticide dealers), and extension officers who are usually located in central areas like smaller and larger cities. Thus, external knowledge was place-based since it was mainly found in urban centres. For example, several farmers stated that they purposely visit input suppliers in Mwanza City to seek advice, e.g. in cases when the application of fertilizer did not fulfil expectations:

> *"Myself I get the information about farming from the input suppliers. If I have a question I ask them. Sometimes they even visit our farms to see the progress. And you find that these input suppliers are the specialists in farming. So they help us a lot" (Farmer#4 with a phone, 2015).*

Public extension officers were also important external contacts as they facilitate the transfer of complex knowledge to rural areas e.g. updated knowledge on production techniques. They had their offices in Mwanza City and came to the farms irregularly because of poor road and transport

infrastructure. Therefore, knowledge transfer took the form of training and demonstrations if it was tacit. But extension officers also provided codified knowledge via phone, e.g. immediate advice on pest handling or the application of fertilizer:

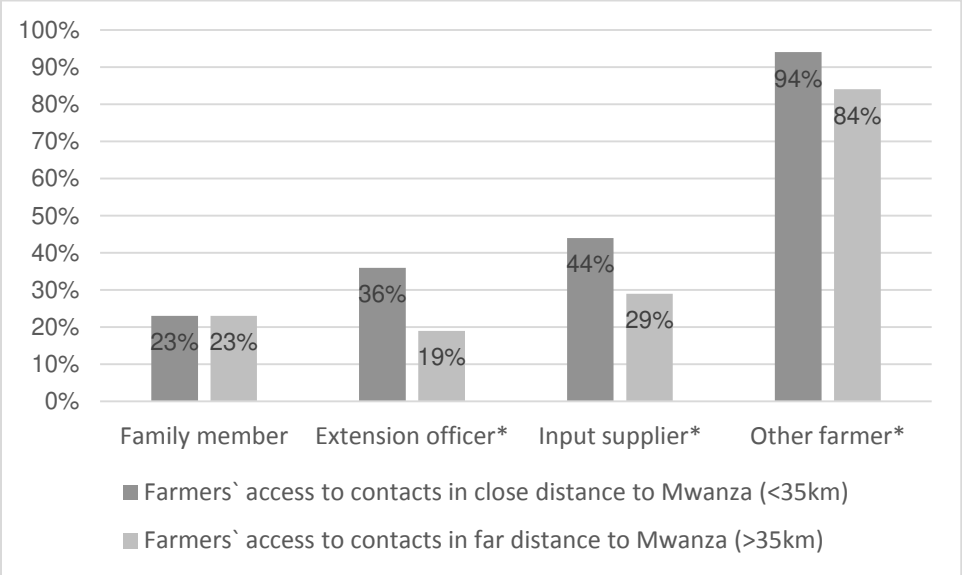
> *"I receive the advice from the agricultural extension officer. But these extension officers they don't visit us at the farm. If you call him, he could advise you via the phone or he will tell you that you meet him at a certain point" (Farmer#14 with a phone).*

External knowledge was mainly transferred in a planned meeting at the respective office in town. In contrast to local knowledge transfer, it did not occur automatically, but had to be planned in advance by organising a meeting. Hereby the phone can function as a distant managing too due to the distances between farmers and external contacts.

Like in buzz structures, relational proximity between farmers and external contacts was not automatically given, but was necessary for successful transfer of tacit knowledge. Unlike the buzz structure, it required more time and costs since it was linked with continuous face-to-face meetings in distant places and, thus, travel was required (cf. BATHELT/TURI 2011). Particularly remote farmers had difficulty accessing external contacts in the first place and then establishing relational proximity given the poor public and private transport infrastructure in the research area and the high costs of travel (cf. NAKASONE et al. 2014: ; see Figure 15).

As shown in Figure 15, more farmers closer to Mwanza City significantly accessed external contacts than remote farmers. For example, 36% of farmers who lived close to Mwanza City regularly accessed extension officers for advice compared to 19% of farmers who lived more than 35km from Mwanza City. Continuous face-to-face meetings in Mwanza City to establish relational proximity and for the transfer of tacit knowledge are a challenge for remote farmers and, thus, they are disadvantaged in their access to external knowledge. Consequently, a spatial knowledge divide between remote farmers and farmers closer to Mwanza regarding access to external knowledge can be observed. In the next sub-chapter, it will be questioned in how far the use of mobile phones can bridge such a divide.

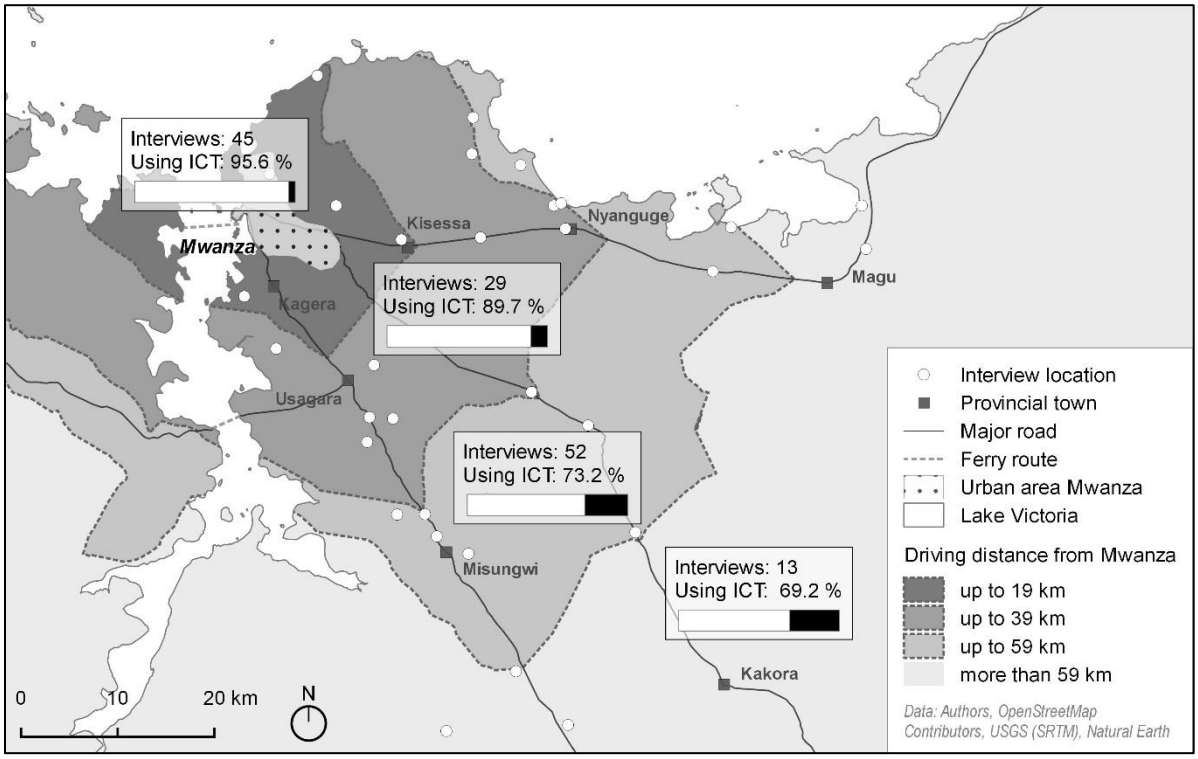
Figure 15. Access to contacts by farmers in relation to different driving distances to Mwanza; source: own data and calculations.



Note: *P<0.1

The potential and limits of phones to bridge a spatial knowledge divide – For about a decade, mobile phones have started to become popular in the Mwanza Region due to the increasing availability of cheap pre-paid phones and low cost tariffs. Thus, it is not surprising that the majority of the small-scale farmers interviewed used phones regularly for their farming business (83%, n=141). In contrast, the Internet was only used by a very low number of farmers (3%, n=5). Moreover, only a minority of farmers did not use mobile phones for farming (17%, n=29), due to limited awareness of their importance for farming. Further, the limited availability of electricity and networks also limited the use of mobile phones in rural areas (cf. FOSTER/BRICEÑO-GARMENDIA 2011). Accordingly, the extent of mobile phone use differs across locations. Our results clearly showed significantly more farmers close to Mwanza city using a phone than those in peripheral locations (see Figure 16). 96% of farmers up to 19km from Mwanza city used a phone compared to 69% of farmers who lived more than 59km away from Mwanza. According to BUYS et al. (2009), this can be explained by the general probability of having a mobile phone network in Sub-Saharan Africa with increasing population density. It further decreases significantly with higher levels of installation and maintenance cost factors e.g. a longer distance from the main road, a longer travel time to the nearest major city. Even though farmers in rural areas share a phone or the electricity source to charge their phones, we assume that they stay behind those in spatial proximity to urban centres.

Figure 16. Driving distance from Mwanza and the share of farmers using ICTs.



In general, the use of mobile phones enabled farmers to access different types of knowledge from different places. However, the use of phones particularly improved access to local contacts. As shown in Figure 17, more farmers with a mobile phone accessed those contacts who are mostly local such as family members and other farmers than farmers without a phone:

> *"If I want to learn about anything I only have to use my mobile. I ask a friend or other farmers 'How can I go about this and that?' And they will tell you directly instead of visiting" (Farmer#2 with a phone, 2015).*

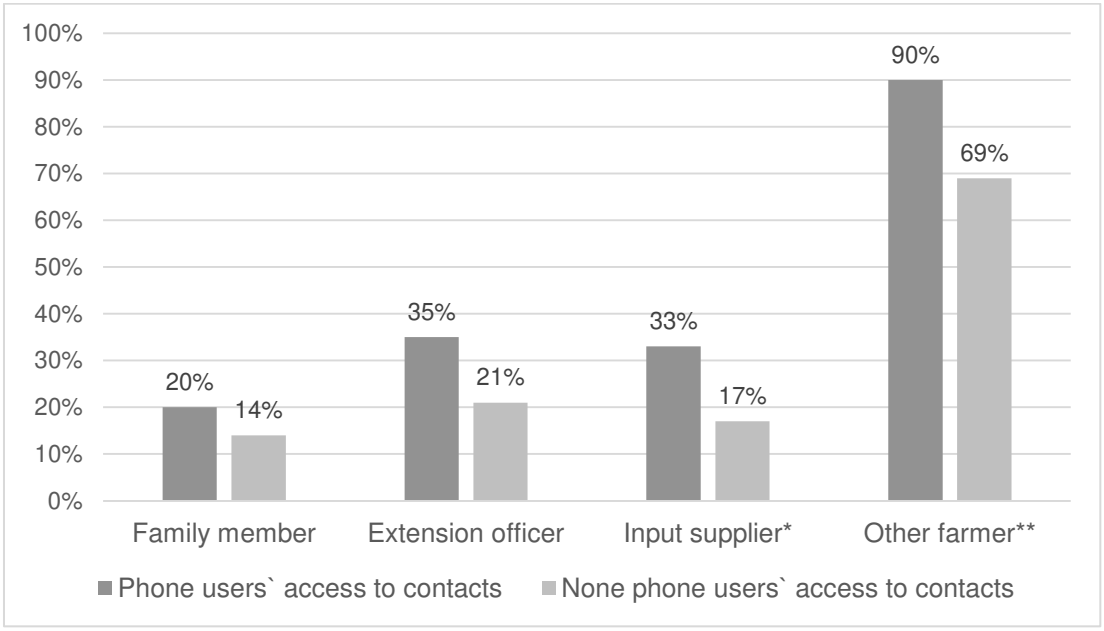
In this way, mobile phones helped farmers to overcome spatial constraints for simple and complex codified knowledge access at least at a local level as personal meetings were not required anymore. However, in the case of complex tacit knowledge from local contacts, co-presence was essential since it is mainly tacit as this quote exemplifies (cf. GERTLER 2003; MORGAN 2004):

> *"I use my phone when I need short and simple information. It's easy to call somebody for a short question, but sometimes I have more complex problems on my farm like unexpected*

problems with my new fertilizer. Then I call another farmer I know and we arrange a meeting" (Farmer#1 with a phone, 2015).

