3 Development or Divide? Information and Communication Technologies in Commercial Small-Scale Farming in East Africa

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Introduction

Over the last decade, there has been much debate about the potentials of information and communication technology for development (ICT4D). This debate has been fueled by the rapid distribution of mobile phones and access to the Internet in most low-income countries, including in remote areas and among low-income groups (e.g., Okello et al. 2013). Various studies have come to the conclusion that ICTs are improving economic and social development (Kirk et al. 2011; Qiang et al. 2011; UNDP 2012). According to these studies, ICTs create new modes of connectivity and enable the integration of thus-far marginalized businesses and regions into commercial value chains in the globalized world. As a result, large programs and activities have been brought into being: by private firms who want to develop new markets for mobile phone companies, by donors who support small businesses in low-income countries, and by national governments who want to use ICTs to better integrate their export-oriented production into global markets (Kirk et al. 2011; Okello et al. 2013; UNDP 2012; Qiang et al. 2011).

Examining the scholarly literature of recent years, however, makes it obvious that this optimistic perspective is partly driven by wishful thinking and lacks a fundamental theoretical and empirical foundation (see also the critique by Donner and Escobari 2010; Heeks 2010). Without a clear scientific foundation, and given the fact that the mid- and long-term effects of these developments are unpredictable, some of the optimistic studies mentioned above might be misleading. In fact, some recent studies on mobile phone use indicate negative economic effects for segments of the population (e.g., a digital divide; Carmody 2012; Murphy, Carmody, and Surborg 2014).

There is, therefore, a danger that practitioners and policymakers are rushing to embrace and translate conceptual thinking into their agendas before the theory is sufficiently robust and, as a result, are failing to achieve their stated objectives (see the debate on "theory led by policy"; Yeung 2015; Lovering 1999).

In this chapter, we aim to contribute a more robust scholarly foundation to this question by analyzing examples from small-scale fresh fruit and vegetable (FFV) farmers in Tanzania and Kenya and their use of ICT to integrate themselves into commercial value chains. Based on a quantitative and qualitative study of FFV farmers in the Mt. Kenya region (Kenya) and Mwanza region (Tanzania), we discuss to what extent and under which conditions ICTs lead to positive or negative effects. In this way, we contribute to a more differentiated and specific conceptual and empirically based framework for the assessment of ICT4D, in contrast to previous relatively one-sided perspectives (e.g., Kirk et al. 2011; Qiang et al. 2011). We first identify distinct ICT usage types of farmers and discuss this usage in relation to their characteristics and capabilities. We then identify and analyze the effects that these distinct ICT usages can have on farmers.

ICT for Development and Its Relevance for Small-Scale Farming

Positive Aspects in General and for African Small-Scale Farming

The organization and coordination of business activities worldwide is largely supported by ICT-based solutions like web-enabled management tools in complex logistics systems (Lasserre 2004). In low-income countries, the rise of ICTs—albeit still often based on simple hardware and software—has dramatically increased access to, as well as volume and richness of, business-relevant knowledge (Unwin 2009) and has opened up various ways of overcoming remoteness and spatial barriers for social and economic interactions (Pfaff 2010). This has also led to positive expectations about the impacts of ICTs on economic, social, and political developments in low-income countries, including agricultural production systems and their integration into professional and international markets (Unwin 2009; Loh 2013).

These expectations have resulted in the realization of public and private programs and projects funded by international banks and donor organizations, such as USAID, the Food and Agriculture Organization (FAO), and

the World Bank, under the term ICT4D. Studies of such initiatives often highlight the positive effects of ICTs, including economic recovery through leapfrogging (by skipping the stage of landline telephones) and improving business as well as social connectivity (Graham 2011b; Friederici, Ojanperä, and Graham 2017). Aker and Mbiti (2010) identify five potential mechanisms through which ICT can provide economic benefits: (1) improving access to and use of information; (2) improving productive efficiency, allowing businesses to better manage their supply chains; (3) creating new jobs to address the demand for ICT-related services; (4) facilitating communication within social networks in response to shocks; and (5) facilitating the delivery of financial, business, health, and educational services (see also Carmody 2012).

Access to commercial markets is an especially great challenge for small-scale farming in Africa (see Bbun and Thornton 2013) and for small-scale resource-based businesses in low-income countries in general. Qiang and colleagues (2011) argue that access to text-messaging services or websites bears the potential to fundamentally increase small-scale farmers' access to market links, distribution channels, financial services, and extension services that have previously been unavailable to them. Dannenberg and Lakes (2013) show that mobile phone use can support farmers in linking up with local organizations and extension officers to access knowledge and to fulfill the process requirements of their respective buyers. The authors further indicate that simple information (e.g., simple facts on weather or prices) can be exchanged easily by farmers via ICTs, although this is much more difficult or limited in the case of complex knowledge exchange (e.g., production techniques).[1] Generally, the opportunity to exchange knowledge and interact depends on type of ICT usage (e.g., the Internet can be used to exchange large volumes of codified complex knowledge like manuals, which is not possible in telephone calls or text messages).

