# Learning with Mobles

A Developing Country Perspective on Mobile Technologies use in Learning for Livelihood Support

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## A Developing Country Perspective on Mobile Technologies use in Learning for Livelihood Support

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# Dedication

***To Sanyu, Rosa Parks, Bakhita and Spire***

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## List of Abbreviations

| | |
|---|---|
| ANT | Actor-Network Theory |
| CC | Community Connector |
| CCO | Community Connector Officer |
| CoP | Community of Practice |
| CKWs | Community Knowledge Workers |
| DELP | Distance Education Leapfrogging Project |
| FGDs | Focus Group Discussions |
| GPS | Global Positioning System |
| ICT | Information and Communication Technologies |
| ICTD | Information Communication Technologies for Development |
| L3F | Lifelong Learning for Farmers |
| mLearning | Mobile Learning |
| M4D | Mobiles for Development |
| NAADS | National Agricutural Advsory Services |
| NGOs | Non Governmental Organizations |
| NITA | National Information Technology Authority |
| SC | Social Constructivism |
| SDGs | Sustainable Development Goals |
| UCC | Uganda Communications Commission |
| USAID | United States Agency for International Development |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| VHTs | Voluntary Health Trainers |

## Summary

This doctoral thesis focuses on understanding the role of mobile technologies as tools to enhance learning for livelihood support. To date, the body of knowledge on the use of mobile technologies for development is growing, as mobiles avail a chance for many developing countries' communities to improve their economic and social well-being. The current integration of mobile technologies for development has to a large extent focused on information dissemination, with less emphasis on how mobiles offer learning spaces to propel development. Yet, mobile technologies offer possibilities for access to learning for communities in resource constrained settings. Dedicated studies in pedagogical integration of mobile technologies in teaching and learning mainly focus on formal and informal learning classroom-related activities, neglecting the substantial majority like smallholder farmers who constitute the biggest percentage in many rural areas.

Similarly, the paucity of qualitative empirical studies that analyze mobile technologies' support for livelihoods makes this study upfront. The challenges of the time, like changing trends in technologies and the need to learn new adaptive strategies, often limits our capacity to use technology as a platform to help the less privileged communities get access to actionable digitalized content. Therefore, on the premise that systematic integration of mobile technologies facilitates knowledge access and sharing, as reflected in the title of this thesis - *'Learning with Mobiles. A Developing Country Perspective on Mobile Technologies use in Learning for Livelihood Support'*, the aim of this study was, on the one hand, to understand the role of mobile technologies in supporting livelihoods, and on the other hand, to contribute towards a conceptualization of mobile learning for livelihood support. The research questions that guided this study include (1) What are the perceptions among smallholder farmers on the use of mobile technologies for livelihood enhancement? (2) What are the smallholder farmers' experiences regarding the adoption and use of mobile technologies for learning purposes? (3) What are the possibilities and constraints of applying mobile technologies for learning in livelihood projects? (4) What mLearning capabilities can support food security systems among smallholder farmers in rural communities? and (5) What mLearning conceptualization can support smallholder farmers livelihoods?

Considering that this research was multidisciplinary in nature combining elements of technology (mobiles), education (non-formal learning), and development (livelihoods), to address this interdisciplinarity, the study employed four theoretical lenses. (1) The Actor-Network Theory (ANT) helped to explore how human and non-human actors and networks support information sharing and use among smallholder farmers in rural communities. (2) The Unified Theory of Adoption and Use of Technology (UTAUT) facilitated the exploration of factors that explain the adoption and use of mobile technologies for learning. (3) The Community of Practice (CoP) theory supported an understanding of different activities inherent within farmers' mLearning practice. While CoP explained elements of social learning, it was not clear on the actual learning experiences that integrated assessment capabilities. (4) Social Constructivism (SC) was then used to analyze how knowledge was socially constructed and assessed in non-formal learning with smallholder farmers. The use of multiple theories helped to fill in missing links in some theories and provided a more in-depth understanding of mobile technologies and learning for livelihood support. This notwithstanding, mobiles for development and mobile learning as key fields in this study are considered to be relatively new (Crompton, 2013; Kaliisa, Palmer, & Miller, 2017). This explains why the integrated theories bend towards education, information systems, and social sciences.

This thesis employed a qualitative interpretive case-study design in a multiple case study approach. A series of ethnographic interactions and follow-ups of the study participants over a long period facilitated the acquisition of localized norms and practices about smallholder farmer's interactions with mobile technologies in resource constrained settings. Purposefully, three Mobiles for Development (M4D) organizations, all located in Southwestern Uganda were selected for this study. (1) Grameen Foundation Community Knowledge Worker project (Bushenyi District), (2) Lifelong Learning for Farmers (L3F) project (Kabale District), and (3) USAID Community Connector (CC) project (Ibanda District) were case studies with salient on-going organizational activities that offered opportunities for learning. A total of 90 participants including Community Knowledge Workers (CKWs), smallholder farmers, local leaders, religious leaders, youths, organization staff, project personnel, key informants like agriculture and nutrition experts, police officers, loans officers, and non-project farmers participated in this study.

The findings from this thesis indicate that many smallholder farmers have prioritized the use of mobile phones over other mobile technologies. The accessibility, portability, and multifunctionality attributes make mobile phones suitable to support smallholder farmers' diverse activities since farming, in its entirety, is not the only source of income, but just part of it in most rural households. While most farmers had a positive perception regarding mobile phone usage, some considered them disruptive. For instance, increased burglaries, divorce, theft, and vandalism associated with mobile phone usage threatened peoples' safety thereby suffocating social capital within communities. In relation to mobiles as tools for learning (mobile learning), introducing ICTs like mobile technologies to enhance livelihoods is not just a matter of availing the technology. It is essential to consider the key actors (both human and non-human), and most importantly, consider their needs as essential translations to support learning. The mobile learning (mLearning) challenge in the farmers context cannot just be overcome by merely providing the technology. Technology and connectivity are just one component among many that need to work for rural livelihoods. Considerably, mLearning offers a variety of choices available for the different needs and situations of different groups of learners. Amidst constraining factors like technology constraints, farmers' inability to use the knowledge, and mobiles understood as disruptive to society, it is imperative to appreciate mobile technology capabilities considering contextual issues like mobile phones increased uptake and accessibility that can facilitate knowledge sharing even to 'last mile' communities.

This doctoral thesis offers both theoretical and practical contributions. Theoretically, the negative social implications in relation to mobile usage like increased burglaries, theft, marital challenges, patriarchy entrenchment, and health implications add new knowledge to Mobiles for Development research. The necessity of mobile learning in non-formal contexts adds new insights to the conceptualization of mLearning for livelihood support. Regarding this livelihood discussion, it is important to appreciate the diverse portfolio of activities and the changing terrain of learner needs. While this thesis contends that capacity building plays a vital role in supporting livelihood initiatives, mLearning activities ought to integrate local voices that support transformative learning opportunities aimed at building farmers' agency for poverty reduction. To achieve this, M4D practitioners need to view mobiles as part of a powerful network of synergistic systems to improve service delivery. Analyzing mobiles singular contribution to learning is observing just part of the phenomena since mobiles effectively work within a mix of available technologies and network resources like print media, radio talk shows, community sensitizations, and meetings.

For the practical contributions, the thesis suggests six factors that conceptualize mobile learning (mLearning) for livelihood support. These include a) organizational support, b) technological resources, c) the needs of a diverse and dynamic learner, d) problem solving and situated learning, e) the community as agency, and f) sustainability. In anticipation that many development projects are increasingly integrating mobile technological capabilities to support livelihood initiatives among the less privileged, the suggested factors do not form a prescriptive framework. Instead, they offer insights that can guide the operationalization of mobile technologies and learning for livelihood support. The proposed factors are, however, not exclusive as each element interconnects to the other.

The thesis puts forward several limitations that relate to generalizability of research findings, measuring farmers actual learning, use of multiple theories, and strong emphasis on mobiles applicability amid supplementary support systems. These however offer several opportunities for future research. In particular, this thesis points to the need to explore how farmers' owned phones can support learning considering that this study focused on mLearning practices within controlled settings where farmers were given smartphones with installed agricultural content. This will broaden an understanding of informal mobile learning practices among smallholder communities to streamline farmers' learning in natural settings. In addition, all the study case sites were short-term experiment donor funded projects which pose sustainability implications. This calls for the need to follow up with active farmers groups when organization and donor funding ends. Most importantly, future work ought to advocate for localized sustainable business models for technological solutions to work in rural communities.

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# 1. Introduction

## 1.1 Overview

This thesis focuses on understanding the role of mobile technologies as tools to enhance learning for livelihood support with specific reference to Uganda. Considering that ICTs like mobile technologies have contributed to socio-economic development (Heeks, 2008; Donner, 2010; Svensson & Wamala, 2012), this study has prioritized their use as means to support knowledge access and sharing for livelihood support. Livelihood in this thesis implies the (possession of) assets and activities people engage in to sustain a living and achieve viability. Livelihood includes the means of securing the necessities of life; thus, mobile technologies entail capabilities that can support majority in developing regions to secure necessities of life. Mobile technology refers to any portable information technology used for purposes of cellular communication that allows for two-way transactions with mobility capabilities (Crossan, McKelvey, & Curran, 2018). These include laptops, tablets, mobile phones, Global Position System (GPS), 3G, Wireless Fidelity (Wi-Fi), Short messaging service (SMS), and Multi-Media Messaging (MMS). In this study, mobile technologies included mobile phones (with inbuilt advanced technologies) and laptops used in development work. While this study prioritized mobile phones as the most accessed technology in many developing regions, attention was paid to mobility enablers like GPS, 3G, Wi-Fi, SMS, and MMS. Learning in this study is conceptualized as non-formal to fit the characterization of smallholder farming communities.