This quote indicates that phones improved the access to local knowledge since farmers can schedule their face-to-face communication much more easily than farmers without phones. Nevertheless, it has to be kept in mind that these mobile-phone-based improvements were taking place on a local level where personal contacts are rather easy to establish and maintain (due to close spatial proximity) and where the transferred knowledge was ubiquitous and, thus, easily available for everybody. Moreover, local contacts were often limited to providing external knowledge which is important for a successful commercial and competitive farming practice (cf. DANNENBERG/NDURU 2013).

Figure 17. Access to famers' contacts compared between phone user and none phone user; source: own data and calculations.



Note: *P<0.1; **P<0.05.

With mobile phones, farmers were able to access external contacts such as extension officers and input suppliers and thus access external knowledge. For example, 35% of farmers with phones accessed external knowledge from extension staff compared to 21% of farmers without a phone (see Figure 17). Similar to local knowledge, access to external knowledge was transferred via phone if it was codified, e.g. how to use pesticide appropriate. Thus, it seems the phone was used to the overcome the spatial distance to Mwanza city thereby substituting travel:

"Before having the phone I went to see the extension officers at their office in Mwanza. But sometimes I could not reach any and had to go back without getting any advice. Now I call the extension officers, especially when I have questions about immediate changes on my farm" (Farmer#5 with a phone, 2013).

However, most of the knowledge from external contacts was complex, often even tacit and had to be transferred via face-to-face communication, e.g. the identification of insect pests. Thus, the direct external knowledge transfers via phones played a less important role (cf. BATHELT/TURI 2011; MORGAN 2004). But the phone was often used indirectly as a distant managing tool to organize such face-to-face communication and maintain contacts (cf. KRONE et al. 2016). Even though mobile phones were used to maintain contacts that had already been formed, they were, however, limited at creating them in the first place (cf. MORGAN 2004). Farmers emphasized the need for personal interaction at the inception of business relations, which has already been shown in previous studies (cf. MOLONY 2008; PORTER 2015).

Besides the informational function of personal communication, it also has an integrative function building confidence between agents and reduces the risks of interaction, e.g. opportunistic behaviour (BATHELT/TURI 2011). This goes in line with PORTER (2015) who stated face-to-face communication is of particularly great significance in Africa, where personalized relationships are crucial in business due to an unstable economic environment. As OVERÅ (2006: 1331) also points out, communication by phone is not a trust-building mechanism in itself, but rather "a tool to make an already existing trust building mechanism, e.g. transfer of information, observation of behaviour more efficient".

In short, the direct knowledge transfer via phones was only possible if the knowledge was codified no matter if local or external. In the case of tacit knowledge, the phone was used indirectly. The indirect knowledge transfers via phones points to the importance of face-to-face communication.

Apart from this, the need for face-to-face communication for the initial phase of establishing contact was crucial but can however reinforce a divide between farmers who are well-linked with external contacts and farmers who are not. To meet personally and travel to Mwanza City was often too costly for many remote farmers so that they were often excluded from accessing external knowledge contacts.

Furthermore, a digital divide can be observed regarding the use of mobile phones for farming business between remote farmers and farmers close to Mwanza City. As shown in Figure 16, with increased driving distance from Mwanza City, the possibility to use a phone for farming business decreased significantly.

Linked to this, the impact of phones to access external sources beyond Mwanza region was not identified in our survey. So far contacts at the national or international scale have not made with

mobile phones. Particularly because of the limited use of the Internet. But also because farmers did not know whom to contact since they lacked knowledge sources (cf. MURPHY/CARMODY 2015). This was illustrated by the following statement:

> *"My access to simple information, especially price information is very good, because of using the mobile phone. But I don´t know much about how to cultivate my tomatoes properly. I don´t even know who knows that" (Farmer#4 with a phone, 2013).*

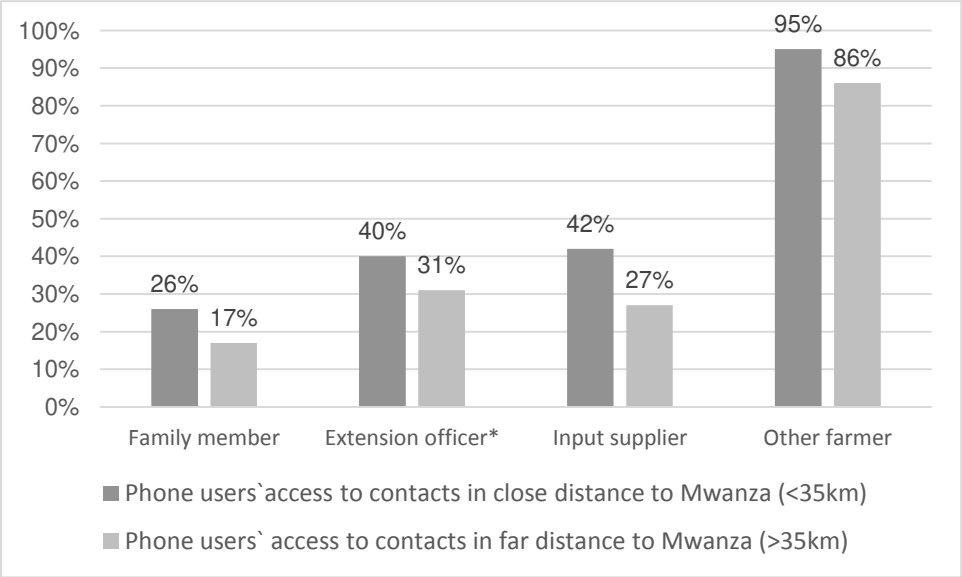
This indicates that so far they have only contacted knowledge sources that were known to them before using phones, e.g. input supplier and extension officers. Often farmers did not know whom to call via phone to get advice on farming. Thus, the use of phones was in some cases limited due to a lack of contacts. TADESSE/BAHIIGWA (2015) also indicated in the example of Ethiopian farmers that the availability of information sources is more important than the lack of information to drive farmers´ decision to use phones to search for information. They further conclude "only those who have access to an information source and know where to search for information are using the technology to facilitate information access" (ibid.: 304). In short, even though the phone has partly facilitated bridging the spatial knowledge divide regarding codified external knowledge, farmers mainly communicated within short travel distances and with people who were known to each other. Despite using phones, farmers often "relied on personal contacts in the immediate localilty" (DUNCOMBE/HEEKS 2002: 64). As stated in other studies (e.g. MURPHY 2013; NAKASONE et al. 2014), this problem of spatial local knowledge is a typical rural problem especially for small-scale businesses.
In sum, using phones contributed to intensifying existing local contacts rather than building new ones from distant locations for external knowledge access (cf. MURPHY 2013). Nevertheless, the indirect improvement of using a phone to access external contacts played a more important role than accessing local contacts as the distances between the external contacts and farmers are longer and, thus, it is more difficult to maintain contacts and organize meetings. Consequently, phones can "have the potential to provide infusions of external information that break the insularity and quality deficits of some information social networks" (DUNCOMBE/HEEKS 2002: 71).

The use of mobile phone use and the role of spatial and relational proximity - According to Figure 16, our results showed a clear decrease in phone use and their related benefits with a growing distance to Mwanza City as the benefits of phone use can obviously only fully take place if the users already possessed crucial contacts. Thus, particularly to access external contacts, spatial proximity to Mwanza was essential. According to Figure 18, more farmers using phones in close proximity to Mwanza (<35km) accessed contacts than those with phones in spatial distance to Mwanza (>35km).

For example, 42% of farmers with a phone in close distance to Mwanza accessed external knowledge from input suppliers compared to 27% of farmers with phones in remote areas (see Figure 18). As already explained, the importance of spatial proximity to contacts remained due to the tacit nature of knowledge and the need to meet personally to establish contact (cf. MORGAN 2004).

As illustrated in Figure 18, even though the differences within local contacts were not as big, remote farmers were also disadvantaged in their access. MUTO/YAMANO (2009) also illustrated farmers in remote areas are not as well informed as farmers close to the district centres even with phones. This means for our results, if the knowledge was external, travel was still needed and, thus, to be in spatial proximity to a number of contacts was an advantage. Only those who have personal access to contacts in spatial proximity were able to use phones efficiently for knowledge access. This also indicates that the mere existence of mobile phones may not necessarily mean farmers are using the technology to solve information problems. Our results showed well-known and trusted contacts in spatial proximity were crucial for successful knowledge access via phones.

Figure 18. Access to contacts by farmers in relation to using phones and none use and in relation to driving distance to Mwanza; source: own data and illustration.



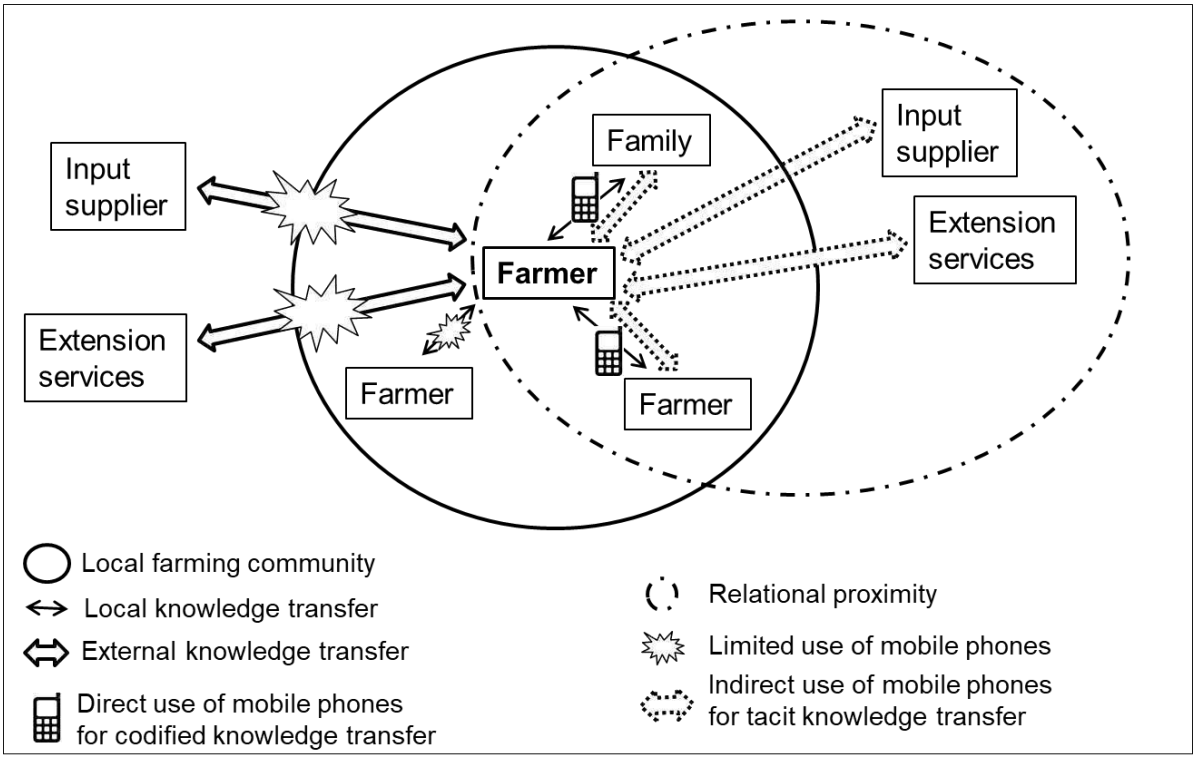
Note: *P<0.1

Figure 19 summarizes the results by illustrating a simplified communication model of a farmer in our research area. In the case of local knowledge, phones were used to communicate, since it was mainly codified and relational proximity between interacting agents mainly existed. Therefore, the direct use of phones for knowledge access was possible. Tacit knowledge transfer was done indirectly via phone and, thus, was also indirectly improved. In contrast, in the case of external knowledge, phone use was limited since knowledge was mainly accessed indirectly via phone since it was often tacit. If no relational proximity between agents existed, knowledge access via phone was also limited.