Humphrey (2002) argues that ICT use can help small agricultural producers reduce information asymmetries with their buyers (e.g., regarding export market prices), which are common features in global value chains, and that, therefore, the use of ICTs can strengthen farmers' bargaining positions. Mukhebi and coauthors (2007) see a transforming potential as a result of Internet- and mobile phone–related innovations, which may result in new forms of organization and access to markets in agriculture.

Critical Perspectives on ICT4D and Their Bearing on African Small-Scale Farming

While the positive achievements and potentials of ICTs have dominated the applied debate, critical visions of ICTs for farming in low-income countries indicate that the effects of ICTs might be overestimated or lead to negative developments (Donner and Escobari 2010; Murphy, Carmody, and Surborg 2014; Murphy and Carmody 2015). Within this debate, scholars criticize the promises of disintermediation and the transformative potentials of ICTs. While Donner and Escobari (2010) predict that progressively increasing use of ICTs in low-income countries will affect production and distribution systems, they argue that these developments will not necessarily change the underlying mechanisms and structures within value chains (in particular, the unfavorable power relations of farmers with their buyers). They see as more likely a consolidation of intermediaries, who themselves use ICTs, especially mobile phones. Similarly, Murphy, Carmody, and Surborg (2014, 264) see a "thintegration," in which only a few benefits arise for small businesses in low-income countries, while power relations and structures that sustain extraversion and underdevelopment persist (Murphy and Carmody 2015; Foster and Graham 2016).[2]

Humphrey (2002) argues not only that the potential positive effects of ICTs might be limited, but that ICTs may even bring about negative outcomes. One negative effect is an increasing digital divide. ICT use depends on the openness of the necessary physical infrastructure and software, which can create entry barriers not only to new ICT-based knowledge flows and transactions, but also to non-ICT knowledge flows and additional transactions that are shifting to an ICT-based exchange. In this context, as Bbun and Thornton (2013) outline, commercial markets are "not a level playing field" but a competition between competitors with different backgrounds and capabilities to adapt to market dynamics or changes in the sociotechnological regime for small-scale enterprises. Given that whether farmers use ICTs depends on each person's different capabilities and characteristics (e.g., financial capability, age, education), the proliferation of ICTs is likely to increase inequalities (e.g., between wealthier enterprises and poorer enterprises that are not able to afford a mobile phone; Heeks 2014).

Carmody (2012) also outlines unequal competition on a global scale as a further negative outcome for southern producers. He argues that if ICTs

help connect to international markets, they also lead to increasing worldwide competition, in which enterprises in low-income countries often struggle to compete against strong international competitors. Another negative development from the spread of ICTs in low-income countries—particularly for producers in international value chains—is the increase of dependencies. The assumption that ICTs can improve the coordination and control of international value chains also means that these technologies are likely to increase the power of companies that already possess coordination and control functions (e.g., the so called "lead firms," which in the case of FFV are usually supermarkets; Dannenberg 2012). Given the asymmetric bargaining position in the chains, the broad dissemination of ICT generally may even lead to a new sociotechnological regime (see, e.g., Wiskerke 2003) in which farmers and traders are forced to adjust or be excluded. This was partly the case after the private standard GlobalGAP was introduced in Kenyan horticultural value chains, when large numbers of farmers and exporters had to reorganize themselves to meet the new requirements (Dannenberg 2011). ICTs could have transformative, but negative, effects (e.g., entry barriers and increased dependencies) on many African small-scale farmers, while other, more powerful, better-skilled actors in the chains gain from the same effects.

Based on these observations, we argue that ICTs have an important influence on farming (especially on knowledge access). They provide the possibility of using different distribution channels and altering the bargaining position of the farmer. We also argue, however, that the influence of ICTs on farming is dependent on different variables, including, at a minimum, the type of ICT usage and the different capabilities of the farmers (e.g., education). To test these assumptions, we posit two research questions:

1. What different ICT usage options do farmers have for business purposes in relation to the characteristics and capabilities of the farmers?
2. How does the different usage of ICT influence farmers' knowledge access, distribution channels, and bargaining positions?