## 1.2 Background

Globalization and digitalization have influenced everyday life. The increasing investments in Information & Communication Technologies (ICTs) have transformed many societies' politics, entertainment, health, agriculture, and education. From the development perspective, ICTs have been considered a panacea to help developing regions improve their institutions (Heeks & Stanforth, 2015). The ICT impact on development has also shown significant contributions to developing regions such as sub-Saharan Africa (Aker & Mbiti, 2010a; Alzouma, 2005). Narratives like "if African countries cannot take advantage of the information revolution and surf this great wave of technological change, they may be crushed by it" (Herselman & Britton, 2002, p. 274) show the need for Africa to invest in emerging technologies. The current mobile technology revolution (Manske, 2014) is considered to bring development opportunities to (many) developing regions. This influx of modern technologies has revolutionized information, making it possible to avail knowledge and awareness by the end-users (Oladele, 2011). ICTs like mobile technologies have in most developing countries helped increase people's knowledge of market information; improve coordination of transportation, especially during emergencies; and enhance the effectiveness of development activities (Martin & Abbott, 2011).

Amidst all these technological initiatives, however, sub-Saharan Africa is still at the epitome of many development challenges like poverty, food insecurity, health-related problems, population increase, and climate change. Climate change is one of the most significant challenges the world faces today as droughts, floods, and storms lead to resource scarcity and undermine entire livelihoods (Schilling, 2012). Among the most affected are the world's poorest communities in developing countries with resource constraints to adapt to climatic challenges (Smith et al. 2003). No where in the world are people more vulnerable to climate change impacts than in sub-Saharan Africa. The continent is prone to erratic rainfall, droughts, floods, cyclones, and climate change will continue to exacerbate these challenges if adaptation strategies are not well implemented (Care, 2010). Most African populations are sensitive to climate change because of the strong dependence on rain-fed agriculture that sustains rural livelihoods (Schilling, 2012; World Bank, 2016). Besides, the adaptive capacity for many people in poor communities is too low to support resilient capabilities and counter the effects of climate change (Majid et al., 2018). Among the severely hit communities are smallholder farmers who constitute a sizable proportion in many African economies, with livelihoods adversely affected by poverty, food insecurity, health challenges, among others. Such smallholders quite often lack access to information and early warning systems, given their peculiar locations in resource-constrained settings.

Research has been conducted on people's adaptive capabilities, but there exists less literature on how best modern technologies can extend learning for communities to adapt to global challenges like climate change. ‘‘Climate change will almost surely make life even harder for the world's poorest and most vulnerable populations. We must avoid restricting their capacity to adapt by not limiting their options…Technology options, in particular, must become more available'' (Lybbert & Sumner, 2012, p. 115). All countries can respond to developmental challenges by the process of adaptation, but this largely depends on socio-economic and environmental circumstances, governance, availability of ICTs funds, and financing schemes (Ospina & Heeks, 2010). Unless people have tools to understand and analyze the world around them, they will not be able to address the challenges that face our society and environment (UNEP, 2008). Mobile technologies are among cheaper pervasive solutions that are easily accessible in many developing regions.

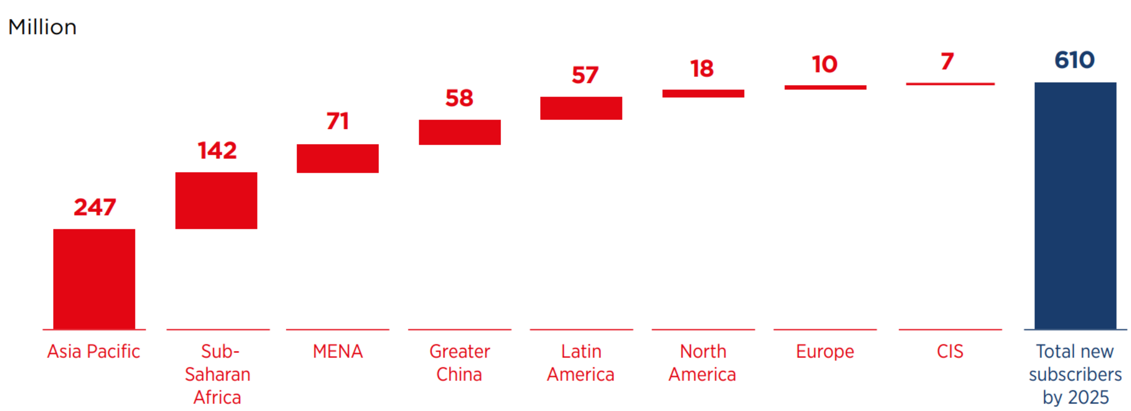
There has been a realization that it is the education system that mainly has to change the world's thinking, and that people need to have access to learning platforms that increase their adaptive capacities and change for the better (Hlalele, 2014). Upholding investments in education and training is one way to address livelihood challenges. There is no other region in the world that needs urgent access to information and training like Africa (Omolewa, 2008). Education is considered a key element in helping communities (especially in developing regions) to reduce vulnerability to economic, social, and environmental dislocations towards building more resilient systems (Stevance, 2015). With the new proposed efforts to support developing regions in attaining the Sustainable Development Goals (SDGs), learning is a fundamental facet (Hlalele, 2014). SDG Goal 4 - 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (UNDP, 2015) offers a premise that most communities in developing regions need adaptive learning strategies to strengthen their resilient capabilities and enhance livelihoods. This calls for the need for present and future development initiatives to embrace learning while acknowledging lifelong learning practices. This realization presupposes knowledge transfer by integrating science and local knowledge (Gwali, 2014) to address the challenges of limited access to actionable information for many communities in developing regions.

Education largely shapes culture, so does technology. Therefore, to explore this nexus, there is a need to recognize the relevance of mobile technologies in supporting learning, even among communities outside formal educational institutions (Mohammed & Josep, 2014; Naismith, Lonsdale, Vavoula, & Sharples, 2004). A large proportion of people in many developing regions are outside the formalized systems in terms of education, banking, trading, microfinance, agriculture - thus the term ‘informal’. Most of these communities comprise smallholder farmers who constitute a sizable proportion in many developing regions. Characterization of their existence is ‘often’ synonymous with either small scale, informal, non-formal, poor, uneducated, illiterate, rural, or unprivileged, in many social and economic development discussions (Musungwini, 2018). This ‘informal/non-formal’ categorization has negative connotations as it is often linked to a lack of formality and quality (Thompson, 2001). Yet education, particularly in non-formal contexts, has shown beneficial effects on the improved well-being of livelihoods of many people in developing regions (Stevance, 2015).

Whereas technologies can support various types of learning, the nuanced understanding of their role in resource-constrained settings - characteristic of limited funding and illiteracy is worth exploration. Similarly, in their study about how mobile technologies impact economic development in sub-Saharan Africa, Crossan and others found that most mobile technology-related projects were mainly urban-based (Crossan, McKelvey, & Curran, 2018). This may broaden the already existing digital divide, yet ICTs like mobile technologies are among the means to bridge this rural-urban digital divide (Heeks, 2015). The current spread of mobile technologies facilitates global interconnectedness, accelerates human progress with the potential to bridge the digital divide, and develops knowledge societies (Stevance, 2015; World Bank, 2016). Smallholder farmers in developing regions lack access to relevant information and learning opportunities to address their livelihood challenges (CoL, 2013; Gwali, 2014), which mobile technologies can address. “The most widely spread Information and Communication Technology (ICT) across the world today, including developing regions, is a mobile phone” (Furuholt & Matotay, 2011, p. 1). Mobile phones are easily accessible and can support African communities to access actionable information to support adaptation strategies. The potential of modern technologies to avail information access to such communities to act for secure livelihoods is an option worth exploring.

Evidently, “we live today in a hugely ‘mobilized’ world as estimates put mobile subscriptions at more than 6 billion globally by 2020, with at least 75% of these being in developing countries” (Mohamed & Avgoustos, 2014; Mohammed & Josep, 2014). In 2017, five billion people were connected to mobile services, where the growth in the sector was driven by developing countries in sub-Saharan Africa (GSMA, 2018). “By the end of 2018, there were 456 million unique mobile subscribers in Sub-Saharan Africa - an increase of 20 million over the previous year” (GSMA 2019). The growing trend in mobile subscriptions in sub-Saharan Africa offers opportunities for mobile usage in the region. For instance, as depicted in Figure 1, “there will be more than 600 million new subscribers by 2025; nearly two-thirds will be from Asia Pacific and Sub-Saharan Africa” (GSMA, 2020, p.12). The emergence of the connected mobile society with numerous information sources available at work, home, community, and schools has arisen considerable interests among educators and technology providers to exploit the capabilities that these mobile technologies offer for the new and engaging learning environments (Naismith, Lonsdale, Vavoula, Sharples, & Series, 2004; McKelvey, Crossan, & Curran, 2020).

**Figure 1: Mobile Subscription in Sub-Saharan Africa**




Source: GSMA 2020

The emerging field of mobile learning (mLearning), given the rapid growth of mobile technologies, has immense potential to revolutionize education in the classroom, in the workplace, community, and many informal learning environments. This development has made education accessible and affordable for many (Mohamed & Avgoustos, 2014; Bernacki, Greene, & Crompton, 2020), including smallholder farmers. Several innovations are being devised to take advantage of the affordances of the current and future mobile technologies, and the education sector is witness to this development given the numerous research and current developments in the field of mobile learning. Smallholder farmers in many developing regions like Uganda lack access to updated information and knowledge about modern farming methods despite being part of this global mobile community. Access and possession of technological tools is a key dimension in everyday life, including learning. Smallholder communities have access to mobile phones that can facilitate learning about different livelihood activities.