All in all, the role of spatial proximity remained important for the following reasons:

1. Personal contact is needed for the initial phase of establishing contact.
2. Personal contact is needed for tacit knowledge transfer.

Figure 19. Knowledge transfer via mobile phones in relation to spatial and relational proximity; source: own design and illustration.



CONCLUSION

In this paper, we assessed the potential and limitations of mobile phone use to overcome spatial constraints that farmers face to access knowledge in rural areas in Tanzania.

First, we showed that most farmers accessed their knowledge from local sources such as other farmers or family members within their community due to their relational and spatial proximity to each other. However, farmers emphasised the need for external knowledge and stated that the local knowledge available often does not include knowledge e.g. on production techniques.

Second, a spatial knowledge divide between remote farmers and farmers close to Mwanza regarding access to external knowledge was observed - more farmers in close spatial proximity to Mwanza City significantly accessed external contacts than remote farmers.

Third, our results regarding the potential of phones to reduce the spatial knowledge divide are mixed, depending on the type of knowledge and the relational as well as spatial proximity between the farmer and the knowledge source. Hence, the phone is either used directly or indirectly to organize meetings for face-to-face communication. Thus, the spatial knowledge divide between

urban and rural areas regarding access to knowledge can only partly be bridged with the use of mobile phones. Only in the case of codified knowledge and high relational proximity between contacts, can phones bridge the spatial knowledge divide.

This article extends the debate on ICTs and space, which has mainly taken place in contexts of the Global North. It shows that even though mobile phone use has brought some improvements to knowledge transfer over distance, it is mostly limited due to the role of relational proximity and the tacitness of knowledge in some cases.

Furthermore, the integration of proximity concepts into the ICT4D debate provided valuable insights and a deeper understanding of the role of spatial and relational proximity and, thus, the factor that limits ICT concerning access to knowledge. We call on more attention to take the different contexts of research into account. Further, the testing and application of this research framework and its results to other research regions and economic sectors are recommended.

7 Concluding Discussion

The concluding chapter first provides a summary of the empirical findings in which they are positioned within the broader academic debate. The chapter further provides the theoretical and policy implications of the study.

The research questions and hypotheses that were addressed are part of two broader discussions; first of how ICTs contribute to economic development and, second, the dynamics of small- scale based horticultural value chains in Sub-Saharan Africa. The aim of this thesis was to contribute to these discussions by providing an improved and differentiated understanding of the conditions and effects of ICT use within small-scale based value chains in Sub-Saharan Africa. This has been achieved through a comparison of different integrated small-scale farmers producing commercially (analysed in particular with the coordination types of the GVC model) and a comparison between small-scale farmers using ICTs and those not using ICTs as well as farmers using different types of ICTs.

As discussed in the chapters above, there have been calls for more analytical and conceptualised studies on the use of ICTs for economic development to resolve the controversial evidence on the effects of ICTs. To fill this research gap, a conceptual approach combining the Global Value Chain framework, economic geography considerations regarding knowledge types and relational proximity and ICT4D studies has been applied. This thesis argued for a more differentiated perspective on the topic by focusing not only on the various effects ICTs can have on value chain integration, but also

focusing on the contextual conditions such as forms of value chain integration, relational and spatial proximities.

In the following sections, I will present and discuss the major findings with reference to the hypotheses outlined in chapter 3.4. The first hypothesis focused on the effects which have been deemed the most important according to existing literature on ICT use in small-scale based production in the Global South (see Figure 2). The second hypothesis examined the underlying conditions of the effects of ICT use within value chains including the different types of ICTs, the types of knowledge, the capabilities and characteristics of the farmers, the form of value chain integration, relational proximity and the spatial distance between farms and the nearest city centre (see Figure 2). These include information and knowledge flow, financial transactions, market coordination, structural changes of the value chain, power relations and the reduction of spatial barriers for information and knowledge flow. The results of the first hypothesis will be outlined taking into account the different variables of the second hypothesis[42].

H1A: The use of ICTs affects small- scale based value chains in Sub-Saharan Africa regarding information and knowledge flow.

The empirical findings in all three articles illustrated that the use of ICTs by small-scale farmers resulted in a better flow of information and knowledge. The direct and immediate access to information on prices, supply and demand were the most important utilities of ICTs, particularly through mobile phones. Thus, our study findings go in line with the majority of other studies revealing that the use of ICTs increases the efficiency of information and knowledge transfer (e.g. BURRELL/OREGLIA 2015; MOLONY 2008; MURPHY/CARMODY 2015). However, differences were observed when it comes to various types of knowledge. While simple information was the most common type of information transferred, more complex types like production methods and advice on pesticide use were also accessed and transferred through ICTs which has not been emphasized in previous studies before (with the exception of DANNENBERG/LAKES 2013). Complex knowledge can be either codified or tacit and often includes farming practices and pest management. As shown in the first paper/chapter four, access to complex knowledge increased with the complexity of ICT types. Hence, internet use provided the greatest access to complex knowledge, but only if it is codified[43]. In the case of tacit (complex) knowledge, the phone was used to make appointments for face-to-face communication. Thus, even though the phone was limited for direct tacit knowledge exchange, it was valuable for providing the access to it.

[42] In some cases, the results of the hypotheses are interrelated and thus overlapping.

[43] However, due to the small numbers of internet users the effect is rather low.

Besides the different types, information and knowledge were also provided at different spatial scales by different actors which was the subject of the third paper/chapter five. The majority of farmers accessed their information and knowledge from other farmers nearby and only to some extent from external knowledge sources (e.g. extension services from urban centres). In both cases, the use of phones enhanced access, even though direct knowledge transfer was only provided if it was codified. However, while local knowledge was mainly ubiquitous, not place-based and, thus, easy to access, external knowledge comes from outside the farming community and, thus, the use of the phone is very valuable for its access and transfer.

Altogether, several benefits have been made clear by the empirical findings. By using the phone information and knowledge can be accessed and transferred faster and with lower transaction costs which has also been shown in the study by AKER (2011) about grain traders and farmers in Niger: "The introduction of mobile phones in Niger decreased farmers' search costs across markets as compared to personal travel" (ibid., p. 11). Especially the benefits through the increased ability to access timely price information were highly valued by farmers who compare those to get the most for their products.

However, limitations have also been observed providing new insights on why the use of ICTs can lead to controversial results. In some cases, evidence showed that the use of ICTs does not automatically lead to more available information and knowledge as well as to new/more contacts. As paper two/chapter five shows, the type of the distribution channel a farmer was integrated in influenced the opportunity for famers to access complex knowledge via ICTs. Examples were given on how farmers integrated in a captive value chain with exporters had a higher chance to access complex knowledge than farmers integrated in a market-based chain with middlemen or traders. However, the use of ICTs to access such complex knowledge within those captive chains was not mandatory, since it was often exchanged via personal meetings on the field. Apart from this, within market-based chains differences regarding access to complex knowledge were also found which can be linked to relational proximity between producer and buyer. Farmers accessed knowledge via phones only from those buyers who were relationally proximate to farmers. The same applies to further knowledge sources like local contacts as shown in paper three/chapter six. Often local contacts shared the same farming experiences, the same problems and also mutual trust which simplified access to such knowledge via phones. For the transfer of tacit knowledge, relational proximity was also essential (cf. GERTLER 2003). Problems arise when relational proximity and, thus, social networks were not built due to missed opportunities to meet physically, e.g. in the case of external contacts from a city. In this case, knowledge transfers via phones also became a challenge. "Given the importance of face-to-face interaction in building trust, ICTs may not be able to entirely replace these interactions" (AKER et al. 2016: 38). Studies have demonstrated that the value of the mobile phone is primarily in making

social networks more concrete (BURRELL/OREGLIA 2015), thereby building trust within a farmer's or trader's existing social network (OVERÅ 2006). Even though mobile phones were used to maintain contacts that had already been formed, they were limited in creating them in the first place. Linked to this, the use of mobile phones was also narrowed in accessing new external knowledge from other regions and countries, because of the lack of contacts. Thus, using phones contributed to intensifying existing local contacts rather than building new ones from distant locations (cf. MURPHY 2013). All told, the effects of ICTs on information and knowledge flow are medium and can be explained by the different types of ICTs, the type of knowledge, the form of value chain integration, the relational proximity and the spatial distance between farms and the nearest city centre.

H1B: The use of ICTs affects small-scale based value chains in Sub-Saharan Africa regarding financial transactions.

Mobile payment was commonly used by the farmers. It provided easy-to-use money transfer over distance as well as storing money in a mobile account as also examined in previous studies (e.g. KIKULWE et al. 2014; KIRUI et al. 2012). Farmer used it to receive payment, buy inputs and for off-farm activities. Since case studies providing insights on the usage of such systems were rare, the results of this thesis supply interesting and new observations and explanations. As shown in paper two/chapter five, mobile payment was only widely used by farmers who were integrated in informal market-based value chains selling to well-known and relationally proximate buyers. This is due to structural problems of the system and the lack of institutional trust in the system (also see MWANGI 2016). Consequently, trust in the person with whom money is exchanged was essential to compensate for this (cf. DONNER/TELLEZ 2008). If this is not provided, cash was still favoured for informal systems since it is linked to immediacy and safety. Further, contractual agreements with formal companies like export companies required secure and formal transfer systems like bank accounts due to the traceability and security problems of mobile payment.

In short, the effects of ICT use on financial transactions are medium, bearing in mind that cash and bank accounts are still used and not substituted by mobile payment systems. The effects depend on the form of value chain and the relational proximity to the respective buyer.

H1C: The use of ICTs affects small-scale based value chains in Sub-Saharan Africa regarding market transactions.

In accordance with numerous studies, the results of paper two/chapter five showed that particularly the use of mobile phones enhanced market access for small-scale farmers and simplified market transactions due to an increase in information on alternative markets including market prices and buyers. Not only were more market information available, the search costs were often also reduced

since travel can be substituted through phone calls (cf. FOSTER/GRAHAM 2014; JAGUN et al. 2008; MOLONY 2008; OVERÅ 2006).

Furthermore, mobile phone use improved the coordination between producer and buyer without physical presence and, thus, reduced transaction costs for both. Terms and conditions for each market transactions can be communicated via phone which also allows higher flexibility. Besides reducing transactions costs in marketing (reduced search costs and transportation costs), the loss of harvest was also decreased to some extent, because perishable products are often sold just after harvest due to fast coordination of sales (cf. MUTO/YAMANO 2009).