Methodology

Case Study Selection

The Kenyan FFV sector is a forerunner and one of the few success stories of integrating small-scale farmers and traders into the European Union's

international value chains (Dannenberg and Nduru 2013).[3] In Tanzania, such a large-scale export orientation in the FFV sector has not yet taken place, but Tanzanian farmers are increasingly supplying professional commercial retailers for domestic and African export markets (König et al. 2011). Thus, the Kenyan and the Tanzanian FFV sectors are two cases that show distinct stages of integration into different distribution systems. Despite these differences in value chain integration, FFV farmers in both countries have experienced the rapid spread of ICT use in their sector over the last few years. To connect with commercial markets and value chains, an increasing number of small-scale businesses in Kenya and Tanzania (as well as in many other low-income countries) are starting to use ICTs, including mobile phones and the Internet (Donner and Escobari 2010).

The data for this chapter are drawn from two rounds of fieldwork in the Mt. Kenya and Mwanza regions in 2013 and 2015 (qualitative interviews and quantitative surveys in autumn 2013; completing qualitative interviews in spring 2015). We selected these two regions based on the large numbers of small-scale FFV farmers producing for commercial value chains as well as the relatively good and affordable mobile phone and Internet networks in both regions (see also Molony 2008a). Instead of focusing on a comparison between the two regions, we have used data from both to provide a broad statistical population, which gives a more differentiated picture of the varying types of commercial small-scale farms and their integration into different distribution systems.

Data Collection

We applied a mixed method approach, including 61 semi-structured qualitative interviews and 368 quantitative surveys with farmers. We selected commercial small-scale farmers involved in horticulture (fresh fruit and vegetables) for the surveys and the qualitative interviews. In Kenya and Tanzania, the horticultural sector has been one of the most dynamic agricultural subsectors over the last ten years, with comparatively high incomes (Krone, Dannenberg, and Nduru 2016). This sector is especially interesting for studying ICT use since it is characterized by the high perishability of products, which require fast trading transactions. Thus, rapid delivery processes and prompt communication are needed (Molony 2008b). To measure the influence of ICT use on agriculture, we interviewed both ICT users and nonusers, contacting the first interviewees through informal leaders

(gatekeepers). After we established contact with selected farmers, snowball sampling followed (Flick 2009).

We conducted further semistructured qualitative interviews with intermediaries, traders, exporters, and external experts (scientists and agricultural extension officers), although the primary focus of the research was on farmers. Interviews were conducted in English or Swahili (by local research assistants accompanied and supervised by the principal researchers).

Data Analysis

The survey questionnaire contained precategorized and partially categorized questions oriented toward particular aspects of the core research questions, including questions concerning ICTs, small business characteristics, and businesses capabilities (table 3.1). Additionally, we asked for the farmers' subjective assessment of access to knowledge, power relations between the individual actors and the buyers (e.g., bargaining position), and the distribution system.

Following the primary survey, we analyzed the collected data with a software package using descriptive analyses and applied statistical testing procedures, including χ^2 tests, to prove the significance of the results. We differentiated the results according to ICT usage types or distribution

Table 3.1
Overview of quantitative interviews

Characteristics of interviewees (N = 368)	%
Residence in Mt. Kenya	52
Residence in Mwanza region	48
ICT user	91
Non-ICT user	9
<30 years	20
30–50 years	63
>50 years	17
Primary education	69
Higher than primary	31
Female	31
Male	69

Source: Authors' findings (Krone, Dannenberg, and Nduru 2016).

channels and tested the significant differences regarding farming or ICT characteristics with χ^2 tests (see Bahrenberg, Giese, and Nipper 2013). Additionally, we used logistic binary regression analysis to identify associations between indicators for the expected dimensions of ICT-driven effects and indicators for the different characteristics of the outlined variables. An advantage of the binary (logit/probit) method over linear regression is that the distribution of binary variables can be correctly modeled. We used the logit method, because the regression coefficients can be more easily interpreted in terms of odds ratios. The analysis of the semistructured qualitative interviews followed the principles of qualitative content analysis (Mayring 2004). The qualitative data were mainly used to interpret the quantitative results.

Empirical Results and Discussion

Different ICT Usage Types in Relation to the Farmers' Characteristics and Capabilities

Table 3.1 gives an overview of the main characteristics and capabilities of the surveyed farmers (in total 368 smallholder farmers). Unexpectedly, the majority of respondents were ICT users (91 percent), all of whom at the very least used mobile phones for farming business.[4] This was a remarkably high share, given official data showing that, in 2014, only 71 percent of all Kenyans and 56 percent of all Tanzanians used mobile phones (see ITU 2016).