Mobile Learning (mLearning) has the potential to strengthen people's resilient capabilities and enhance livelihood support systems in the developing region. mLearning allows learning to take place in the learners' usual environment, fosters people engagement, promotes learner centeredness, knowledge centeredness, and community centeredness (Sharples, Taylor, & Vavoula, 2005). The personalized, contextualized, and situated characteristics of mobile learning (Traxler, 2007) makes it fit to support learning in non-formal contexts. Mobile learning for livelihoods mirrors non-formal learning qualities since it supports participatory learning processes where learners learn over time, their experiences integrated, with higher levels of flexibility in learning. This study therefore seeks, as its main objective, to understand how mobile technologies can facilitate learning with the aim to precipitate knowledge access and information sharing for livelihood support.

## 1.3 Problem Statement

Mobile technologies avail a chance for African communities to improve their economic activities and social well-being (Aker & Mbiti, 2010b; Alzouma, 2005). To date, the body of knowledge on the use of mobile technologies for development is growing (Aker & Mbiti, 2010a; Alzouma, 2005; Crossan et al., 2018; Furuholt & Matotay, 2011; Porter et al., 2012), but there exists less literature on how to integrate mobile technologies in learning to support livelihoods. The current mobile technology embracement offers possibilities for access to learning opportunities, as many people have access to mobile technologies that can facilitate knowledge sharing.  On the other hand, despite these mobile technological discourses (Baumüller, 2013; Manske, 2014; Traxler, 2018), smallholder communities in developing regions still grapple with many development challenges like, for instance, climate change, poverty, illiteracy, high mortality rates, high disease burden, and food security. While it is true that mobile technologies have supported smallholder farmers to get access to actionable information, very many still lack access to updated agricultural knowledge (Duncombe, 2012; Musungwini, 2018). This derails food security systems yet, most communities in developing regions are agrarian based.

The current integration of mobile technologies for development projects in developing regions increasingly focuses on information dissemination, with less emphasis on how such technologies can offer learning spaces to propel development. Similarly, most literature and research on the applicability of mLearning mostly concentrate on formal and informal learning classroom-related activities (Clough, Jones, McAndrew, & Scanlon, 2008; Coffield, Economic, & Council, 2000; Elsafi, 2018; Khaddage, Müller, & Flintoff, 2016; Pimmer et al., 2014; Stockwell, 2013). Dedicated studies in pedagogical integration of mobile technologies in teaching and learning mainly focus on formal education systems, thus neglecting the substantial majority in society (like smallholder farmers) (Zelezny-Green, 2014). Equally, the paucity of qualitative empirical studies that analyze the role of mobile technologies' support for livelihoods makes this study upfront. The challenges of the time, like changing trends in technologies and the need to learn new adaptive strategies, often limit our capacity to use technology as a platform to help less privileged communities get access to actionable digitalized content. Therefore, on the premise that systematic integration of mobile technologies facilitates knowledge access and sharing, the principal motivation of this study is to unveil opportunities about the role of mobile technologies in enhancing learning for livelihood support in a developing country's context, with specific reference to Uganda.

## 1.4 Overall Objective of the Study

The main objective of this study is to contribute to an understanding of the role of mobile technologies in enhancing learning for livelihood support in rural communities.

As reflected in the title of this thesis - *'Learning with Mobiles.* A Developing Country Perspective on Mobile Technologies use in Learning for Livelihood Support, the aim of this study was, on the one hand, to understand the role of mobile technologies in supporting livelihoods, and on the other hand, to contribute towards a conceptualization of mobile learning for livelihood support. The study suggests key considerations for enabling the use of mobile technologies in extending non-formal learning opportunities among smallholder farmers (see Chapter 7). Five research questions were formulated to answer the main objective. To answer the research questions, an interpretivist epistemological approach to understand mobile technologies' use and the possibilities of mobile learning for livelihoods in rural communities was adopted, employing a multiple case study design approach. This general understanding was premised on the fact that social realities, including technological realities, are socially constructed; thus, the study adopted a social constructivist ontological approach to understand peoples' daily construction of meaning.

### 1.4.1 Research Questions

The research questions that are chronologically stated include;

1. What are the perceptions among smallholder farmers on the use of mobile technologies for livelihood enhancement?
2. What are the smallholder farmers' experiences regarding the adoption and use of mobile technologies for learning purposes?
3. What are the possibilities and constraints of applying mobile technologies for learning in livelihood projects?
4. What mLearning capabilities can support food security systems among smallholder farmers in rural communities?
5. What mLearning conceptualization can support smallholder farmers livelihoods?

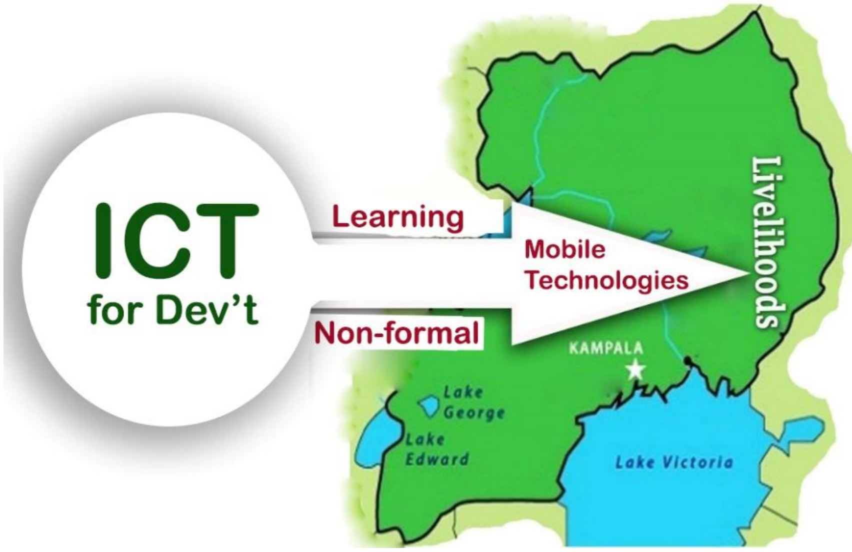
The first research question (RQ) explores the general perceptions of and use of mobile technologies in everyday life. The experiences and narratives from this question gathered pointers on how mobile technologies supported rural livelihoods. Subsequent data showed that the most available technologies were mobile phones and a few laptops. The social implications for mobile use in everyday life were identified. Although mobile use for learning emerged as a positive benefit, the second question sought to critically explore peoples' experiences in the adoption and use of mobile technologies for learning. The aim was to analyze farmers' mobile use experiences in ongoing mobiles for development initiatives available in rural communities. The third question explored the practicability of applying mobile technologies for learning in livelihood projects. The possibilities and constraints of applying mobile technologies for learning was to give a picture of how mobiles thrived in rural communities. This was possible after situating the multiple case studies that used mobile technologies to support smallholder activities. The resulting data informed the analysis of mobile learning, its possibilities, and applicability to learning in non-formal contexts.

Narratives from the first, second, and third research questions gave context to the fourth question that explored the actual impact of mobile learning on livelihoods. In situating this impact, particular focus was accorded to knowledge access and sharing for food security as a key issue challenging most developing countries. Besides, most development projects prioritize food security support systems in most operations. This question advances the link between learning, participation, and change. Many studies on mobile learning are often, however, loosely limited to observing learning interactions. As mentioned earlier, there is less focus on participation and learning for change practice in many mobiles for development projects. Connecting learning to actual impact (food security) was one way to understand livelihoods in this study. For research to be meaningful and yield lasting benefits to those being studied, a significant contribution as the main output is ethically upright. The fifth question extends the practical contribution of this thesis. The question offers a conceptualization of mobile learning that allows for the integration of mobile technologies in non-formal learning.

## 1.5 Study Contextualization

The main thesis contextualization (in Figure 2) is that mobile technologies facilitate learning for livelihood support. This falls within the broad dimension of Information Communication Technology for Development (ICTD), in the sub-category - Mobile for Development (M4D) (Donner, 2010; Jagun & Heeks, 2007; Svensson & Wamala, 2012; Niang, Scharff, & Wamala, 2014). However, given that M4D is relatively in its infancy (Crompton, 2013; Donner, 2010), the need for highly grounded theoretical anchoring in ICTD studies justifies this choice. The theoretical anchoring used in this thesis is derived from broad ICTD literature. Secondly, to explore access to information access and knowledge sharing about farming, learning, specifically non-formal, is prioritized as one way to support livelihoods with mobile technologies as tools for use.

**Figure 2: Study Contextualization**




Source: Author

The study is primarily anchored on the educational rather than the technological perspective. While technologies entail capabilities that allow mobile learning to exist (Crompton, 2013), this study focuses on how ICTs like mobile technologies can enhance learning. The thesis does not analyze the technological functionalities but explores how technologies facilitate learning for livelihood support in a developing country's context. A developing country perspective implies a less developed, low-income country with visible development challenges like poverty, high population growth rates, human rights challenges, and inadequate social services (Pike, Tomaney, & Rodriguez-Pose, 2016). In this thesis, Uganda is a developing country with prevalent development challenges. Thus, the study analysis and conclusions depict mobile technologies for learning experiences among smallholder farming communities in Uganda.

The contribution of this thesis is two-fold, that is, to theory and practice. In theory, it delivers a comprehensive understanding of how mobile technologies support learning for livelihoods, with substantial evidence on how the use of locally available spaces within communities can extend learning opportunities. It brings to light how rural communities use mobile technologies, with specific insights on the real impacts of mobile phones on everyday life. In practice, the thesis conceptualizes context-specific factors relevant to the practice of mobile learning for livelihood support among smallholder farmer communities.

## 1.6 Situating the PhD study

This PhD study is largely grounded into the bigger project - 'DELP (Distance Education Leapfrogging Project). Leapfrogging 1st generation Distance Education into 5th generation Distance Education'; supported by Norad[1] in collaboration with the University of Agder Norway and Makerere University (Institute of Open Distance and eLearning) Uganda. The main project strategy is to enhance ICT pedagogical integration and increase access to education in Africa. Although the project framing was within higher education (primarily university education), this PhD study took a slightly different approach. The study on mobile technologies and learning among farmer communities was outside the confines of higher education. I interacted with farmer communities to understand how mobile technologies facilitated learning for livelihood support.