Even though market transactions could be improved for almost all respondents, some restrictions remained. In the case of farmers who were integrated in a captive value chain, ICTs were rarely used for market transactions since exporters did not allow further alternative markets. Due to the high degree of coordination and monitoring in such chains, face-to-face communication was still important and thus common (facilitated through TAs). The use of phones was limited when it comes to negotiating and bargaining. Due to its tacit nature, face-to-face communication cannot be substituted by mobile phones. Consequently, a physical presence remained of importance for market transactions despite using phones. Thus, the effects of ICTs on market transactions were medium, because only in cases where farmers are integrated in market-based value chains with a good relationship with their buyer ICTs can be fully used. The effects of ICT use on market transactions were influenced by the form of value chain integration and their relational proximity to the respective buyer.

H1D: The use of ICTs affects small- scale based value chains in Sub-Saharan Africa regarding the structure of value chains.

This thesis further focused on the question in how far ICT use can lead to structural changes within value chains, as it is an often discussed topic within applied studies (e.g. DONNER/ESCOBARI 2010; THE WORLD BANK 2011). Hereby, disintermediation is mostly mentioned by emphasizing the potential of ICTs to shorten value chains by bypassing intermediaries such as middlemen in agricultural value chains (GRAHAM 2008). As outlined in paper one/chapter four and two/chapter five and in accordance with other studies (e.g. DONNER/ESCOBARI 2010; FOSTER/GRAHAM 2014; JAGUN et al. 2008; MURPHY/CARMODY 2015), no disintermediation of any value chain actor could have been observed. Middlemen continued to be the main buyer of agricultural small-scale farmers despite using ICTs. As explained in detail in chapter five, different reasons have been found why middlemen even became stronger due to the use of mobile phones and, thus, why an intermediation of middlemen has been observed. Reasons included the early mover advantage regarding mobile phone use, the essential logistic and bundling function of middlemen (particular for remote farmers) and the financial

dependency of farmers. Consequently, buyers were able to use mobile phones in a way that they perform their role more efficiently than without phones and, therefore, hinder farmers from capturing more value from markets.

Moreover, as already outlined above, the use of ICTs partly resulted in a larger variety of business partners and information and knowledge sources, but did not lead to accessing new contacts from distant places. Hence, the value chain has not been restructured and transformed and localised relationships are common. Contrary to DONNER/ESCOBARI (2010: 650), producers were not able to expand their "temporal-geographic footprint". Hence, the effects of ICTs on structural changes within value chains were low.

H1E: The use of ICTs affects small-scale based value chains in Sub-Saharan Africa regarding power relations.

Linked with the reduction of information asymmetries through ICTs, an improvement in the bargaining power of farmers in value chains is often assumed (e.g. MITRA et al. 2015; NAKASONE et al. 2014). The thesis provided mixed results regarding farmers' ability to bargain for better prices. Particularly paper one/chapter four and KRONE/DANNENBERG 2018 presented evidence why growth in the information on prices and the possibility to contact different buyers did not automatically lead to an improved bargaining position for farmers. Most important was the fact that the improvements for farmers using phones have partly been reversed as buyers (often middlemen) also used phones to contact different farmers and compared prices. As outlined before, middlemen performed their role more efficiently since using phones and, thus, their power has been reinforced. Apart from the early-mover advantage of buyers using phones, in some cases even cartel agreements among middlemen have been observed as outlined in KRONE/DANNENBERG 2018. The interviews revealed that, due to the use of phones, middlemen were able to make cartel agreements as a reaction to the increasing marketing possibilities farmers have since using the phone. They aimed to hinder farmers from selling directly to traders and to manifest or even increase their bargaining position. Fixing prices and manipulating farmers were common methods applied by middlemen. However, in the case of low supply when buyers need to find enough produce, farmers have a higher bargaining power. Particularly in the dry season in the Mwanza region when tomatoes are only grown by a few farmers (due to a lack of water) and demand is high, tomato farmers have the chance to receive high prices for their produce. By using mobile phones, farmers can ensure they sell their produce immediately and find the buyer with the best price within the region. Often at this time of year, farmers were called by buyers sourcing produce. The same argument applies to why farmer groups also have a higher bargaining position regardless of the supply and demand of produce. Hereby the mobile phone supported the group in organizing themselves better internally and externally.

Further, the form of value chain integration also influenced the possibility of ICTs to affect power relations. For example, the captive integrated farmers were contracted farmers with limited options for bargaining. Hereby, the use of ICTs had no advantage.

In short, the effects of ICTs on power relations within agricultural value chains were medium. While in the case of farmers, mobile phones only had a limited effect on their bargaining position, buyers' power relations were reinforced. The effects of ICT use on power relations were influenced by the form of value chain integration (and seasonality).

H1F: The use of ICTs affects small-scale based value chains in Sub-Saharan Africa regarding the reduction of spatial barriers for information and knowledge flow.

In the third article/chapter six, the particular interest was the question of the spatial implications of the use of ICTs concerning the flow of information and knowledge. As explained above, mobile phones enabled farmers to access different types of knowledge from different places. Particularly information and knowledge from local contacts were easily accessed by farmers using their mobile phone since they share the same local and cultural background and often the interacting agents were not only spatially proximate to each other, but also relationally proximate. Hence, these personal contacts were rather easy to establish and to maintain due to short distances and frequent face-to-face communication. However, spatial barriers at a local level were only reduced if the transferred information and knowledge were codified and relational proximity exists (see above). The same restrictions applied to the transfer of knowledge from external contacts like extension services in urban areas. Only codified knowledge can be transferred if the actors were relationally proximate to each other. Hence, even though mobile phones can bridge the spatial knowledge divide between remote farmers and farmers close to cities regarding external knowledge, challenges remained. Since most of the external knowledge was tacit and had to be transferred via face-to-face interaction like field demonstrations, the direct use of mobile phones was limited and only needed as a distant managing tool to organize personal meetings and maintain contacts. Further limitations reducing the possibility of mobile phones to overcome spatial barriers included the establishment of relational proximate contacts which were essential for mobile communication with phones. Thus, spatial proximity to urban centres still remained important to access contacts despite using mobile phones. Since personal interaction maintained its importance, travel was still needed and, therefore, remote farmers were disadvantaged due to travel costs and time requirements. In contrast, farmers close to a city had continuous face-to-face meetings and, thus, could access not only tacit knowledge, but also establish relational proximity for distant knowledge transfer via mobile phones. While this has been partly a subject of previous studies (e.g. MORGAN 2004; PORTER 2015), the risks of a spatial knowledge divide between remote farmers and farmers close to cities and the limitations of mobile

phones use to bridge it has not been mentioned before. Only those who have personal access to contacts in spatial proximity were able to use phones efficiently for knowledge exchange.
All told, the use of mobile phones was limited in reducing spatial constraints concerning information and knowledge transfer, because personal interaction is needed for tacit knowledge transfer and for the initial phase of establishing contacts. Even though mobile phones can support information and knowledge transfer over distance, they cannot substitute for spatial proximity. In short, the effects of ICTs on the reduction of spatial barriers within agricultural value chains were medium and influenced by the type of knowledge, the relational proximity and the spatial distance between farms and the nearest city centre.

Taking these results into account, the overall research question can be answered; *To what extent and under which conditions does the use of ICTs affect small-scale based horticultural value chains and in how far can these developments provide general explanations of value chain dynamics in Sub-Saharan Africa?* As indicated above, the results confirmed that the effects of the use of ICTs on agricultural value chains are mixed (e.g. AKER et al. 2016; FOSTER/GRAHAM 2014; NAKASONE et al. 2014). Except for the structure of value chains, it has been shown that the use of ICTs had effects on small-scale based agricultural value chains in all the dimensions analysed, but to different extents (see Figure 20). However, most of these effects only had a medium extent meaning that ICTs were used to supplement the existing modes of doing business (and are not substitutes). For example, the use of mobile phones did not replace face-to-face communication for information and knowledge transfer, but functioned as an additional mode of communication for most farmers. Furthermore, financial transactions were done by mobile payment, but cash was also still a common mode of payment. In line with BAIRD/HARTTER (2017: 462), these results offer support for a "larger narrative within the scholarship on mobile phones in rural contexts: that new technologies, rather than transforming socio-economic systems, become embedded in them. Along these lines, a general concern is that phones are supporting existing activities and patterns of communication, but not stimulating new connections". Hence, ICTs have not appeared to drive any major change in value distribution, and farmers have seen very little change in socio-economic benefits, despite the dynamics in the affordability of connectivity over the last few years. ICTs have been generally *thinly integrated* (MURPHY et al. 2014) into small-scale based value chains, through which farmers tend to make communication and productivity improvements without substantial upgrading. While the mobile phone was used as a marketing tool by some farmers in everyday business transactions, the internet was rarely used for business transactions. Particularly the phone was mainly only used as a consumer item rather than an investment item which could lead to economic growth.

In sum, a greater structural transformation was absent: no disintermediation and moving across value chains could be observed (cf. DONNER/ESCOBARI 2010; MOLLA/HEEKS 2007). Even though farmers could expand their markets, no new actors participated in the analysed value chains. Power relations also did not change substantially. To some extent, farmers become even less powerful due to powerful intermediaries. Despite using phones, face-to-to face communication and spatial proximity still played an essential role for information and knowledge flow.

Figure 20. Overview of ICT effects on analysed dimensions; source: own design and illustration.

	Information and knowledge flow	**Financial transactions**	**Market transactions**	**Structure of the value chain**	**Power relations**	**Spatial barriers**
Extent of effect of ICT use	Medium	Medium	Medium	Low	Medium	Medium

While this can be in part, explained by the conditions analysed, this thesis provided evidence for why the use of ICTs can lead to mixed results[44] (see Figure 21). First of all, even though the empirical findings show that ICTs were commonly used for business purposes in farming (91% of the respondents used ICTs), only a small number of farmers used the internet for their business (11%) due to high connection and hardware costs, lack of awareness, and language difficulties. Thus, the ICT effects were mainly linked to mobile phone use (except for information and knowledge flow).

Secondly, it has been proved to be helpful to distinguish between simple and complex knowledge and local and external knowledge to differentiate the importance of ICT use and its limitations. While simple information was easily accessed via mobile phones, access to complex knowledge was limited by ICTs and often needed additional face-to-face interaction. However, ICTs provides the opportunity for farmers to access complex knowledge by enabling the personal communication process needed, e. g. by arranging meetings or training.

Third, as particularly highlighted in the second paper/chapter five, the form of value chain integration of farmers provided a great part of the explanation of why ICT effects are mixed or even controversial. Depending on the value chain form, ICTs were used not only to a different extent, but also in a different way. Especially concerning financial and market transactions, the results showed the tendency that producers integrated in a market-based chain derive more benefits from ICT use

[44] Since the explanation of the conditions was part of the previous discussion, only the most significant conditions will be outlined at this point.

than their counterparts in a captive chain. Due to their loose coordination structure, mobile phones were highly valued for transactions as a marketing tool.