We identified three types of ICT usage among the farmers: (1) voice-only user; (2) voice and text user; and (3) voice, text, and Internet user (see table 3.2).[5] The least complex ICT usage type comprised farmers using their phones for calls only (13 percent). These farmers usually would call to immediately access information on a particular topic, such as market prices. Among the different ICT usage types, the combination of text and voice was dominant (67 percent). These farmers often used text messages to confirm business deals that had been negotiated previously. Additionally, 64 percent of all respondents used mobile payment systems like M-Pesa via text messaging (see figure 3.1).[6] This payment system is commonly used to store and transfer value in a mobile account (with simple handsets and without being connected to the Internet). Texting for crucial knowledge

Table 3.2
Overview of ICT usage types (N = 361)*

ICT usage types	% (no.) of interviewees
No ICT usage	9 (32)
Voice only	13 (45)
Voice and text	67 (243)
Voice, text, and Internet	11 (41)

Source: Authors' findings (Krone, Dannenberg, and Nduru 2016).
*The total numbers of N vary between the different tables as not all farmers answered each question; see also tables 3.3 and 3.4.

Figure 3.1
M-Pesa shops for mobile payment in Mt. Kenya. *Source*: Authors.

transfer, however, was often described as unreliable as an immediate means of communication.

Only 11 percent of all farmers used the Internet. This usage was mainly basic, including email, web searching (e.g., for price information or production techniques), and business-relevant Facebook groups. The limited usage was partly related to such factors as lack of awareness of the Internet, limited knowledge about using it, and prohibitive connectivity and hardware costs (see also Dannenberg and Lakes 2013). Nevertheless, some respondents who used the Internet replied that they do use it to access knowledge—such as on specific pesticides and their usage, or on prices outside the region—and generally saw it as a valuable source of information.

We next ran a binary logistic regression analysis to determine how significantly ICT usage types correlated with farmers' characteristics and capabilities, such as age, gender, monthly income, and level of education (table 3.3). The results from the model were only partly significant (at $p < .1$ and $p < .05$).

Predictably, using the Internet in East Africa requires not only being able to read and write but also having a command of the English language, while

Table 3.3
Effects of characteristics and capabilities on ICT usage types

Characteristics and capabilities (odds ratios)	Nonuser of ICT	Voice-only user	Voice and text user	Voice, text, and Internet user
Characteristics				
Age: 30–50 years (1 = yes)	–1.088*	–0.665	1.014**	–0.104
Age: >50 years (1 = yes)	–0.323	0.519	–0.200	–0.446
Gender (1 = male)	–0.082	–0.233	0.202	0.086
Capabilities				
Monthly income: >KSh20,000 (1 = yes)	–1.311	0.463	0.003	0.446
Educational level: >primary school (1 = yes)	–1.286*	0.073	0.452	1.130**
Pseudo $R^{2\dagger}$	0.050	0.035	0.060	0.041
Prob χ^2	0.103	0.063	0.088	0.077

Source: Authors' findings (Krone, Dannenberg, and Nduru 2016).
†We calculated Cox & Snell R-Quadrat.
*$p < .1$; **$p < .05$

further education is an advantage in understanding more complex written texts and applications. Thus, having more than a primary school education is especially important for using the Internet. This was also reflected in our interviews and statistical results.

Regarding age, we compared three categories: under thirty years, between thirty and fifty, and over fifty. The results showed that age was a significant factor for ICT use in general and especially for calling and texting. Farmers between thirty and fifty years old used calling and texting significantly more than both other groups. Our qualitative interviews helped explain these differences: the generation currently in middle age grew up at least in part with these technologies and are experienced enough farmers to be able to make effective use of ICT as (for example) a marketing tool (see also World Bank 2016).

Interestingly, gender was not clearly associated with farmers' use of ICTs. Neither our quantitative nor our qualitative findings supported the argument that cultural attitudes and women's multiple roles would exclude them from ICT access (as outlined by, e.g., World Bank 2016).[7]

Furthermore, we found no significant link between financial resources and access to ICTs, in contrast to findings in, for example, Dannenberg and Lakes (2013). But their study draws on data from 2008 to 2009, and since then, prices for electronic devices have gone down; farmers today can buy mobile phones for less than US$20 (figure 3.2). Furthermore, the costs for Internet access have decreased thanks to the arrival of fiber optic broadband communications cables installed in East Africa between 2009 and 2012 (Graham and Mann 2013).

Overall, our results showed that a broad variety of farmers with diverse capabilities and characteristics use ICTs. The main capability that influenced ICT usage in our study was education, but age was also an influencing characteristic. Use of the (more complex) Internet tended to be higher among well-educated and middle-aged farmers, but most farmers still did not use the Internet. Nevertheless, nearly everybody used simple ICT functions (voice), including women and low-income small-scale operators. This suggests that a strong digital divide is not taking place on the level of simple ICT usage but could increase in the future if the Internet or other more complex usage forms (e.g., tracking systems) become more important.