Higher education discourse demands that universities have core functions, not only in education and research, but also in their roles to contribute to society (Ssentongo, 2017). Acero insists that "higher education institutions need to have activities to ensure that accumulated knowledge is circulated directly back to society and that they do not become "ivory towers." (2017, p. 225). Makerere University Strategic Plan 2007/08 - 2017/18 proliferates the need to engage in outreach and community development activities to increase community access to knowledge and advice for a better society. In the plan, innovations are not only limited to cutting-edge scientific discoveries but rather include the use of existing knowledge to transform communities (Makerere University, 2007). Studying available community-based initiatives like research on mobiles for development interventions helps to garner new knowledge for communities to attain a better quality of life.

Similarly, in this project, extending the need to explore how mobile technologies can enhance learning for livelihood support is among avenues where higher education

[1] Norad is the Norwegian Agency for Development Cooperation that funds research in capacity development in higher education through a wider project - NORHED (Norwegian Programme for Capacity Development in Higher Education and Research for Development).

institutions like Makerere University and the University of Agder contribute to society through research. The desire to study how mobile technologies can leapfrog learning among smallholder farmers in rural communities makes this study fall within the main DELP project framework. Moreover, this study is premised on the realization that '…Information revolution offers Africa a dramatic opportunity to leapfrog into the future' (Herselman & Britton, 2002, p. 274). Makerere university where this project is housed has a mandate to engage in studies that benefit society and impact change so, is this PhD study.

Whereas the initial DELP project design aimed to initiate, improve, and develop technological solutions to increase access to learning, this PhD focus took another perspective. Understanding the interactions between people and technologies and how mobile technologies enhance learning for livelihood support is the aim of this PhD. The key thrust of this PhD discussion is to analyze how mobile technologies can be used to leapfrog information access and sharing to the next level access. This PhD's fit in the bigger DELP project is partly demonstrated by how it engages with questions like: Can mobile technologies support leapfrogs in learning? What learning activities are leapfrogged? How did the leapfrogged activities impact on peoples' livelihoods? These are adequately answered in the general thesis comprehensive story.

## 1.7 Thesis Outline

In eight chapters, this thesis presents contributions from five research publications, each contributing to the overall PhD study. These publications entail the overarching discussions of the thesis as a whole and will be referred to in supporting main thesis arguments.

**Chapter One** outlines the background information to the study, thereby setting the context for the discourses about mobile technologies in international and local debates relevant to the study. It presents the statement to the problem, aims, and the key research questions in the thesis. It further situates this PhD study in the broader DELP ICT project framework as rationale for setting the mobile technologies for learning context.

**Chapter Two** presents reflections on the background information and related literature that posit this study. Literature review about mobile technologies, with specific reference to mobile phones and development, and an exploration of what livelihoods constitute is then reviewed. Further, the chapter defines mobile learning and situates learning within non-formal contexts to offer an understanding of the core relational factors within the general mobile learning discussions.

**Chapter Three** entails the theoretical foundations of this study. Given the multidisciplinary nature of this study, four theories provided theoretical guidance, each complementing the other in a more synergetic approach. Background information about the Actor-Network Theory (ANT) and its main concepts in line with the study are explored. The Unified Theory of Acceptance and Use of Technology (UTAUT) was used to understand the adoption and use experiences of mobile technologies. The Community of Practice (CoP) analyzed the nature of learning within the farmers mLearning practice, but more importantly, in a livelihood context. Lastly, Social Constructivism (SC) was used to analyze how knowledge was socially constructed and assessed in non-formal learning activities among farmers. A theoretical blend of the four theories in a more synergistic manner summarizes this section.

**Chapter Four** discusses the research methodology and methods adopted in this study. It explains the philosophical foundations, that is, social constructivist ontology and interpretivist epistemology. The general research design, data gathering methods, and data analysis procedures are explained. Deeper engagements on both ethical and methodological issues are also highlighted. A reflexive discussion on my positionality in a qualitative study gives analytical attention to how the study findings and discussions revolved.

**Chapter Five** provides a summary of each individual publication that contributes to this thesis as a whole. The main arguments from each paper and the link between papers are highlighted. It ends by explaining how the research publications are representative of the research questions, thereby answering the research questions to this PhD. A representation of this link is demonstrated in Chapter 5 (Table 8).

**Chapter Six** details the main study findings and provides answers to the first, second, third, and fourth research questions. This section resonates with research paper findings and unveils new emerging considerations, with specific reference arguments that did not appear in the paper publications. In line with the study research methodology, qualitative studies are highly iterative with emerging concepts. This section is a testimony to this thinking.

**Chapter Seven** demonstrates knowledge, methodological, theoretical, and practical contributions from this thesis. Just like academia is intended to influence practice, to make research impactful to society, this chapter highlights contributions made to practice with specific reference to the fifth research question.

**Chapter Eight** offers conclusive reflections of this thesis. Specifically, reflections are on general conclusions of the empirical and theoretical implications to the findings, limitations to the study and opportunities for further work. Personal reflections of the general PhD study are outlined with specific insights into how learning on mobile technologies enhanced my knowledge as a researcher.

The research papers that generate the contributions to this thesis are

(1) Nampijja, D., Øyhus, A. O., Webersik, C., & Muyinda, P. B. (2021). Access to Learning through Mobiles: A Socio-Technical Tale of Mobile Learning Actor-Network Among Smallholder Farmers. In *Perspectives on ICT4D and Socio-Economic Growth Opportunities in Developing Countries* (pp. 252-277). IGI Global.

(2) Nampijja, D. (2018). "If you take away my phone, you take away my life..." Community Narratives about the Social Implications of Mobile phone Usage for Livelihood Security. In *Interactive Mobile Communication, Technologies and Learning* (pp. 368-384). Springer, Cham.

(3) Nampijja, D. & Muyinda, P., B., (2016) Adoption and Use of Mobile technologies for Learning among Smallholder Farmer communities in Uganda. Proceedings in *Interactive Mobile Communication, Technologies and Learning (IMCL), 2016 International Conference on* (pp. 83-87). IEEE.

(4) Nampijja, D. (2017). Mobile Technologies as Tools for Learning in Non-formal Contexts. Experiences with Smallholder Farmers in Resource-Limited Settings.

Conference proceedings in *"Smart Universities: Education's Digital Future." (Pages 107-115), λογος*

(5) Nampijja, D. (2017). Mobile learning in Non-formal contexts. Exploring the nexus of practice and use of mobile technologies among smallholder farming communities in Resource limited environments. Proceedings in the *9th International Conference on Education and New Learning Technologies Barcelona, Spain. 3-5 July 2017. ISBN: 978-84-697-3777-4 / ISSN: 2340-1117.doi: 10.21125/edulearn.2017*. IATED.

(6) Nampijja, D., Øyhus, A.O., Webersik, C., Muyinda, P.B. (Under review). 'It is not only about food, but food of nutritious benefit'. Mobile Learning Possibilities for Food Security among Smallholder farmers in Uganda. Paper submitted to Springer Journal - Agricultural and Food Economics.

# 2. Related Research and Study Context

This chapter presents research related to the field of mobile technologies, learning, and livelihoods. It begins by linking this study to Mobile for Development research. The state of the art that discusses the relationship between study key concepts then follows. Literature on mobile learning and the livelihoods and how they relate to non-formal learning among farmer communities is reviewed. In this chapter, while some gaps were identified, it should be emphasized that mobile learning research in the non-formal settings was limited. The focus was to analyze how the available literature can extend the conceptualization of mobiles to support learning among smallholders. The chapter ends by exploring the context of smallholder farmers and agricultural extension within the Ugandan context.

## 2.1 Linking the Study to Mobiles for Development

The contribution of ICTs in developing countries has been noticeable in development research (Heeks, 2008; Thapa & Sæbø, 2014; The World Bank, 2016). There is a remarkable breakthrough regarding the rise and use of mobile communication technologies (Castells, Fernandez-Ardevol, Qiu, & Sey, 2009; Svensson & Wamala, 2012). The outburst in connectivity in many developing parts in 2001-2010 has extended telecommunication services to more than half of the world (Donner, 2009). The telephony era of the 20th century that excluded many communities set the pace for mobiles to extend cheaper solutions to communities in developing regions. Thus, the widespread use of mobiles curtails the exclusion of previous technologies (Ibid). This increasing advancement within mobile communications has given rise to new research fields like Mobile for Development (M4D) (Svensson & Wamala, 2012). M4D falls within the broader ICT for development (ICTD) research, although its birth is from the rise of communication on mobile phones that have opened a range of possibilities to empower and transform people in developing regions. As a new research field, M4D is a child from ICTD, struggling to gain its stature. This justifies why Scholars in M4D research (Aker & Mbiti, 2010a; Aversano, Evers, Latif, & Vaca-Viana, 2013; Donner, 2008, 2009) employ ICTD theories. M4D looks at the capabilities or potentialities of mobile technologies to facilitate the delivery of financial, agricultural, health, and educational services (Aker & Mbiti, 2010b).