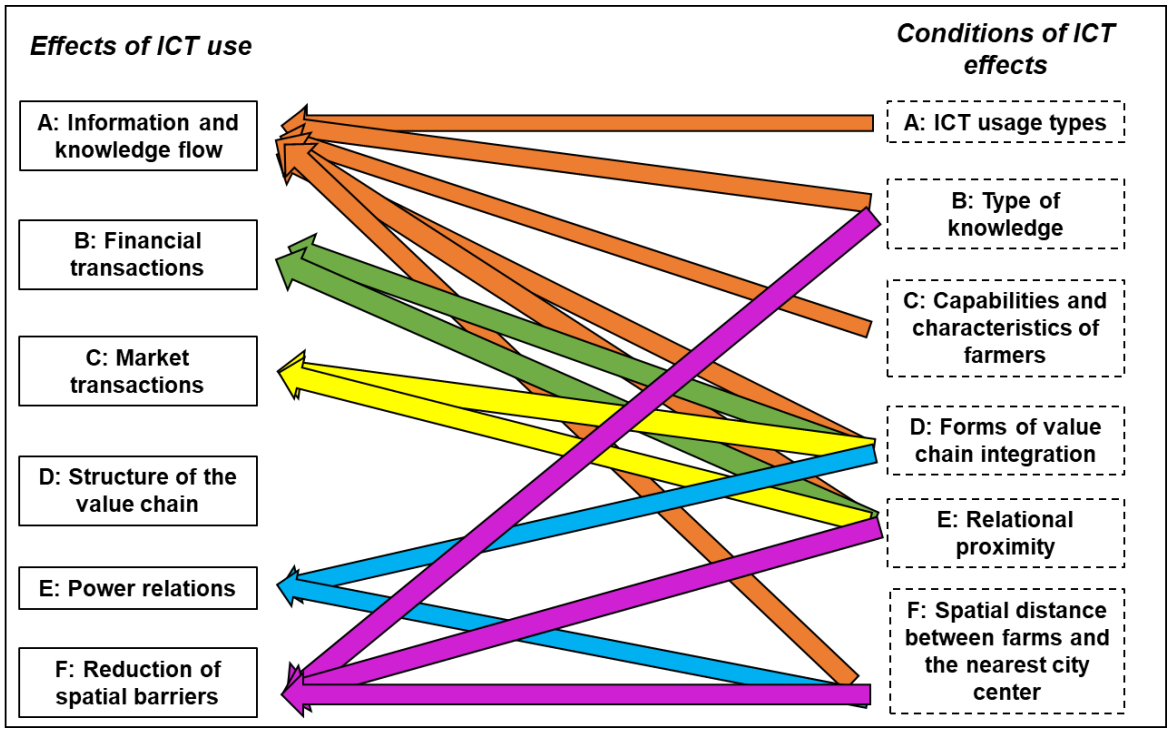
Fourth and linked to this and emphasised in the second and third paper was the importance of relational proximity between interacting actors and the use of ICTs. Not only did it influence the flow of information and knowledge via mobile phones, it also affected the use of mobile phones for financial and market transactions and the reduction of spatial barriers for information and knowledge flow. Most importantly was the fact that before agents can efficiently use mobile phones (no matter for what reason), relational proximity is a must which can be related to the general importance of personal and oral interactions as an integral part of African culture (cf. MOLONY 2008; PORTER 2015). MOLONY (2008: 649) also concluded in his study on farmers in Tanzania "all these interactions between a farmer and his dalali [buyer] rely on trust, but there is nothing conclusive in this case study (or a recent study in South Africa and Tanzania by Goodman 2005: 64) to suggest that the mobile phone itself can actually facilitate the trust relationship between any type of farmer (smallholder, middling smallholder or large-scale farmer) and his dalali". In short, given the importance of face-to-face interaction in building trust, ICTs may not be able to entirely replace these interactions (DUNCOMBE/HEEKS 2002; JAGUN et al. 2008; MOLONY 2008; OVERÅ 2006). I agree with other studies demonstrating that the value of the mobile phone is primarily in making social networks more concrete, thereby building trust within a farmer's or trader's existing social network (cf. BURRELL/OREGLIA 2015; OVERÅ 2006).

Fifth, as clearly illustrated in paper three/chapter six, the spatial distance not only influenced the possibility of farmers to use mobile phones, but also the opportunity to access external knowledge. The empirical results showed that farmers close to a city centre had a higher possibility to use a phone than farmers in remote locations. Thus, the potential of ICTs declines with increasing distance from cities due to network failure and electricity challenges. Moreover, the advantage of the close distance to cities can also be justified by the higher chance to personally meet contacts who provide valuable knowledge (either local or external, simple or complex). This, in turn, influences the effectiveness of mobile phones for information and knowledge transfer since only farmers who have access to contacts in spatial proximity can use phones for knowledge transfer to its full potential.

All told and contrary to the popular narratives, simply having information and knowledge access via ICTs does not automatically lead to economic benefits or power transformations. Often "the mainstream ICT4D discourse generally overstates the role that mobile phones, computers, the internet can play in transformative forms of socio-economic and industrial change in Africa" (MURPHY/CARMODY 2015: 200), because of failing to consider the influence of institutional structures

and power relations. Thus, contextual factors (e.g. type of value chain integration) not only limit the effective use of ICTs, but also the possibility of the empowerment of small business (cf. KUMAR 2014). Summing up, the analysis of the effects outlined in relation to the influencing variables helped to identify and explain under which circumstances and to what extent ICT-driven dynamics in small-scale business based value chains in Sub-Saharan Africa are taking place. Rather than searching for these dynamics and effects in relation to specific imminent development initiatives (e.g. UNIDO program to promote computerized logistics), as is commonly the case in the ICT4D literature, this thesis focused on the role of ICTs in typical small-scale based business in the Global South.

Figure 21. Overview of the conditions of ICT effects; source: own design and illustration.



The study identified several ICT-facilitated dynamics and trends in the horticultural value chains including thin integration and intermediation. While there have been many advantages to the introduction of particularly mobile phones, its cumulative impact has been rather low. In this context, ICTs do not have any "independent" causative power (MURPHY/CARMODY 2015: 205) and their low impact can be rather explained by the way in which ICTs have been absorbed into existing structures (different social actors with different power capabilities).

Furthermore, access to more information and knowledge did not result in an improved positionality of small-scale farmers within value chains. Although upgrading was not part of this study, it can be observed that neither economic nor social upgrading has happened due to the introduction of ICTs.

However, the increasing commercialisation of farmers can be supported by the use of ICTs at least for the market-integrated farmers, since mobile phones were used as a marketing tool leading to improved market access and simplified communication and coordination.

This can, however, also lead to new digital divides as illustrated in this study. Although this study did not deal with the digital divide in detail, the results point to different digital divides that can evolve because of such different conditions influencing ICT use. First of all, there is a risk that the use of the internet and more complex ICTs in distribution channels can lead to a digital divide based on the existing differences in farmers' characteristics and capabilities. Particularly given ICT use is becoming compulsory for communication with exporters, this might lead to a digitally driven exclusion of less capable farmers. It can be assumed that internet use (e.g. using emails to coordinate activities between farmers and exporters) will become mandatory in the future which can lead to entry barriers for disadvantaged farmers. Secondly, the results point to a digital divide that presents differences between actors under a favourable value chain context who can gain more benefits from using ICTs (e.g. reducing transaction costs and access to simple and complex knowledge) than those who lag behind due to an unfavourable context. Third, a digital divide can evolve that presents differences between actors who can gain more benefits from using ICTs than those who lag behind due to lack of contacts. While access to ICTs does not pose a problem for farmers, access to new information and knowledge sources for competitive farming and upgrading does.

In short, the results showed that there is not only risk of one digital divide, but several divides. Further, the study provided evidence that the digital divides are more complex than the often argued technological fix suggests (CRAMPTON 2003). Providing cheaper computers and bigger bandwidths will not erase the divide as often argued.

This raises important policy issues. In general, policy implications need to change the focus from purely technologically-deterministic notions of information provision through ICTs to consider the various relationships and structures of actors within value chains.

First, I argue that a better understanding of the role of ICTs in market relationships would be the way forward since the introduction of ICTs is only one step in gaining economic benefits. The common framing of ICTs neglects the different forms of social and economic interconnection ICTs can facilitate (cf. MURPHY/CARMODY 2015). In this regard, I argue treating small-scale farmers as a complex group with distinctive needs, depending on their form of integration and relationships. Linked to this is the recognition that the use of ICTs emerges from a socially embedded context that significantly influences usage. Policy initiatives remain misdirected if they ignore a strong reflection that details the social aspects of socio-economics. This conceptual framework enables practitioners (and researchers) to analyse the constraints of small-scale farmers regarding value chain integration and explore their mobile phone adaption and usage patterns for value chain activities. For example, each

farmer can be integrated in a different value chain and, thus, uses ICTs differently – actors and activities define the use of ICTs. Examining the impact of ICTs on such value chain activities requires the understanding of the activities and actors in value chains. This study attempts to enable practioners to conduct such an assessment by providing the conceptual framework. Further, it means practitioners should design distinct ICTs solutions or programs aligned to the various perspectives.

Second, I argue that ICT use alone will not lead to development – other kinds of support and entitlements have to be provided additionally (e.g. credit provision schemes or reforming property and land rights). In addition to the focus of capability enhancement, small producers need to be linked to external knowledge sources. For an effective use of ICTs, it has to be ensured that farmers have the possibility to access knowledge and contacts independently from their value chain context and the location of their farm, i.e. distance to urban centres. Thus, policies need to focus on supporting farmers to build linkages and networks with other agricultural stakeholder and service partners (interpersonal networking and community networking). For example, public agricultural extension services need to be increased, particularly in remote agricultural areas or agricultural exhibitions set up where different stakeholders can meet. So far, sharing information via extension has been limited due to problems related to scale, sustainability, relevance and responsiveness (AKER 2011). Another recommendation would be to strength the role of local leaders as knowledge sources. "The role of leaders is crucial to bridge different pools of knowledge and link different types of networks (like primary / family and neighbourhood networks with secondary /value chain networks)" (BODE et al. 2008: 16). Leaders as change agents can act as intermediaries in the process of information and knowledge diffusion and appropriation. They act as a bridge between different organizational levels and types of stakeholders.

Third, the divide between simple and complex ICT types has to be reduced by providing training and awareness programs on using more complex ICT types like the internet for farming business. Further, public access to internet has to be ensured in rural regions. In this regard, farmers in unfavourable conditions (limited financial and educational assets) can have the chance to access knowledge from the internet for their farming business.

Fourth, besides these supply side challenges, socio-economic conditions also limit thicker forms of ICT integration. Policies should focus on reducing dependencies between farmers and buyers, support competitive advantages by building farmers cooperatives and self-help groups and provide financial facilities like credits to reduce dependency on buyers (their traditional source of credit). Communication improvements and the reduction of information asymmetries alone cannot substitute for this. It needs to be considered that "informationalism by itself cannot compensate for other material, social and political challenges, such as the need for dramatic improvements in farming systems" (MURPHY et al. 2014: 279).

While it is clear that some of these findings are specific to the context of small-scale farmers in East Africa, I argue that some trends are generalizable to other small producers in the Global South. Kenya is one of the leading horticultural export regions in Su- Saharan Africa and Mwanza represents a typical production region of horticultural crops for the domestic market. As such, the effects of ICTs on small-scale based businesses serve as relevant and transferable experiences with respect to both the potentials and limitations of ICT use and the increasing commercialisation of small producers.

As, e.g. (FOSTER/GRAHAM (2017); JAGUN et al. (2008)) observed for other regions, this thesis too showed how a concentration process (through the power enhancement of intermediaries) occurred and major transformation benefits are absent for small producers (MURPHY/CARMODY 2015). Besides, the importance of the inter-firm relationship and the role of trust for the successful use of ICTs has also been shown by e.g. (MOODLEY (2002); OVERÅ (2006)). Undoubtedly, the importance of relational proximity for the use of ICTs can be observed not only in other African regions, but throughout the agricultural sector and other rural economies. Limited access to new external contacts and, thus, a focus on localised relationships has also been found in other studies, e.g. the wood sector in Tanzania by MURPHY et al. (2014). Since various forms of value chain integration were analysed, I believe that transferring these results to other economic sectors focusing on small producers in the Global South would be of value. I am confident that the experiences of the small-scale farmers interviewed reflect those of many African and other Global South contexts.

From a conceptual perspective, this study provided an approach to evaluate the use of new technologies in relation to business practices and distinct business structures that also include context-specific aspects by combining the value chain approach with proximity and knowledge conceptualisations.