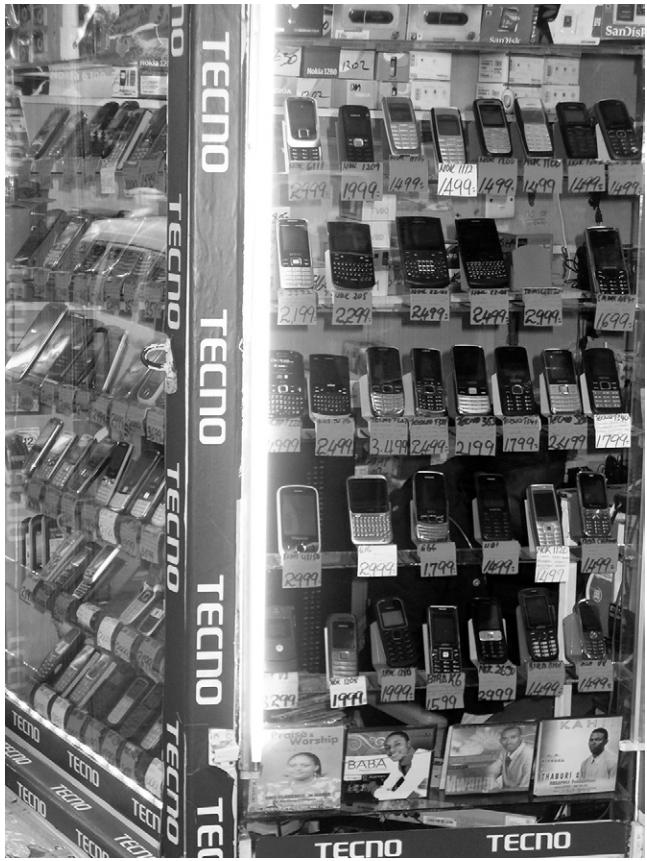

Figure 3.2
Front of a mobile phone shop in the Mt. Kenya region, with mobile phones going for less than KSh2,000 (US$20). *Source*: Authors.

Dimensions of Knowledge Access

Existing studies have already demonstrated that mobile phones can provide quick access to simple but relevant information, leading to improved agricultural productivity (e.g., Aker and Mbiti 2010). Farmers in our case study especially valued increased access to timely price information, as explained by one farmer: "Previous[ly] 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 harvest and sell the products" (Farmer 5, 2013).

Nevertheless, 57 percent of the farmers who did not use ICTs stated that they had good or very good access to simple information, revealing that ICT usage is not necessarily a precondition accessible relevant knowledge. Several farmers stated that they could acquire simple information, such as updated market prices, via face-to-face contact with other farmers and villagers at the local scale.

The advantage of using ICTs was greater when farmers needed access to complex knowledge not generally available locally, such as information on how to implement standard requirements. Such knowledge often requires access to external experts. Our data show a significant statistical correlation between access to complex knowledge and a broader combination of ICT usage types (figure 3.3). The Internet especially tended to facilitate good access to complex, codified knowledge, transferring it in written form (e.g., documents about standards). Because of farmers' limited use of the Internet, however, the impact of the Internet on their access to complex knowledge is low.

To some extent, codified complex knowledge (e.g., on the application of fertilizer) was exchanged through calls. But phones are of limited use if the knowledge is too complex or tacit to convey, like the application of process

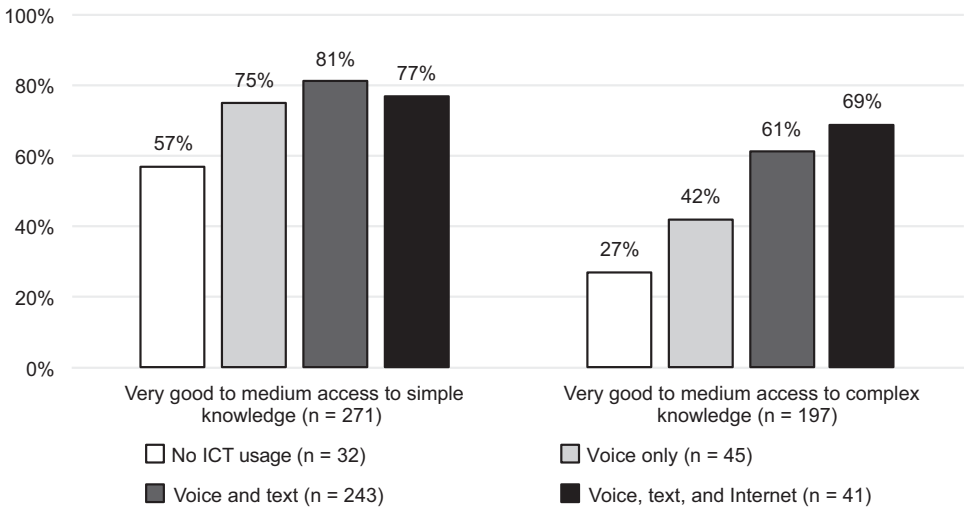

Figure 3.3
Dimensions of knowledge access according to different ICT usage types. *Source*: Authors' findings (Krone, Dannenberg, and Nduru 2016).