The most portable mobile communication device used by the majority in many developing regions is the mobile phone, given its functionalities of more than telephony (Jagun & Heeks, 2007; McKelvey, Crossan, & Curran, 2020). The mobile phone has been considered the fastest communication technology in development communication history (Castells, 2008, 2011; Castells et al., 2009). From a development perspective, technologies offer developing countries a strategy to integrate into the knowledge economy (Kahiigi Kigozi, Ekenberg, Hansson, Danielson, & Tusubira, 2008), with regard to education, health, environment, and empowerment. As clearly stipulated in the 17 goals, the current Sustainable Development Goals (SDGs) embrace the need to integrate media like ICTs to support all development activities. In this case, ICTs like mobile technologies are considered a means to support different proposed interventions to realize sustainable economies. As argued by Wu, Guo, Huang, Liu, and Xiang (2018), there is a need to innovate and energize ICTs to best assist all nations in achieving the SDGs by 2030. Therefore, the study on mobile technologies and learning for livelihood support precipitates this discussion by unveiling how ICTs like mobile technologies can benefit communities where services and facilities are in hard to reach areas (Thapa, 2012).

## 2.2 Mobile Technologies, Learning, and Livelihoods: The State of Art

The integration of technologies in most day to day life activities has influenced how technologies can be beneficial in development practice. Currently, M4D practitioners (Aker & Mbiti, 2010; Donner, 2010; Duncombe, 2011) upraise the use of mobile phones at the cost of other necessary aspects of life like food security, access to clean water, reduction in disease, and good education. Most communities in developing regions have embraced mobile technology usage, and it is from this backdrop that this study analyses the role of mobile technologies in enhancing learning for livelihood support. The rationale is not to down score the need for other development initiatives like food security, good health, and finance, but rather to analyze how technologies like mobile phones can extend, support, and complement service delivery.

Mobile technology integration details capabilities that create situations for access and inclusiveness of the disadvantaged groups in society. Technologies offer possibilities that allow people to participate through low-cost delivery channels, thereby reducing communication and coordination challenges (Best, 2009). In an exclusive public dialogue about the role of ICTs in development, Clotilde Fonseca ponders why there is an increasing focus on mobile technologies in human development, questioning the significant shift towards mobile phone usage (Best, 2009). Human development concerns understanding how communities can move out of poverty using rightful capacities to advocate for change. It focuses on the richness of human lives rather than on the richness of economies (UNDP, 2016). ICTs, like mobile phones, are both resources and tools that support collaboration and communication to achieve human development targets, that is - a sustainable economic people-centered development for all (UNDP, 2016). The visible inclusion of mobiles in most development related activities is the realization that human development cannot only be attained by the past linear view of development where people are given basic needs to attain secure livelihoods (Best, 2009). This implies that, with mobiles in people's hands, bottom-up community engagements to support people-centered development for all can be realized.

The current emphasis on the relevance of the knowledge economy advocates for increasing capacities people need to be part of this knowledge society. Within the knowledge economy lies the power of the mind and the agency people need to act upon their livelihood challenges. As Clotilde emphasizes, the human component of the mind is central to contemporary society (Best, 2009). People need to learn, people need access to new knowledge, and mobile technologies can offer affordable resources to facilitate this transition. Therefore, in so doing, accessing good food sources, improving health wellbeing and ensuring hygiene and sanitation in homes will be attained if development appreciates the necessity of how mobile integration can work within unique settings.

While ICTD studies aim to address the digital divide, sometimes, this digital divide includes a cognitive divide, which relates to capacity and learning people need to thrive (Best, 2009). Understanding how smallholder communities in rural Uganda use mobile technologies to support learning activities is one way to address this cognitive divide. Empowering farmers to access actionable information ultimately contributes to the fulfillment of the knowledge economy. Equally important, discussions in relation to mobiles' support for human development ought to embrace the other affordances integrated within mobile devices. As argued by Svensson and Wamala (2012, p. 4), "the mobile phone is a device that lends itself to so much more than just mobile telephony." The explanation below gives a clear depiction of mobile phones as part of mobile technologies.

### 2.2.1 Mobile Technologies

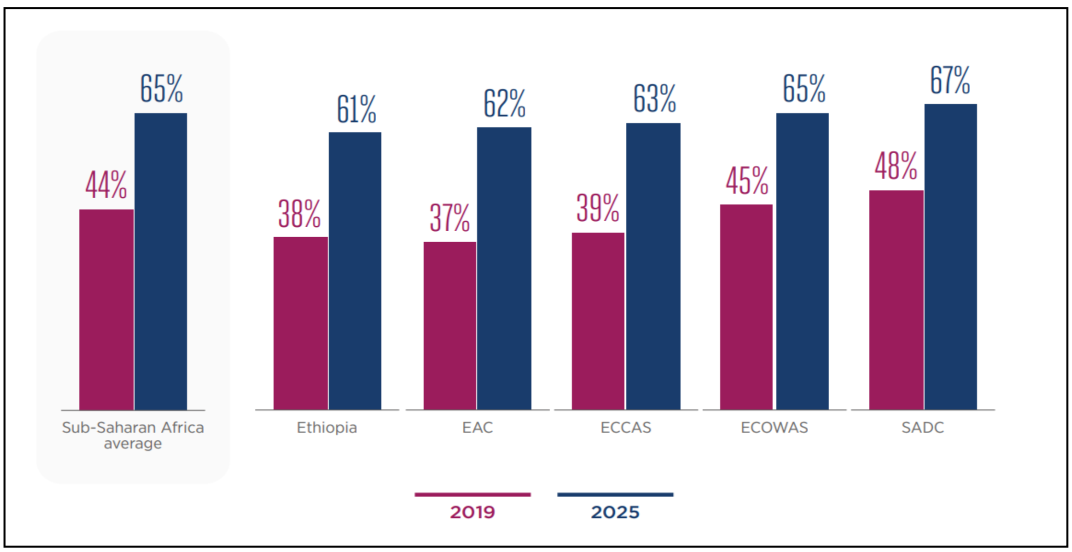
Mobile technologies are part of the blossoming technologies in the world today. The mobile technology sector is among the rapidly growing sectors, merging with other sectors to make full potential from the use of new technologies (Crossan, McKelvey, & Curran, 2018). Educational technologies are available for pedagogical practice, but quite captivating is the increasing adoption of mobile technologies in mainstream education activities. The latest technologies and updated features included in handy mobile devices like mobile phones have extended access to information anywhere and anytime. Mobile technologies have the potential to reach larger audiences and are rendered effective for capacity building to end-users (Oladele, 2011).

Mobile technology access is a prerequisite for the use of the available ICT tools to support livelihoods. Mobile technologies facilitate dialogical communication, which enhances collective knowledge sharing (Tan & Pan, 2003). The current discourse about the increasing mobile technology usage for many developing regions offer avenues to understand the social and economic impacts of mobile technologies. This understanding surpasses 'just providing access' to exploring the actual derived benefits from mobile technology use in development. While this study considered mobile phones as central mobile technologies used by case study organizations, other technologies like laptops supplemented the mobile activities given the visible limitations like low space and limited user interface (Kearney, Schuck, Burden, & Aubusson, 2012).

Mobile phones have been touted as the commonest and widely adopted ICTs in availing pertinent information to many people in most developing regions (Heeks, 2008b; Jagun & Heeks, 2007; Knoche, Rao, & Huang, 2010). The feasible and effective way to deliver information in most rural areas is through mobile phones because they can work even in settings with less/no reliable electric power supply (Knoche et al., 2010). This justification does not rule out the fact that phones require electricity, but compared to other ICTs, mobile phones can work in places with no electrification. With the numerous claims on the increased use of mobile technologies in many developing regions, it should be noted that small end (traditional) phones[2] are the commonest.

Whereas smartphone adoption is increasing, globally, sub-Saharan Africa continues to drag. However, amid the continental challenges, as depicted in Figure 3 below "sub-Saharan Africa will have nearly 700 million smartphone connections by 2025 as low-cost devices and smartphone financing schemes accelerate adoption" (GSMA, 2020, p.16). The need to consider the kinds of mobile phones possessed by the majority is important for this study. Traditional small end phones are the majority given their low cost and cheaper affordances related to phone maintenance. For example, smartphones require regular charging, and given that most rural communities have limited electricity connectivity, solar availability is equally rationed. More so, the presence of many smallholder communities in most developing regions explains this variance, given that the majority are non-literate as most mobile technology functionalities are in English. This limits fuller benefit maximization from smartphones thereby influencing the adoption of cheaper small end phones.

**Figure 3: Smartphone Adoption rates**




Smartphone adoption rates adapted from (GSMA, 2020)

[2] Small end phones are traditional basic level phones mainly used for calling. These have limited or no internet capabilities but can offer other functionalities like calling, messaging (SMS), torch, calculator, basic games, among others.

On the other hand, as depicted in Figure 3, the 65 percent adoption of smartphones in sub-Saharan Africa explains how societies pick up their use, of which youth are the commonest users. For example, in Uganda where over 74 percent of the population are youth (below 35 years), the most visible smartphones are among such categories given their familiarity with smartphone settings and the fact that most youths have access to formal basic education that supports mobile navigation with ease. The next section explores mobile phone penetration in Uganda, a developing country context where this study was conducted.

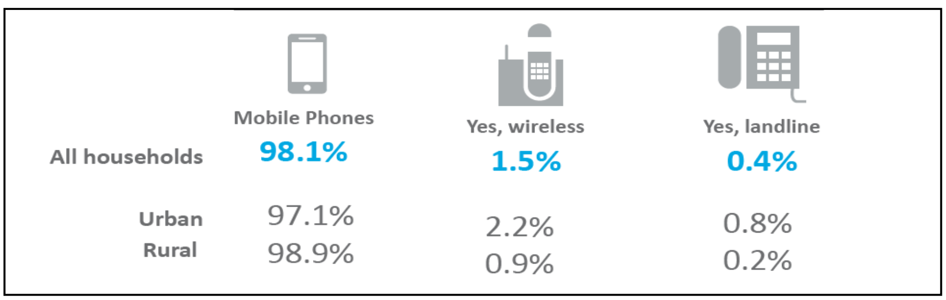
### 2.2.2 Mobile phones Infrastructure in Uganda

Uganda is a landlocked country located in East Africa. It borders Kenya to the east, Tanzania to the south, Rwanda to the southwest, the Democratic Republic of Congo to the west and South Sudan to the north. Just like many developing countries, Uganda has gone through a series of Information Technology (IT) transformations to reach the current digitization stature (UCC 2018). Before the 1996 reform period, Uganda Posts and Telecommunications Corporation (UPTC) was responsible for all telecommunication services (Minges, Brown, Kelly, & Gray, 2001). The ICT policy reform of 1996 led to the liberalization of the telecommunication sector, thereby allowing more telecommunication players in the communications industry (Ssewanyana, 2007).