In particular, the use of the concept of relational proximity has demonstrated its value in examining the less tangible dimensions of trust, culture and shared intuitional settings, which are crucial in the rural context in Sub-Saharan Africa and are difficult to grasp in concepts like GVC. By adding the dimension of relational proximity to the analytical dimensions of GVC, the analysis provided a more comprehensive analytical perspective and also added a deeper understanding of the concept of coordination within GVCs and the relationships particularly between producers and buyers.

The distinction between the different types of information and knowledge also provided a nuanced perspective on the effects of ICT use. The differentiation between simple, complex, tacit, codified and even local and external knowledge provides an explanatory framework to understand the potential and the limitations of ICT use.

In this regard, the conditions analysed help to understand why controversial results concerning ICT effects exist by providing a differentiated perspective on the use of ICTs within value chains. Moreover, those findings call attention to how mobile phones are currently used in the debate for development outcomes (see ICT4D). Rather than analysing the use of phones as an artefact alone I integrated the context for its use – rural areas in the Global South where farmers work in unstable economic situations with generally poor infrastructure, uncertain economic situations and the preference to know each other before calling. Thus, it is possible to understand more clearly where the limits lie in terms of the potential of phones to access knowledge and, thus, its transformative potential.

Summary/Zusammenfasung

Summary

Agriculture is the main economic activity in Sub-Saharan Africa and also the largest employer. Hereby, smallholders often form the base of agricultural production but face challenges, including limited access to markets, a lack of information and knowledge linked to information asymmetries and high transactions costs.

Advances in information and communication technologies (ICT) have expanded the possibility to communicate knowledge across geographical distances and to shorten the link between producers and buyers. Many studies, therefore, argue that ICTs play an important role in integrating small producers into (global or regional) value chains by improving inter-firm relationships, creating new market opportunities and increasing a supplier´s access to information and knowledge by overcoming spatial constraints. These expectations have resulted in various public and private programs and projects funded by international banks and donor organizations, which are generally categorized under the term ICT for Development (ICT4D).

By linking the ICT4D debate with the Global Value Chain approach, this thesis aims to critically discuss the effects of ICT use on small-scale farmers in commercial agricultural value chains in Tanzania and Kenya and the underlying conditions. This thesis analyses various types of ICT usage, different types of information and knowledge, different types of value chain integration and the spatial implications of ICT use to give more differentiated explanations under which conditions ICT use has certain positive or negative effects on farmers and value chain integration.

For the empirical analyses, a mixed method study was conducted between 2013 and 2015 focusing on small-scale farmers and their direct buyers in the Mt. Kenya region and Mwanza region.

The results show that the use of ICTs affects the transfer of information and knowledge, financial and market transactions and power relationships. To some extent, the use of ICTs even leads to a reduction of spatial barriers for access to external knowledge. However, a greater structural transformation is absent: no disintermediation and new actors in value chains could be observed. In sum, these effects only have a medium extent, meaning that ICTs are used supplementary to the existing modes of doing business (and not substitutionally). While this can, in part, be explained by the conditions analysed, this thesis provides evidence on why the use of ICTs can lead to mixed results. Relational proximity, different forms of the value chain integration of farmers, the different types of knowledge and ICTs as well as the spatial distance between farms and city centres provide a great part of the explanation as to why ICTs' effects are mixed or even controversial.

The results contribute to the current applied and conceptual debate on market access for smallholders, ICT4D, and the understanding of changing agricultural value chains.

Zusammenfassung

Die Landwirtschaft ist die wichtigste Wirtschaftsaktivität und der größte Arbeitgeber im ländlichen Subsahara Afrika. Dabei bilden Kleinbauern oftmals die Basis für die landwirtschaftliche Produktion. Jedoch stehen diese vor Herausforderungen wie z.B. der fehlende Zugang zu Informationen und Wissen in Verbindung mit Informationsasymmetrien, schlechte Finanz- und Markttransaktionen und strukturelle Probleme wie z.B. eine hohe Anzahl an Mittelsmänner.

Fortschritte in den Informations- und Kommunikationstechnologien (IKT) haben die Möglichkeit erweitert, Wissen über geographische Entfernungen hinweg zu vermitteln und die Verbindung zwischen Produzenten und Käufern zu verkürzen. Viele Studien argumentieren daher, dass IKT eine wichtige Rolle bei der Integration kleiner Produzenten in Wertschöpfungsketten spielen, indem sie neue Marktchancen eröffnen und den Zugang zu Informationen und Wissen durch die Überwindung räumlicher Beschränkungen erhöhen. Diese positiven Erwartungen führten auch zu der Implementierung verschiedener öffentlicher und privater Programme und Projekten, die von internationalen Banken und Geberorganisationen finanziert wurden und im Allgemeinen unter dem Begriff *ICT for Development* (ICT4D) kategorisiert werden.

Durch die Verknüpfung der ICT4D-Debatten mit den wissenschaftlichen Ansätzen zu globalen Wertschöpfungskette und Wissenstypen sowie relational Nähe, diskutiert diese Dissertation die Auswirkungen der IKT-Nutzung auf Kleinbauern in landwirtschaftlichen Wertschöpfungsketten in Tansania und Kenia. Zudem analysiert diese Arbeit verschiedene Arten der IKT Nutzung, Typen von Informationen und Wissen, Formen der Integration von Wertschöpfungsketten und die räumlichen Auswirkungen der Nutzung von IKT, um Erklärungen zu geben unter welchen Bedingungen die

Nutzung von IKT positive oder negative Auswirkungen auf landwirtschaftliche Wertschöpfungsketten haben können.

Für die empirischen Analysen wurde zwischen 2013 und 2015 eine Mixed Methods Studie durchgeführt, die sich auf Kleinbauern und ihre direkten Käufer in der Mt. Kenia Region und Mwanza Region fokussiert. Die Ergebnisse zeigen, dass die IKT Nutzung den Transfer von Informationen und Wissen, Finanz- und Markttransaktionen sowie Machtverhältnisse beeinflusst. Zum Teil führt der Einsatz von IKT zu einer Reduzierung räumlicher Barrieren für den Zugang zu externem Wissen. Eine stärkere strukturelle Transformation fehlt jedoch: Keine Disintermediation und keine neuen Akteure in der Wertschöpfungskette konnte beobachtet werden.

Zusammenfassend lässt sich sagen, dass diese Effekte nur in einem mittleren Maße wirken, sodass die IKT Nutzung nur ergänzend zu den existierenden Geschäftsmodalitäten und nicht substituierend zu sehen ist. Während dies teilweise durch die analysierten Bedingungen erklärt werden kann, liefert diese Arbeit Belege für die Erklärung der IKT Effekte auf Kleinbauern.

Relationale Nähe, die verschiedenen Formen der Wertschöpfungskettenintegration, die unterschiedlichen Arten von Wissen und IKTs sowie die räumliche Nähe zwischen Betrieben und Stadtzentren liefern einen großen Teil der Erklärung, warum die Auswirkungen von IKT gemischt oder sogar kontrovers diskutiert werden.

Die Ergebnisse tragen zu der gegenwärtig angewandten und konzeptionellen Debatte über ICT4D, die Wertschöpfungskettenintegration von Kleinbauern und dem Verständnis von sich wandelnden landwirtschaftlichen Wertschöpfungsketten bei.

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Appendix 1

List of interviews

Table 17. Overview of semi-structured interviews with farmers.

Interview #	Date	Country	Place
F1	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F2	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F3	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F4	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F5	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F6	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
F7	January 2015	TZ	Mwanza Region, Misungwi district, Misungwi ward
F8	January 2015	TZ	Mwanza Region, Misungwi district, Misungwi ward
F9	January 2015	TZ	Mwanza Region, Misungwi district, Misungwi ward
F10	January 2015	TZ	Mwanza Region, Misungwi district, Misungwi ward
F11	January 2015	TZ	Mwanza Region, Sengerema district, Mwabaluhi ward
F12	January 2015	TZ	Mwanza Region, Sengerema district, Mwabaluhi ward
F13	February 2015	TZ	Mwanza Region, Magu district, Kahangara ward
F14	February 2015	TZ	Mwanza Region, Magu district, Kahangara ward
F15	February 2015	TZ	Mwanza Region, Magu district, Kahangara ward
F16	February 2015	TZ	Mwanza Region, Misungwi district, Usagara ward
F17	February 2015	TZ	Mwanza Region, Magu district, Kisesa ward
F18	February 2015	TZ	Mwanza Region, Misungwi district, Bulmeji ward
F19	February 2015	TZ	Mwanza Region, Misungwi district, Bulmeji ward
F20	February 2015	TZ	Mwanza Region, Misungwi district, Bulmeji ward
F21	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F22	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F23	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F24	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F25	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F26	February 2015	K	Nyeri County, Kieni East District, Kabaru Ward
F27	February 2015	K	Nyeri County, Kieni East District, Kimahori Ward
F28	February 2015	K	Nyeri County, Kieni East District, Kimahori Ward
F29	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F30	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F31	February 2015	K	Nyeri County, Kieni East District, Aguthi Ward
F32	February 2015	K	Kirinyaga County, Sagana District, Kahuro ward
F33	February 2015	K	Kirinyaga County, Sagana District, Kahuro ward
F34	February 2015	K	Kirinyaga County, Sagana District, Kahuro ward
F35	February 2015	K	Kirinyaga County, Mwea District, Karri ward
F36	February 2015	K	Kirinyaga County, Mwea District, Karri ward
F37	February 2015	K	Nyeri County, Mathera district, Ihwagi ward
F38	February 2015	K	Nyeri County, Mathera district, Ihwagi ward
F39	February 2015	K	Nyeri County, Mathera district, Ihwagi ward
F40	March 2015	K	Meru county, Meru central District, Kianthumbi ward
F41	March 2015	K	Meru county, Meru central District, Kianthumbi ward
F42	March 2015	K	Meru county, Buuri district, Timau ward
F43	March 2015	K	Meru county, Buuri district, Timau ward
F44	March 2015	K	Meru county, Buuri district, Timau ward

F45	March 2015	K	Meru county, Buuri district, Timau ward
F1	September 2013	TZ	Mwanza Region, Misungwi district, Usagara ward
F2	September 2013	TZ	Mwanza Region, Misungwi district, Misungwi ward
F3	September 2013	TZ	Mwanza Region, Misungwi district, Misungwi ward
F4	September 2013	TZ	Mwanza Region, Misungwi district, Misungwi ward
F5	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F6	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F7	September 2013	TZ	Mwanza Region, Misungwi district, Usagara ward
F8	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F9	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F10	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F11	September 2013	TZ	Mwanza Region, Misungwi district, Usagara ward
F12	September 2013	TZ	Mwanza Region, Magu district, Kisesa ward
F13	August 2013	K	Kirinyaga County, Mwea District, Karri ward
F14	August 2013	K	Kirinyaga County, Mwea District, Karri ward

Table 18. Overview of semi-structured interviews with buyers.