standards, which requires training on the job (also see Krone, Schumacher, and Dannenberg 2014). Our interviews revealed, however, that the main advantage of phones is to provide farmers with the opportunity to start and maintain the personal communication process with external experts outside their villages (e.g., with extension officers, exporters, and donors). Especially in export markets, a high degree of complex knowledge is required, which can usually be provided only by external experts. Such knowledge includes how to identify pests or the correct use of chemical inputs. It also focuses especially on the implementation and use of standards (e.g., GlobalGAP) that are crucial for market production (see also Ouma 2010).

To get and stay in contact with external experts who possess such valuable complex knowledge is much more difficult for farmers who have no access to ICTs because, without access to such technologies, they have no way to personally contact these experts. As a result, only a few farmers (27 percent) who did not use ICTs had very good to medium access to complex knowledge. The farmers we interviewed from this group were either integrated in a knowledge network (e.g., a self-help group) or had the opportunity to borrow a phone from someone else.

Distribution Channels

The farmers interviewed for this project accessed a range of different distribution channels. These distribution channels could be distinguished by different types of buyers, various levels of complexity in the buyers' requirements, the formalization needed to enter the channels, and the geographic distance between the farmer and the buyers. In total, four direct distribution channels could be identified:

1. Selling to other farmers (12 percent of all interviewed farmers), who then resell the products along with their own, was the easiest channel for many because of the deal's informality and the proximity of buyer farmers. Selling to another farmer did not require using ICTs to contact the buyer, which could usually be done directly and face-to-face within the same village.
2. Overall, farmers most often sold to local intermediaries (48 percent), who bought products without formal contracts and in small volumes.[8] For farmers aiming to sell to intermediaries, phones were important, enabling them to compare the various buyers' prices.

3. In Tanzania, farmers also sold in larger volumes to more formalized professional regional traders (13 percent), who either came to the farm or could be met at a wholesale market (see also Eskola 2005). In this case, farmers used their phones mainly to coordinate business activities.
4. The most lucrative, but also the most complicated and formal, channel was selling directly to exporters (27 percent).[9] While exporters usually pay the highest prices for products, they also demand the most challenging requirements. Exporters usually operate from larger cities, often prefer long-term contracted farmers, and require high standards (e.g., regarding the use of pesticides; see also Dannenberg and Nduru 2013; Graham 2011a; Dannenberg, Kunze, and Nduru 2011). The geographic distance and sophistication of this channel made ICT use, in most cases, essential for farmers.

As demonstrated in figure 3.4, our results show that farmers who use the Internet sold to exporters (42 percent) more often than those who only used phones (33 percent voice users; 26 percent voice and text users) or those who did not use ICTs (12 percent). When interacting with exporters, farmers' ICT use was important for coordination and control. Here, the exporters usually coordinated the activities. Interviewees stated that accessing exporters requires an intense communication process via ICTs

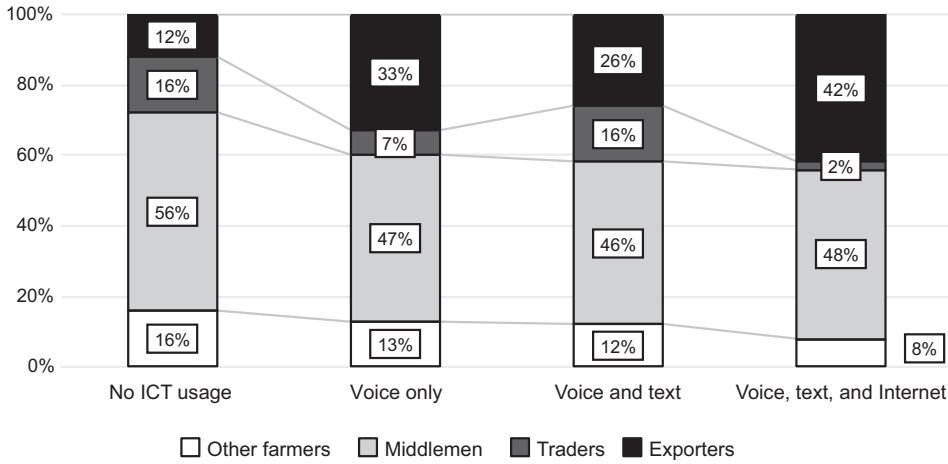

Figure 3.4
The usage of distribution channels by nonusers of ICT and different ICT usage types.
Source: Authors' findings (Krone, Dannenberg, and Nduru 2016).