Uganda has experienced a substantial increase in the subscriber base for both fixed and mobile subscriptions. In 2017, the subscription in the country had increased with registered 24.8 million mobile users (NITA, 2018). By March 2020, mobile subscription stood at 28.4 million (Katungulu, 2020). In a country where over 60% of the total population (44 million) is below 35 years, the mobile phone ownership population is estimated at 32 million Ugandans, putting the mobile subscription rate at 70.9%. The increase in the mobile subscription is attributed to growth in telecommunication networks and the good investment climate in the telecommunication industry. Nonetheless, amidst such increased penetration, there is a location bias with more urban people owning mobile phones than people living in rural areas (as depicted in Figure 4). A gender bias with more males owning mobile phones than females was also noticeable, with 81.6% and 63.2%, respectively (NITA, 2018, p. 130). In a national household survey, 98.1% households used mobile phones as household phones (NITA, 2018, p. 119).

Most people possessed small end phones, with only 15.8% of individuals owning smartphones. Interestingly, "a higher proportion of females owned smartphones (18.1%) compared to males (13.4%)" (NITA, 2018, p. 132). This observation relates to how a mobile phone is considered a basic necessity a man has to provide to his spouse. Also, the youths owned a higher proportion of smartphones compared to older adults. To sustain mobile phone usage in rural areas, most people charged their phones at a shop (42.7%), given low rural electrification in many parts of the country (NITA, 2018).

**Figure 4: Proportion of households with different types of household phones by location**




Source: NITA 2018

To regulate ICT integration, Uganda has enacted legal frameworks to regulate the ICT access and usage in the country. For instance, National Information Technology Authority – Uganda (NITA-U) Act 2009; Uganda Communications Act 2013; Electronic Signatures Act 2011; Electronic Transactions Act 2011; Computer Misuse Act 2011; and Access to Information Act 2005. These Acts seek to prevent unlawful access and misuse of information systems, regulate for use, security, facilitation, and improve the capacity to conduct electronic business by ensuring that there is functional equivalence in relation to legality of online transactions. In 2017, the Ministry of ICT and National Guidance embarked on the Digital Vision Uganda initiative that 'aims to leverage technological innovations to meet various national and international goals including universal inclusion, sustainable development, economic progress, and poverty eradication' (NITA, 2018, p. 35). This digitalization initiative responds to the current global digital trends which in developing countries aim at technology-based empowerment through fostering relevant ICT use.

In 2018, when the government tried to regulate the mobile phones subscriptions through national campaigns of mandatory individual registrations, there has been a noticeable decline in mobile subscriptions (UCC 2018). Most mobile numbers were cut off from the network either because owners failed to register or due to incomplete registration process. More so, the presence of many non-literate Ugandans derailed this registration process as many people could not easily understand the English translation processes. This policy, however, was essential given the multiple cyber cases like murders, robberies and theft associated with mobile phone usage in the country.

Nonetheless, there is increasing integration of mobile phones in most social, economic, and political sectors in Uganda. This integration is linked to Uganda's internet connectivity landscape that has been steadily growing (Namatovu, 2012). In the 2018 mobile week conference in Kampala, Uganda had 44% Internet Penetration Rate above the Africa average (Sebunya, 2018). By March 2020, 24.4 million Ugandans were active internet users (Katungulu, 2020). The increase in use is exponentially connected to the increased penetration of cheap smartphones. This percentage takes care of the smallholder farmers who make use of smartphones to access agriculture-related services. Whether smartphones or small end phones, it is essential to analyze their derived benefits to smallholder communities.

### 2.2.3 Mobile Phone Usage

The significant rollout of mobile phones in sub-Saharan Africa (Aker & Mbiti, 2010; McKelvey etal., 2020) has unlocked other opportunities for newer innovations to take off (Nampijja, 2020). The multi-functionality of mobile phones supported by inbuilt mobile systems has been advantageous to many communities. In sub-Saharan Africa, mobile phones have extended and supported service delivery. The mobile phone acts like a radio, a source of light, a communication tool in terms of contacting one another, and a mobile bank. Smartphones can support access to newspapers online, television signals, and access to other social media platforms like Facebook, WhatsApp, and Twitter. Further mobile phones use are sectionalized below.

*Mobile phones and Agricultural productivity (m-Agric)*

A significant contribution regarding the role of mobiles in developing regions is in the area of agricultural productivity (m-Agric) (Evans 2018). There is a significant correlation between the role of information and communication technologies (like mobile phones) on increased access to markets, weather information, and easiness in contacting extension officers (Donner, 2009; Knoche et al., 2010; Martin & Abbott, 2011). Most telecommunications firms in African markets are undergoing rapid transformations given connection to the international fiber optics (Kahiigi Kigozi et al., 2008). This development has supported many telecommunication companies to access relatively cheaper and fast internet connectivity. This change in the state of connectivity has prompted device makers to avail cheap smartphones and tablets that can support agrarian economies in the region. For instance, in reducing shocks, mobile phones have supported many communities in Africa engaged in both agricultural and non-agricultural related activities. At the helm of many covariate shocks like disasters, conflicts, and epidemics (Aker & Mbiti, 2010; Duncombe, 2016), sub - Saharan Africa has benefited from the agility of the mobile phones in supporting quick access to information flow that help people to act in such situations. Such quick access has been facilitated by the ingrained social networks within the kinship of most African communities that allow for device sharing.

*Mobile phones, Labour market, and Business*

The labour markets have also equally benefited from the potency of mobile phones. A study by Aker and Mbiti (2010) reports on how mobile phones have reduced search costs for the required labour and have also equally supported the establishment of many employment opportunities. Both rural and urban labour markets have benefited from mobile phones' use regarding the generation of additional employment (Duncombe 2014). Agencies are employing social media platforms like Facebook and WhatsApp to share their labour market requirements that support quick information sharing. In business, "the mobile phone sector has spawned a variety of business and entrepreneurship opportunities in the informal sector" (Aker & Mbiti, 2010, p. 219). Informal businesses like shops selling mobile phones, phone chargers, and other mobile-related accessories have availed employment opportunities. The youths, for example, have received skill course trainings related to mobile phone repair. Such additional employment has risen from the establishment of the mobile phone industry.

*Mobile phones and financial services (m-Money)*

Within the whims of 'banking the unbanked,' mobile phone's significant contribution is felt. The development of mobile financial applications like 'm[3]-money (Uganda), m-banking, and m-Pesa (Kenya) since 2005 has seen similar applications being developed in other developing countries. "m-money systems allow users to store values in an account accessible by the handset, convert cash in and out the stored value account, and transfer value between users by using a set of text messages, menu commands, and Personal Identification Numbers (PINs)" (Aker & Mbiti, 2010, p. 221). There is a technological shift where most mobile financial applications have seen their origin from Africa (World Bank, 2016). To date, the application is widespread, and all sects of the economy have integrated mobile money transactions in their daily operations (Mirbargkar, Ebrahimi, & Soleimani, 2020). A cut-edging field is international mobile money transfers like money gram, western union, and world remit that have hastened mobile financial transactions. This has facilitated income flow from developed to developing states, which supports and sustains communities of the recipient countries.

*Mobile phones and Health (mHealth)*

Another mobile phone break through is health (mHealth). In countries like Kenya, Malawi, Uganda, Zambia, and South Africa, mobile phones have supported health-related interventions in HIV/AIDs campaigns, family planning, malnutrition, sanitation, and hygiene (Sondaal et al., 2016). In extending the reach of medical workers and medical services, mobiles have been instrumental in reducing the limited health personnel gap (Namatovu & Kanjo, 2019). Health ministries and development agencies have pioneered and supported the development of mobile health applications where the local communities are trained to monitor and supervise different health issues in their respective areas. With the use of smartphones, Village Health Trainers (VHTs) can monitor malnutrition cases in children, report child births and deaths, and maternal mortalities, and any other pandemic. The current exploitation of social media cites by health departments has quickened information transfer in case of disease outbreaks.

[3] ‘m’ means mobile. In this context, all financial applications that use mobile phones.

This mobile phone integration in service delivery has been possible because the telecommunication market in many developing countries is no longer a monopoly (Kasekende, 2016). The availability of many telecommunication service providers has facilitated competition, allowed for price negotiations, which in turn has resulted in the availability of cheaper solutions in developing regions. With such a generalized perspective on mobile phone use, the next section points to mobile technologies key role in facilitating learning in non-formal settings.

## 2.3 Mobile Learning

Mobile learning (mLearning), although a relatively new field of learning, has varying definitions and qualities to be analyzed. Constructs like pedagogy, technological devices, context, social interactions, and learner mobility define mobile learning (Traxler, 2018). Mobile learning is "learning across multiple contexts through social and context interaction using personal electronic devices (Crompton, 2013, p. 3). To Sharples et al. (2005), mobile learning is learning that is personalized, informal, contextual, with the aid of mobile devices that allow for spontaneity of the learning process. Other mLearning practitioners have defined mLearning towards a more learner perspective. For example, O'Malley et al. (2005) define mLearning as "any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies" (p. 7).