Interview #	**Date**	**Country**	**Place**
M1	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
M2	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa
M3	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa Buhongwa
M4	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa Buhongwa
M5	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa Buhongwa
M6	January 2015	TZ	Mwanza City
M7	January 2015	TZ	Mwanza City
M8	January 2015	TZ	Mwanza City
M9	February 2015	TZ	Mwanza Region, Magu district, Kisesa ward
M10	February 2015	K	Nyeri County, Kieni East District, Kabaru Ward
M11	February 2015	K	Kirinyaga County, Sagana District, Kahuro ward
M12	February 2015	K	Nyeri County, Mathera district, Ihwagi ward
M13	February 2015	K	Nyeri County, Mathera district Karatina town
M14	March 2015	K	Meru county, Meru central District, Eqautor town
M15	March 2015	K	Meru county, Meru central District, Eqautor town
M16	March 2015	K	Nyeri County, Kieni East District, Naru Moro town
Exporter1	February 2015	K	Nyeri County, Kieni West District
Exporter2	February 2015	K	Kirinyaga County, Mwea District, Kibebe ward
Exporter 3	February 2015	K	Kirinyaga County, Mwea District, Kibebe ward
T1	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa Buhongwa
T2	January 2015	TZ	Mwanza Region, Sengerema district, Mwabaluhi ward
T3	February 2015	K	Nyeri County, Mathera district Karatina town

T4	March 2015	K	Meru county, Imenti south district, Ntharene ward
T5	March 2015	K	Meru county, Imenti south district, Ntharene ward
T6	March 2015	K	Meru county, Imenti south district, Ntharene ward
R1	January 2015	TZ	Mwanza Region, Ilemela district, Buswelu ward
R2	January 2015	TZ	Mwanza Region, Nyamagana district, Buhongwa Buhongwa
R3	February 2015	K	Nyeri County, Mathera district Karatina town

Note: M=middlemen, T= trader, R= retailer

Table 19. Overview of expert interviews.

Interview #	**Date**	**Country**	**Place**	**Respondent (Title)/ Institution**
E1	January 2015	TZ	Dar es Salaam	Statistics Manager / Kariakoo Markt
E2	January 2015	TZ	Dar es Salaam	CARI Programm Manager / GIZ
E3	January 2015	TZ	Dar es Salaam	Lecture and Researcher / USDM, Institut of Ressource Assesment
E4	January 2015	TZ	Dar es Salaam	Ministry of Agriculture and Food Security
E5	January 2015	TZ	Dar es Salaam	Head of ICT Department, Lecture and Researcher / Dar es Salaam Institut of Technology
E6	January 2015	TZ	Dar es Salaam	Head of ICT Division / Tanzanian Industrial Research Development (TIRDO)
E7	January 2015	TZ	Mwanza City	Country Manager / Hellen Keller International
E8	February 2015	TZ	Mwanza Region, Misungwi district	Ministry of Agriculture Training Institute Ukiguru / Coordinator Farmer Training
E9	February 2015	K	Nairobi	Manager / Agricultural Sector Support Program/NAFIS
E10	February 2015	K	Nairobi	Policy, Research and Partnership Manager / Kenya National Farmers' Federation
E11	February 2015	K	Nairobi	Economist / Post-Doc, ICIPE
E12	February 2015	K	Nairobi	Outreach Officer / Biovision
E13	February 2015	K	Nairobi	Technoserve
E14	February 2015	K	Nairobi	Judhi Kilimo
E15	February 2015	K	Nairobi	Manager / GSMA, mAgri and mFarmer
E16	February 2015	K	Nairobi	Development Manager / Techfortrade
E17	February 2015	K	Nairobi	Chief operation officer / Mfarm
E18	February	K	Nairobi	Chief Horticultural Division / MoA

	2015			
E19	February 2015	K	Nairobi	Chief Extension Division / MoA
E20	February 2015	K	Nairobi	HCDA
E21	February 2015	K	Nyeri County, Kieni East District, Naru Moro town	Horticultural Chief Officer / Ministry of Agriculture and Food Security, Nyeri County, Kieni East District
E22	February 2015	K	Nyeri County, Kieni East District, Kabaru Ward	Extension Officer / Ministry of Agriculture and Food Security, Nyeri County, Kieni East District
E23	February 2015	K	Nyeri County, Kieni East District, Kimahori Ward	Book Keeper of Tumaini Farmers Group
E24	February 2015	K	Nyeri County, Nyeri Central District, Nyeri town	Country Station Manager / HCDA, Nyeri County
E25	February 2015	K	Nyeri County, Nyeri Central District, Nyeri town	Assistant Director of Agriculture, Home Economics Officer / Ministry of Agriculture, Nyeri County
E26	February 2015	K	Kirinyaga County, Mwea District, Karri ward	Technical Advisor
E27	March 2015	K	Meru county, Meru Central district, Eqautor town	Supermarkt supplier
E28	March 2015	K	Meru county, Imenti south district, Ntharene ward	Transporter
E29	March 2015	K	Meru county, Meru Central district, Meru town	County Officer of HCDA
E30	March 2015	K	Meru county, Buuri district	Manager of Sunlight Ltd.
E1	September 2013	TZ	Mwanza City	Country Manager / Hellen Keller International
E2	September 2013	TZ	Mwanza Region, Misungwi district	Principal Agricultural Field officer / Ministry of Agriculture Training Institute Ukiguru
E3	September 2013	TZ	Mwanza Region, Misungwi district	Principal Agricultural Tutor / Ministry of Agriculture Training Institute Ukiguru

Interview guidelines for Tanzania and Kenya

Interview guide: farmers

1. Introduction/ Capabilities and characteristics of the businesses and actors

Name

Age

Products

Size of farm

Size of family

Since when are you doing horticulture?

How many people regularly work on the farm?

Do you have other income activities?

What is your educational level?

Are you able to read and write in English?

2. Questions on ICT use

Do you use a mobile phone/internet for your farming business?

Since when have you been using a mobile phone/internet?

Why did you start to use a phone/internet?

Who do you call most frequently (for farming)?

How often do you use your phone/internet?

How much money do you spend for your phone/internet per week?

Do you share your mobile phone with others?

Which mobile phone application/features do you use most frequently? (e.g. texting, calling, camera, internet)

What are disadvantages and advantages do you see in using text, calling, internet?

Please, tell me when do you use your mobile phone/internet and for which purpose? (At which stage of farming)

For which purposes do you use SMS and with whom do you text?

For which purposes do you use calling and with whom do you call?

For which purposes do you use internet?

Where do you access internet?

In which language do you the internet?

For what do you the internet?

How do you use the internet?

From whom do you know how to use it?

Do you know farmers using not using a phone/internet for farming?

What has changed since you use a mobile phone/internet for farming?

If not using ICTs

Do you know other farmers not using a phone/internet for farming?

Why don`t you use a mobile phone/internet?

Do you share your mobile phone with others?

How often do you share a phone?

From whom do you share a phone?

For what reasons do you use the phone from others?

Are they always willing to give you the phone?

Do you give them money for using their phone?

Do your buyers use phones?

Do you feel excluded/left behind/disadvantaged not using mobile phones/internet, and if yes?

Do you see differences between your business and the business of those farmers using phones?

Do you lose out orders due not having phones?

In your opinion, what has changed since farmers are using a mobile phone/internet for farming?

3. The distribution channel

To whom do they sell your products to?

Where do you sell your product to?

How often do you sell?

To how many buyers do you sell to regularly?

Do you sell to exporters/traders/middlemen?

Where do those buyers sell your products to?

Where are these exporters/traders/middlemen from?

Do you use standards for your production?

Do you have a certification for your produce?

4. Information and knowledge flow

From whom do you get information about prices?

From whom do you get information about farming (e.g. type of products)?

Who do you contact when you have problems with your farm (e.g. standards, production techniques)?

From whom do you get information about applications of pesticides?

Who gives you advice on farming and business management (e.g. book keeping)?

How do you exchange those information? (via phone/internet, face-to-face)

Do you use mobile phones/internet to get informed about process and markets?

Do you use mobile phones/internet to get informed about types of pesticides, cultivation practices?

What do value more concerning getting information about farming: phone/internet or face-to-face?

What kind of information do you exchange via phone? And with whom?

How do you exchange information with your phone/internet? (e.g. via calling or texting)

Do have contact with extension officers regularly? How do you contact the them?

How do you contact your buyer?

What do you talk about with your buyer via phone?

Do you feel better informed using a mobile phone? / Is your access to knowledge improved due to mobile phones/internet?

In our opinion, do you feel well informed?

What information and knowledge do you miss?

5. Financial transactions

What is your main form of paying (e.g. input supplies)?

How do you get paid?

Do you get credits and loans from your buyer or input supplier?

Do you use mobile payment?

Is mobile payment widely used by farmers and buyers?

How is mobile payment used? (For which activities within farming?)

What are advantages and disadvantages of mobile payment?

Do you use less cash due to using mobile payment?

Do you have better access to credits and loans due to your mobile phone?

6. Market transactions

How do you bring your product to the market?

Who organizes the transport of your products?

How do you use the mobile phone for marketing/selling?

Did you change your transport system due to using a phone?

Do you experience less loss of harvest by a using phone?

Do you spend less time travelling for business through using the phone?

Where do you buy your inputs from?

Do you communicate with your supplier via phone?

Do you buy from the same input supplier before you had a phone?

7. Structural changes of the value chain

How do you communicate with your buyers?

Who starts communicating first (farmer or buyer)?

How many buyers do you sell to regularly?

How did you get to know your buyer?

Do you sell to more buyers because of using a phone?

Did you contact new or other buyers since you have been using a phone?

Do you use your mobile phone/internet to get access to new buyers/suppliers?

Did you change your buyer after using your phone?

Do you sell to other markets because of using your phone?

How did you get to know exporters/traders?

Have did you sell to exporters/traders before using the phone?

When/Where do you negotiate with them? On the phone?

Where are these exporters/traders from?

8. Bargaining power

How do you judge your bargaining power with your buyer and with your supplier?

Does the buyer provide you loans/credits?

Do you provide him loans/credit?

Do you have a contract or a buying agreement with your buyer?

Do you organize with other farmers, e.g. for selling products together?

Do you have enough information about prices and markets?

9. Relational proximity

Do you have permanent buyers?

For how long have you been knowing and trading with the permanent buyers?

How did you get in contact with them?

How often do you change your buyers?

Why do you change buyers?

Does the buyer supervise your production?

What kind of information does your buyer provide you?

How often do you meet your buyer?

How often do you call each other?

Does your exporter/trader/buyer provide you a mobile phone for business purpose?

Where do you meet them (e.g. farm, market, collection point)?

Could say a few words about your relationship with your buyer?

Do you trust him?

Are your experiences with your buyer mainly good or bad?

Did your relationship changed after using the phone?

10. Spatial factors

How far is the next main (concreted) road from your farm?

Where is the next market? (How far is it away?)

Do you have to travel to get information about prices?

Do you have to travel to get knowledge/advice about farming?

Did the use of mobile phones reduced the need to travel?

Interview guide: buyers (exporters, traders, middlemen)

1. Introduction

Name

Age

Since when are you selling and buying agricultural products?

Do you have other income activities?

What is your educational level?

Are you able to read and write in English?

2. The distribution channel

What products do you sell?

From whom do you buy them, producer or from middlemen? – volume of produce?

From how many farmers to you buy regularly?

Where do you pick/collect the produce of the farmer?

Do you have your own transport? What type of transport?

To whom do you sell your products?

Do you have any contracts or agreements with farmers or other buyers?

How do you pay the farmers and how are you getting paid? (e.g. cash, Mpesa)

Do you trade with farmers without phones?

3. Relationship with farmers

Do you have permanent farmers?

For how long have you been knowing and trading with the permanent farmers?

How did you get in contact with them?

How often do you change your farmers?

Why do you change farmers?

From whom do you get the contacts of farmers?

How often do you meet your farmers?

How often do you call each farmers?

What kind of information do you provide to farmers?

How do you communicate with farmers? (calling, text)

How often do you communicate with a farmer?

What do you prefer for communication with farmers, face-to-face calling or texting?

Do you provide loans, credits to farmers?

How important is trust between you and the farmers for trading?

Could say a few words about your relationship with your farmers?