because exporters do not regularly visit farms. Calling and texting have thus become necessary as coordinating activities need to be carried out over greater spatial distances (see also Boadi et al. 2007). The Internet, in particular, provides access to specific knowledge on how to produce (e.g., using chemicals) and, therefore, how to fulfill complex exporter standards. Additionally, via the Internet, exporters often provide farmers with complex knowledge about production methods for high-value production. Although direct sales to exporters usually have higher margins, our results indicate that such a sophisticated distribution channel often requires using ITCs to become integrated into the coordination and communication process and to access the necessary knowledge.

The results underline the opportunities offered by ICT usage while also revealing the problematic side, when access to ICTs becomes increasingly essential to doing business with exporters as well as with intermediaries and traders. Therefore, the risk of exclusion rises for those farmers who do not use certain ICTs. They are in danger of becoming marginalized and losing their commercial markets in the long term (see also Carmody 2012). According to our interviews, this problem had thus far been minimized, as most farmers who did not use ICTs had been able to sell via another farmer or a farmers' group/cooperative. As different farmers outlined, however, this solution came at the cost of reduced margins (as the intermediate farmers charged for their services). Furthermore, this approach can lead to new dependencies on these intermediaries.

ICTs have the potential to restructure value chains and distribution channels, for example, by introducing new actors or disintermediating intermediaries (Donner and Escobari 2010). Interviews with farmers confirmed our survey data demonstrating that ICT use improved farmers' ability to access increasingly complex and sophisticated distribution channels. For example, one Tanzanian farmer stated: "We have a larger variety of buyers and even places to sell our products. We exchange the contacts of buyers among ourselves" (Farmer 6, 2013). Farmers experienced advantages in accessing market information from different sources. In addition, ICTs 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.

Nonetheless, our study could not identify any restructuring or transformation of distribution channels. So far, no genuinely new actors could be

identified, and middlemen continued to be common buyers. Furthermore, our interviews with farmers and exporters indicated that even though ICTs could bridge the spatial barriers to enable contact with exporters, the exporters themselves were often not interested in such direct contact, preferring intermediaries who collected larger volumes for them. Farmers were also usually not able to provide a continuous supply of bulk produce, which also hindered them from doing direct business with exporters.

Bargaining Positions

In the literature (see, e.g., Baumüller 2012), scholars often argue that improved access to information, especially market prices, can improve the bargaining position of a farmer with business partners by reducing information asymmetries. As shown in table 3.4, our statistical analyses (χ^2 test) could not clearly support this observation.[10] Regardless of the ICT usage type, using ICTs seems to have no effect on the bargaining position of a farmer, even though farmers used ICTs to compare prices. This contradictory finding can be explained by looking at the buyer side of the chain. As outlined above, exporters also use ICTs to coordinate and to control farmers (e.g., in how far they meet demanded product and process requirements). Furthermore, the introduction of ICTs has led to profound changes in the opportunities available to traders and intermediaries, which has partly reversed the improvements that enabled farmers to select a buyer. As intermediaries and traders also use phones more widely, they have been able to make cartel agreements or even increase their bargaining position.

Table 3.4
The effects of ICT usage types on bargaining position with buyers

	No use of ICTs % (n = 32)†	Voice-only user % (n = 44)	Voice and text user % (n = 240)	Voice, text, and Internet user % (n = 41)
Superior bargaining position	6 (2)*	18 (8)	18 (42)	12 (5)
Equal or inferior bargaining position	94 (30)*	82 (36)	82 (198)	88 (36)

Source: Authors' findings (Krone, Dannenberg, and Nduru 2016).
†Not all voice-only users and voice and text users responded to this question, so N differs from table 3.2.
*$p < .05$

They also had an early mover advantage, having started to use phones earlier, which gave them more time to use these technologies to organize themselves.

Nonetheless, our interviews did surface improvements in the bargaining situation of farmers that were notable even if not quantitatively relevant. One improvement is related to the seasonality of produce. In the low-supply season, real-time information on market prices from different markets via mobile phones can strengthen the bargaining position of farmers. In such cases, when the buyers urgently needed to buy, cross-checking market prices enhanced the bargaining power of farmers. Conversely, in the high-supply season, buyers decided the (generally low) price based on the high number of products available.