This view puts the learners at the centre of the learning process, and just as Laouris and Eteokleous (2005) suggest, there is a need to shift focus from the technology perspective to the human perspective to position the learner at the centre of learning. The technology perspective of defining mobile learning emphasizes the use of mobile devices for learning with a focus on mobile design solutions to suit learning goals. Whatever the approach, it is clear that mobile technologies like "mobile phones can be applied as pedagogical instruments given their flexibility and portability" (Fuegen, 2012, p. 49). They can be both pervasive and penetrative, thereby extending the reach of access to many communities, including smallholder farmers. This implies that mLearning is not only restricted to learners' mobility but also incorporates active involvement of learners in different contexts and their frequency of change depending on individual location (Brown, 2010).

There is an emphasis on the mobile technology revolution than the mobile device to cater for the synergistic functioning that makes a device work as a technology (Bernacki, Greene, & Crompton, 2020). While the prime purpose of most mobile devices was intended for cellular communications and two-way transactions, mobile technologies have not only facilitated human life communication capabilities but teaching and learning possibilities have become self-evident and unavoidable (Macharia, 2013). Mobile learning entails learning resources, functionalities, contents, and pedagogical aspects adapted to benefit from mobile technologies (Kurkela, 2008).

Currently, several mobile devices have been widely adopted in the scope of education, given the support they offer Ubiquitous Learning[4] (Wu et al., 2018). This ongoing integration has also impacted on how mobile learning is defined. For instance, Attewell, Savill-Smith, and Douch (2009) defines mLearning as the exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance, and extend the reach of teaching and learning. While mobile technologies allow mobile learning to exist, "mobile learning is not in the learning or the technology, but its a marriage between the two entities" (Crompton, 2013, p. 10)." Appreciating both learning and technology capabilities is essential to situate mobile learning in a given context.

Mobile technological trends have supported educators and trainers to access learning resources anytime and anywhere (Mohamed, 2009b). This anytime and anywhere access has supported people in far to reach areas to access learning materials. For example, mobile technologies have been considered to provide learning in remote locations where access to infrastructures is a challenge (Ibid). The increased access to educational resources in such contexts also informs mobile learning. "Rather than acquiring another technology to receive learning materials, people throughout the world will want to access learning materials on their existing mobile devices" (Mohamed 2009b, p. 2). According to such a view, technology is an actor tool that facilitates access to information.

[4] Ubiquitous learning is the use of ubiquitous computer devices to learn anywhere and at any time" (Hwang & Tsai, 2011).

Other contenders, however, underscore reliance on technologies/devices alone in defining mobile learning. Hosman (2010) claims that "technology may make the peripheral process and capabilities associated with learning far efficient, but the learning process is not more sped up through technology" (p. 15). The whole point here is to show how mobile technology alone cannot influence and determine what and how much learning happens on mobile devices but instead affords it. Therefore, in a much broader understanding, mobile learning does not only focus on delivering and transmitting content on mobile devices but, an appreciation of the new and ever-changing learning spaces is vital in understanding mobile learning comprehensively. The increase of mobile phones for information access in M4D research underscores the role of mobiles as a means to facilitate learner-centered practices.

The overarching consensus from all these definitions is an appreciation of the learner, technology, and the learning activity. For instance, Sharples points to the general understanding of mobile learning as "mediating tools in learning processes where designing of a mobile learning activity will imply respecting the learners and their personal relationships, emphasize what the learner is learning, and where and when is the learner learning from" (Sharples, 2006, p. 6). This is, precisely, the learner centredness where technology does not merely drive the learning, but rather, the learner defines what and when to learn. Correspondingly, such a view resonates with learning in non-formal settings where learners determine what to learn.

This realization takes into consideration the need to analyze what type of learning can happen on mobile technologies. Often, learning on mobile technologies is usually blended with other types of learning. There is a need to recognize mobile learning frameworks with blended approaches that do not only focus on people or technology in isolation but rather "focus on the activities and the dialectic relationship between the learner and the technology" (Sharples, 2006, p. 2). This means learning on mobile devices presupposes learning that is mediated and supported by several factors. For instance, "context, curricula, cultures, ethics, tools, learning activity, access to information and people, communication, community building, and appropriation" (Sharples, 2006, p. 7) are essential considerations in mobile learning. Such factors give more attention to social learning activities where technology is given a secondary role. The potency is to integrate mobile technologies into people's activities to achieve immediate learning benefits.

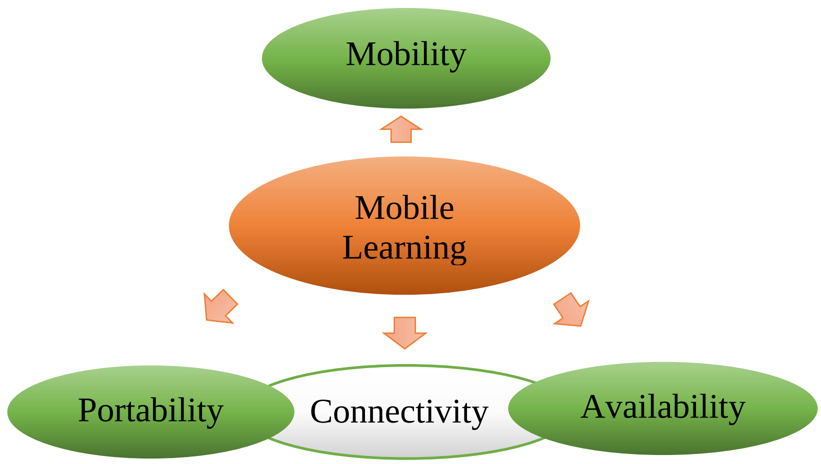
Emerging trends in educational technologies emphasize how technologies can facilitate and enhance increasing collaborations amongst educators and learners. Attention is placed on what and how much learners can engage with these technologies. With less usability in terms of engagements, there are higher chances that the technology will just entrench the instructivist traditional approaches where the teacher is in full control of the learning process. Therefore, appreciating the role of mLearning in collaborative learning environments will generate far-reaching outcomes. This necessitates matching technology with the learning domain that defines a relevant problem and respects the learner's social context (Sharples, 2006).

### 2.3.1 Mobile learning categorizations

Mobile devices account for the biggest proportion of technologies used in teaching and learning processes, given their affordability to varying learning spaces (Crompton, 2013). In developing regions like Africa, mobile technologies are taking the lead to support higher education activities (Kaliisa, Palmer, & Miller, 2019). In categorizing mobile technologies in education, Isabwe points out mobility, portability, and availability as central features that support learning anytime and anywhere (Isabwe, 2014). To explain the *mobility* notion, in mLearning, learners can engage in learning activities regardless of time and space. In mLearning, learning has no boundaries of physical locations and goes beyond traditional learning locations. Like Isabwe notes, "a mobile learning scenario involves delivering learning content and support to the learner when s/he is not necessarily at a fixed, pre-defined physical location" (2014).

*Connectivity* entails the presence of several networking technologies ranging from cellular networking, wireless local area networking to personal area networking technologies. Network connectivity makes it possible for users to socialize through touch and voice-based interactions (Isabwe, 2014). *Portability* has made it easy to carry and transfer content from one place to another. For instance, the increasing processing power of mobile devices has made them popular tools to handle high-quality pictures, videos, texts, and other forms of digital media (Isabwe, 2014).

**Figure 5: Mobile Learning Features**




Adapted from Isabwe 2014

While Isabwe considered availability in terms of connectivity, in Figure 5, I add *connectivity* as another aspect different from availability. Moreover, many scholars explain availability relatedness to being connected to different networks. However, in the livelihood context, availability can go beyond connectivity. For instance, a mobile phone can be available, but not connected on any network, the case with many smallholder farmers' mobile phones. *Availability* implies increase accessibility of mobile devices. Unlike before, where electronic learning could take place entirely on desktop computers and laptops, the availability of several mobile devices among the populace has facilitated mobile learning processes. Hence, in this study, availability was sought to be a central component in supporting learning on mobile technologies. This availability looks at mobile device possession and ownership that make pedagogical integration possible. This has been reinforced by the presence of cheap and affordable mobile devices on the market.

Therefore, mobility, portability, connectivity, and availability of mobile devices justify why educational institutions are increasingly adopting mLearning (Isabwe, 2014; Isabwe, Reichert, Carlsen, & Lian, 2014; Macharia, 2013). To recognize the value of learning on mobile technologies, this study qualifies non-formal learning to fit mLearning in the farmers' context.

## 2.4 Non-Formal Learning

Learning in the knowledge economy is one way to sustainably live in a changing society. The use of mobile technologies as learning tools to extend knowledge and skills is one way to fit within the knowledge society. As mentioned earlier, there is a gap in literature where most mobile learning classifications have been integrated into formal and informal learning environments. Yet, in the livelihood context, learning is situated in the practice of adult education where learning, participation, and change (Jarvis & Orr, 2016) is ingrained in non-formal settings (Jobe, 2014). This means that learning should not be a series of events but a continuous process available to anyone, anywhere and at any time (Rosenberg 2001).

Distinguishing non-formal and informal learning from formal learning is not straightforward. Over the years, scholars have tried to restrict the existing distinctions, but this has not happened with ease, given some resemblance in the different learning typologies. Colley, Hodkinson, and Malcolm (2002) explain different learning environments like formal, non-formal, and informal learning where learning is categorized as structured, semi-structured, and unstructured, respectively. Nevertheless, categorizing learning with such polarization suffocates the learning capabilities that can be embraced in different typologies. Malcom et al. (2003) suggests dimensions of formal, informal, and non-formal learning based on process, location and setting, purpose and content. In *process*, non-formal learning is for everyday activities, democratic oriented, and learner led. In l*ocation* and *setting*, non-formal learning can be local, community-based, open-ended with few predetermined learning objectives. In *purpose*, learning is needs-oriented, and learner determined while in *content*, learning is embedded in everyday practice with less expert facilitation. These classifications match mobile learning amongst smallholder farmers where learning is ingrained in non-formal settings.