Are your experiences with your farmers mainly good or bad?

Did your relationship changed after using the phone?

4. Bargaining position with farmers

How do you negotiate with farmers about the price (e.g. farm, market, at the phone, etc.)

How do you judge your bargaining power between you and the farmers e.g. (superior, inferior)

Are farmers calling you regularly to ask about the current market price?

Are farmers aware of current market prices?

Do you always tell the farmers the correct market prices?

5. Questions on ICT use

Do you use a mobile phone/internet for your business?

Since when have you been using a mobile phone/internet?

Why did you start to use a phone/internet?

Who do you call most frequently (for business)?

How often do you use your phone/internet?

How much money do you spend for your phone/internet per week?

Do you share your mobile phone with others?

For which purposes do you use SMS and with whom do you text?

For which purposes do you use calling and with whom do you call?

For which purposes do you use internet?

Where do you access internet?

In which language do you the internet?

For what do you the internet?

What has changed since you use a mobile phone/internet for your business?

Do you contact more/other farmers and buyers because of using phones?

Do you source and sell products from other/new places?

Do you think due to using the phone your trading business changed?

In your opinion, what are the main benefits of using phones for trading?

Are you making more profit using the phone?

Do you think farmers are making more profit/income since using the phone?

In your opinion, are farmers without phones left behind/excluded from trading?

Do see any negative effects due to phones for the trading business?

Do you operate differently between high and low supply season?

Do you get money for giving information on farmers to other buyers (location, contact)?

Questionnaire

Introduction [45]

This questionnaire is part of an international scientific study of St. Augustine University of Tanzania and targets market oriented farmers who use cell phones and internet in their business, as well as farmers who do not. Its aim is to analyse in how far cell phones have changed the farmers' production, the gender relations within the family and their relation to other business actors. Based on the results of the study, recommendations will be made on how to improve the conditions of farmers in future.

You have been selected as one of the participants in this study to assist in providing information. You are requested to feel free to answer all of the questions asked or decline in any instance you may not wish to.

Your name will not be quoted in the findings of this study, unless you so wish. Furthermore, the information you provide will be used strictly for academic reasons and your confidence will be upheld.

This study does not involve any payment and hence you are requested for assistance on a voluntary basis. Your contribution will be highly appreciated. In case you have any reservations, please feel free to express them. Otherwise you are very welcome to answer the questions that hereby follow.

A. Questions on farm characteristics

What is the size of your farm that is used for commercial horticulture (please indicate acres)?

What is the educational level of the manager of this farm?

O University O College O Secondary school O Primary school O None

What is your age? O < 20 O 20-30 O 31-40 O 41-50 O 51-60 O >60

What organisations is the farm or (its manager) a member? O cooperative O quality management systems O self-help group O women group O others (please specify _____ O none

What is the average monthly turnover of your farm (*only the business which deals with commercial horticulture*)? TSh _____

Are there other income sources for the household, if yes who brings in this income? O yes O no

[45] This questionnaire is constructed for the Tanzanian research region. The questionnaire for the Kenyan research region is the same (except of the introduction).

O The man/husband O the woman/the wife O both O others (specify)_____ O none

How many members belong to your household?

_____

How many of them work on the farm (including production, sales, etc.)?

_____

Who owns the farm? O The man/husband O the woman/the wife O both O others (specify)

_____

B. Questions on gender roles

Who sells the commercial horticulture products?

O The man/husband O the woman/the wife O both O others (specify) _____

Who sells to the local consumer products?

O The man/husband O the woman/the wife O both O others (specify) _____

Who was selling the local consumer products before the farm went into commercial?

O The man/husband O the woman/the wife O both O others (specify) _____

Who is integrated into the decision making process of the farm business?

O The man/husband O the woman/the wife O both O others (specify) _____

Who was integrated into the decision making process of the farm business before went into commercial?

O The man/husband O the woman/the wife O both O others (specify) _____

Who makes the decisions on commercial horticulture business finances? (buying seeds, selling products etc.)

O The man/husband O the woman/the wife O both O others (specify) _____

Who used to make the decisions on business finances before the farm went into commercial?

O The man/husband O the woman/the wife O both O others (specify) _____

Who is responsible for the family finances? (buying food, clothes, school fees etc.)

O The man/husband O the woman/the wife O both O others (specify) _____

Who was responsible for the family finances before the farm went into commercial?

O The man/husband O the woman/the wife O both O others (specify) _____

Who spends more time working on the field (only commercial horticulture)?

O The man/husband O the woman/the wife O both O others (specify) _____

Who used to spend more time working on the field before the farm went into commercial?

O The man/husband O the woman/the wife O both O others (specify) _____

C. Questions on the business relationship (only commercial horticulture)

Which standards do you use? (Mark appropriately)

O Global Gap O Others (specify): _____ O None

Do you have a certification for your products? O Yes O No

(If applicable) Do you see any labour related changes related to the standard? O Yes O No

Who do you sell your products to (mark appropriately)? O Exporter O Broker O Another farmer O Cooperative Society O Other (specify)

How do you consider your bargaining position in relation to your buyer?

O Superior O Slightly superior O Equal O Slightly inferior O Inferior

How do you consider your bargaining position in relation to supplier (e.g. chemicals)?

O Superior O Slightly superior O Equal O Slightly inferior O Inferior

Who do you ask mainly for advise regarding farming business?

O public extension officers O direct buyer/agronomists O input supplier

O cooperative society O other famers O family members O NGO staff

O others (specify)_____

Who helps you to implement the standards (if applicable)?

O public extension officers O direct buyer/agronomists O input supplier

O cooperative society O other famers O family members O NGO staff

O others (specify)_____

Do you attend to regular trainings on commercial horticulture? O Yes O No

D. Questions on ICT

Who owns a cell phone in your household? O The man/husband O the woman/the wife O both O others (specify) _____ O no cell phone

What media do you use for your farming business?

O Cell phone O Internet access O Other (Specify) _____ O none at all

How would you consider your access to simple information (e.g. on prices, weather etc.)
O very good O good O medium O poor O very poor

How would you consider your access to complex knowledge (e.g. on standards or production methods)?
O very good O good O medium O poor O very poor

How do you judge the changes that the usage of cell phones has done to horticulture?
O major changes O minor changes O no changes

How do you judge the changes that the usage of the internet has done to horticulture?
O major changes O minor changes O no changes

What do you think are the main advantages of using the phone?

Do you see disadvantages for people not using a phone (e.g. being excluded, missing information etc.)?
O No O Yes (please specify)_____

Do you see disadvantages for people not using the internet (e.g. being excluded, missing information etc.)?
O No O Yes (please specify)_____

E. Specific questions phone users

What kind of phone do you have? O simple cell phone O smart / multifunctional cell phone

Which applications do you use? O text messages O mobile payment O newsletters O hotlines
O weather apps O internet O interactive voice response O photo O others (please specify) _____

To whom do you talk to with your phone for business purposes?
O public extension officers O direct buyer/agronomists O input supplier
O cooperative society O other famers O family members O NGO staff O casual workers
O others (specify)_____

Do you experience limitations or problems when using a cell phone?

O Yes (please specify) _____ O No

Do you experience a larger variety of business partners (e.g. from a larger distance) because you use your mobile phone? O Yes O No

F. Specific questions for internet users

Where do you use the internet? O Own internet access O public internet access

O other internet access (e.g. friend, family member; please specify)_____

What do you use the internet for?

O coordination (e.g. email with business partners)

O access to complex knowledge (e.g. on standards or production methods)

O access to simple information (e.g. on prices, weather etc.)

O payment

O others (e.g. e-commerce; please specify)_____

Do you experience a larger variety of business partners (e.g. from a larger distance) because you use the internet? O Yes O No

G. Specific questions no phone

Why do you not use a phone?

H. Specific questions no internet

Why do you not use internet?

I. Final Questions

What do you consider to be the future of this farming business in the next 5-10 years?

O Very good O Good O Neutral O Bad O Very bad O Uncertain

Do you have any more information you would wish to share?

Thank you very much for your time and cooperation in answering these questions!

Operationalisation

Table 20. Overview of the independent and depend variable and indicators.

Independent variable	**Indicator (quantitative or qualitative)**
Information and knowledge flow	Access to knowledge • Simple knowledge • Complex knowledge
Financial transactions	Use of mobile payment
Market transactions	Coordinating sales with buyers
Structural changes	Variety of buyers Disintermediation New actors in the value chain
Bargaining power	Bargaining position of producer with buyer
Depend variable	**Indicator (quantitative and qualitative)**
Different types of ICTs	1. Voice use 2. Voice-text use 3. Voice-text and internet use
Types of knowledge	Access to simple knowledge Access to complex knowledge • Codified complex knowledge • Tacit complex knowledge External knowledge sources Local knowledge sources
Capabilities and characteristics of the businesses and actors	Farm characteristics • Size • Monthly turnover • Location of the farm – remote/central Qualification of the farm manager • Educational level • Attending trainings • Age • Gender
Forms of integration within value chains Relational proximity	Type of buyers – exporters/middlemen/traders Export or local market production

Appendix 2

Own contributions made to publications in Chapters 4 to 6

All article included in this dissertation were co-authored by Peter Dannenberg and one also by Gilbert Nduru. Articles 1 through 3 are based on empirical material that was collected within the research project which was funded by the German Research Foundation (Deutsche Forschungsgesellschaft).

PI of the project was Peter Dannenberg.

To these three articles, the PhD candidate contributed in the following ways:

- Further development of the theoretical concept (linking of global value chains with ICTs in the Global South)
- Identification, sighting and analysis of literature relevant to the respective foci of the articles
- Participation in the preparation of the questionnaire
- Collaboration of quantitative surveys of small-scale producers
- Development and adaptation of the interview guides for the semi-structured interviews with small-scale producers and buyers as well as for expert discussions
- Conducting quantitative and qualitative interviews in cooperation with translators in both research regions
- Review of interview transcripts
- Entering the quantitative results in SPSS and data cleansing
- Independent calculation of descriptive and bivariate analyses with the software SPSS
- Independent interpretation of the interview transcripts with the software MAXQDA
- Stand-alone writing of the manuscripts
- Revision of the manuscripts for submission in the above-mentioned trade journals under the guidance of Peter Dannenberg

Eigenständigkeitserklärung gem. §4(1)9

Ich versichere, dass ich die von mir vorgelegte Dissertation selbständig angefertigt, die benutzten Quellen und Hilfsmittel vollständig angegeben und die Stellen der Arbeit − einschließlich Tabellen, Karten und Abbildungen −, die anderen Werken im Wortlaut oder dem Sinn nach entnommen sind, in jedem Einzelfall als Entlehnung kenntlich gemacht habe; dass diese Dissertation noch keiner anderen Fakultät oder Universität zur Prüfung vorgelegen hat; dass sie − abgesehen von unten angegebenen Teilpublikationen − noch nicht veröffentlicht worden ist, sowie, dass ich eine solche Veröffentlichung vor Abschluss des Promotionsverfahrens nicht vornehmen werde. Die Bestimmungen der Promotionsordnung sind mir bekannt. Die von mir vorgelegte Dissertation ist von Prof. Dr. Peter Dannenberg betreut worden.

Köln, den 18.12.2017

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Publications

Krone, M./Dannenberg, P. (2018). Does space matter? A spatial perspective on mobile phone use and access to knowledge in Tanzanian small-scale agriculture. In: Tijdschrift voor economische en sociale geografie.

Krone, M./Dannenberg, P. (2018). Analysing the effects of Information and Communication Technologies (ICTs) on the integration of East African farmers in a value chain context. In: Zeitschrift für Wirtschaftsgeographie.

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