For example, one Tanzanian farmer stated: "Negotiating the price is depending on the period of supply. If there is high supply our tomato will not sold to buyers at the farm gate. So I must call them and to take the products to the market. They don't agree to come in the farm during high supply. But in low supply season the buyers are calling and asking for the products. And if I just say I have the products I can even get like 30 buyer in a very short time selling to good price" (Farmer 17, 2015).

In addition, a Tanzanian buyer confirmed: "According to our experience we are equal in bargaining the price. It happens that when there is low supply of watermelon, that's where you can find that the farmer increases price and we have low power in making decision" (Middleman 6, 2015).

Further, our interviews underlined that farmers who organize themselves into groups or cooperatives could achieve a better bargaining position (cf. Dannenberg and Nduru 2013). This organization could be improved through the use of phones (voice and text). Farmers could organize themselves better internally (integrating more and remote farmers, coordinating meetings and agreements more effectively) and externally (communicating with different buyers and suppliers), therefore improving their bargaining position. The cooperative usage for external business contacts also indicates that the positive effects of ICTs in farming can even spread beyond the direct users, as not every farmer in a cooperative needs his or her own phone or Internet access but can participate with the others. Such indirect participation of nonusers can help in preventing a digital divide. Nevertheless, even though our qualitative results identified some areas of improvement in the buyer relationships of farmers through the use of ICTs,

the overall results could not support the argument that ICTs lead to such improvements in general.

Conclusion and Outlook

Generally, ICTs positively influence the ability to access knowledge and overcome spatial barriers to building and maintaining linkages between farmers as well as to a large variety of buyers, improving access to commercial markets. In this way, ICTs contribute to economic inclusion. The effects of ICT on farming businesses, however, are dependent on the actual types of ICT usage. While mobile phones are widespread, Internet use is still limited. Low education and advanced age are characteristics that tend to preclude using the Internet, although neither gender- nor income-related exclusion was identified for the analyzed ICT usage types. In this way, ICT usage is "not a level playing field" (Bbun and Thornton 2013), as the chances of gaining from ICT usage depend on favorable preconditions.

Regarding the different areas of potential benefits, the effects of ICT usage types differed. Even though all ICT usage forms support the exchange of simple information, Internet use significantly increased the exchange of complex knowledge and the possibility to enter more sophisticated and lucrative distribution channels and markets. Nonetheless, 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. ICT use becoming compulsory for communication with exporters, for example, might lead to a digitally driven exclusion of less capable farmers.

Although we identified smaller structural changes in distribution systems, we did not observe transformational changes at the farm gate level, as have been mentioned in the broader ICT4D literature. Moreover, we could not demonstrate an improvement in information-related bargaining positions with buyers and suppliers (this supports the argument of a "thintegration" made by Murphy, Carmody, and Surborg 2014). Although increased access to knowledge and improved information exchange with other farmers can positively affect the bargaining position of the farmers, ICTs are also used by powerful actors in the chain to control farmers and to sustain asymmetric power relations.

In sum, the results revealed that the analysis of different ICT usages (and its associated complexity) and the different characteristics and capabilities of the farmers help explain the variegated effects of ICTs on small-scale farming. ICT4D strategies that do not take into account the different capabilities, characteristics, and buyer relations of targeted businesses (e.g., through training and educational approaches) are likely to increase existing disparities to the disadvantage of those who already have lower capabilities and who are therefore especially at risk of (further) exclusion and marginalization.

Notes

1. As explained by Lundvall and Johnson (1994) and Polanyi (1967), simple information can be defined in terms of facts ("know-what," e.g., market prices), while complex information includes different types of knowledge that go beyond, such as "know-why" and "know-how" (e.g., implementation of standards).

2. The ICT usage of firms is limited to exchanges of discrete bits of information, for example, prices or delivery dates. This information is essential for the everyday operations or success of the enterprise but usually does not result in a firm upgrading, creating value, or innovating (Murphy, Carmody, and Surborg 2014).

3. For this study, small-scale farmers are defined as farmers with less than two hectares of land.

4. We asked only about ICT use for farming business, not ICT use in general.

5. All the farmers surveyed who used the Internet also used phones for texting and voice.

6. For export production, however, farmers mainly used bank checks because of banks' formalized contract systems and higher security.

7. These findings could also point to a bias in our sample, since women who don't use ICTs were less likely to take part in our survey.

8. Farmers often trust intermediaries because of their shared cultural background and long relationships.

9. Exporters operating in Mt. Kenya mainly sell to EU markets.

10. As power relations are difficult to measure, we asked the farmers for a subjective assessment of their bargaining position related to their buyer. The answer options were given as a set of items (Likert-type scale) including inferior, slightly inferior, equal, slightly superior, and superior.

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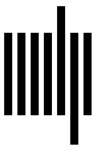

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