Ngaka, Openjuru, and Mazur (2012) consider non-formal learning as learning activities organized outside the framework of formal education for a particular target group in a given region. Non-formal learning can also include intentional educational activities with curriculum and facilitators (Merriam, Caffarella, & Baumgartner, 2007; Blaak, Openjuru, & Zeelen, 2013). The relevance of tracing opportunities of non-formal learning is to help reach out to people who never had a chance to attend formal education attain better and improved quality life through organized learning (Blaak et al., 2013). Non-formal learning also includes learning opportunities organized by community-based programmes, cooperative extension, churches and hospitals, for as long as participants get an opportunity to learn (Merriam et al., 2007). Such learning considers those who have failed to benefit from mainstream education provisions given challenges such as poverty, lack of access to good schools, and other socioeconomic factors.

Opportunities for non-formal learning in developing regions aim at offering learning as a compliment, alternative, and a supplement to formal learning (Brennan, 1997, p. 187). Non-formal education as a *Compliment* for formal schooling targets people who dropped out and missed formal schooling opportunities without gaining some basic survival skills. A case in point are the adult literacy programmes that give a chance to many adults to attain literacy skills. As a S*upplement*, non-formal learning responds to social and economic national imperatives where seem to be urgency for community wellbeing. Health education and extension education are examples within this categorization, often supported by international organizations in the guise of helping communities to gain meaningful humanity through knowledge and skills enhancement. Non-formal education as an *Alternative* supports traditional indigenous knowledge practices that are never integrated into formal schooling. This indigenous learning cuts across all community activities ranging from culture, religion, and farming. While Brennan in this classification considered non-formal education, for purposes of this study, we consider learning since education and learning are synonymous and used interchangeably. Given the setting where learning was envisaged among smallholder rural communities, using learning makes the knowledge acquisition process closer to the participants.

Furthermore, analyzing non-formal learning as a supplement, compliment, and an alternative does not imply that these categorizations are designed and implemented as stand alone. Very often, community development programmes ensure a blended approach for better learning outcomes. Mobile learning for farmers in this thesis is an example of non-formal learning as a supplement and an alternative. Indigenous learning is partly passed on to farmer communities with mobile technologies (both laptops and mobile phones). The case study organizations used in this thesis are associated with international development programmes designed to improve the living conditions of people in developing countries. These are expressly concerned with social inequalities and often seek to raise awareness and consciousness of participants towards empowerment and social action (Merriam, Caffarella, & Baumgartner, 2007). Such learning programmes are also classified as community-based learning whose mandate is for social action and betterment. To expound on mobile technological affordances for non-formal learning, the next section advances this discussion.

### 2.4.1 Mobile learning in non-formal settings.

> "…It is necessary that our understanding encompasses all forms of unique characteristics, and that we recognize that any form of learning that takes place using a mobile device is mLearning, whether in informal or non-formal settings, whether working collaboratively or alone…" (Parsons, 2014).

Research in the field of mobile learning is increasing. However, in developing countries like Uganda, there is limited research on mobile learning in non - formal settings. Mobile learning studies have concentrated on formal education systems with specific reference to higher education (Zelezyn-Green, 2014). Even with available mobile learning research in informal settings (Clough et al., 2008), the pedagogies and frameworks developed focuses on mobile learning applications in colleges and at university levels. Learning environments in non-formal contexts are challenged with less pedagogical applications that are suitable in resource-limited settings. Yet, such learning environments are characteristic of learners with high motivations for learning and with much control of their learning goals. By suggesting a mobile learning conceptualization, the study intends to help farmers and other organized groups appreciate mobile technologies' use to enhance learning for livelihood support. Most importantly, non-formal learning is vested in appreciation of adult learning principles, whose centrality lies in cultivating the adult learner experiences (Blaak, Openjuru, & Zeelen, 2013). Therefore, exploring adult learning principles was also significant in understanding non-formal learning activities.

### 2.4.2 Andragogy

Andragogy relates to understanding teaching and workplace learning environments that involve adult participants as learners. Andragogy refers to the art and science of adult learning (Knowles, 1973). Understanding andragogy is significant because in this study, mobile learning was situated within smallholder farming communities where the majority who accessed and shared content on mobile technologies were adult participants. Andragogy is based on the process model compared to a content model in traditional pedagogy (Knowles, Holton, & Swanson, 2012). The process model implies preparing a conducive learning environment where mutual planning, diagnosis, and implementation of the learning objectives are shared between the learner and the facilitator (Ibid). In andragogy, emphasis is premised on cultivating learners' experiences with a focus on evaluating learning outcomes and re-diagnosing learning needs. Changes in the self-concept, the role of experience, orientation, and readiness to learn are central assumptions behind andragogy (Malcolm Knowles, 1973; Malcolm Knowles, 1984).

Considering the above assumption and characteristics of adult learners, Pulse Learning explains five adult learning principles that are in line with electronic learning activities (PulseLearning, 2015). These are highly grounded in Knowles (1984) principles of adult learning and relate to mobile learning activities among smallholder farmers.

i. *Adults are practical*. Given the heavy work and family schedules, adults need to learn what relates to real-life scenarios. Thus, for eLearning, the effective use of technologies to demonstrate tasks is essential. This implies the need for adults to be involved in planning and diagnosing their learning needs for learning and instruction to address practical issues. Adults are most interested in learning subjects that have immediate relevance to their job or personal life.
ii. *Adults are goal oriented*. Goal orientedeness means learning has to be of value and use. It must address real-life situations that are developmental and can address social problems. In Knowles language, this is what is referred to as problem-centered rather than content-centered learning.
iii. *Adults are self-paced*. Self-directedness and self-paced learning fit the daily schedules of adult learners. Thus, training programmes ought to ensure that learning resources can be accessed anywhere and at any time using modern

technologies for adults to learn at any time. In addition, some degree of respect has to be accorded to adult learning participants in the learning process.

iv. *Adults have life experience and prior knowledge*. Adults have accumulated reservoir of experiences and knowledge. This means that experience ought to be integrated into learning activities, and it is the role of the facilitator to nurture this experience. Thus, the need for self-reflection activities gives learners a chance to share and reflect on their prior experiences and knowledge.

v. *Adults learn by doing*. Adults are practical. Adults need active participation in all learning activities to feel self-worthy and respected. They may not be interested in learning for knowledge's sake but learning for useful action. Learning by doing ought to appreciate collaborative learning activities to situate and stimulate experience sharing.

Mobile learning in non-formal settings cultivates on the above adult learning principles that fit learning in the livelihood contexts with smallholder farmers. The next section throws more light on what livelihood implies; and to be specific, farmers' livelihoods in relation to learning with mobile technologies.

## 2.5 Understanding Livelihoods

Development literature, mainly situated in studies of poverty and rural development, has presented the different interpretations of the term livelihoods. To begin with the English thesaurus dictionary, livelihoods imply the 'means to earn a living.' 'Means' can entail a way of survival or managing to exist and achieve the necessities of life like food, shelter, and health. Being considered as

> "a mobile and flexible term, 'livelihoods' can be attached to all sorts of other words to construct whole fields of development enquiry and practice. These relate to locales (rural or urban livelihoods), occupations (farming, pastoral or fishing livelihoods), social difference (gendered, age-defined livelihoods), directions (livelihood pathways, trajectories), dynamic patterns (sustainable or resilient livelihoods) and many more" (Scoones, 2009, p. 172).

In rural communities, livelihoods imply diversification; that is, "rural families tend to adopt survival strategies composed of a diverse portfolio of activities that cut across orthodox economic sectors and transcend to rural-urban divide" (Ellis, 2000, p. 231).

Livelihoods tend to take the form of "an asset-access" of activities where rural communities tend to cope with different circumstances presented by the different challenges. Most smallholder farming communities are vulnerable to many shocks which explains why most tend to engage in several livelihood activities. The potency rests on their ability to not only cope but rather stay resilient.

In this study, the use of Ellis rural livelihoods approach was deemed relevant, given the characteristic features that suit the study context. "A livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or the household" (Ellis, 2000, p. 10). While this may look a static definition, Ellis clarifies that livelihoods can change over time amid evolving circumstances. Henceforth, the construction we give to livelihoods "should be an ongoing process in which it cannot be assumed that the elements can remain the same from one season to another" (Ellis, 2000, p. 10). Assets, activities, and access can change over time, depending on the households' ability to cope/engage. In this study, the changing activities households engage in, even in different seasons, forms part of their overall livelihood.

For many smallholder farmers, farming is not the only means of survival as most engage in other activities not only for survival, but to live a happy and desirable life. Crop and livestock are among the main activities that generate income in such communities. Engagement in diverse activities is not only for increasing incomes, but also an avenue for nurturing, strengthening, and sustaining social networks for kin and community (Ellis, 2000). Thus, both the social and economic aspects of livelihoods need to be emphasized. Therefore, for understanding how mobile technologies can support learning among smallholder farmers, the livelihoods context needs to be an interdisciplinary part to explain the responsiveness of new technologies to the livelihoods of many in developing regions. Such integration offers an understanding that can support learning for change. Rural livelihoods characterization is threefold, including; (1) Assets, (2) Access, and (3) Activities (Ellis, 2000).

### 2.5.1 Categorizations of Assets

For any household to take part in different livelihood activities, it must have or have access to available means through which the production process and exchange of goods takes place. Assets are "stocks of capital that can be utilized directly or indirectly to generate the means of survival of the household or to sustain its material wellbeing at different levels above survival" (Ellis, 2000, p. 31). Perceiving assets as a stock of capital imply the availability of resources that facilitate production and consumption for future productive capacity (Ibid). Amidst the need to constantly adapt to strategies for upliftment, available assets ought to be used productively (Ibid). Whereas Ellis coined the term 'poor' in his writings about livelihoods, in this study, all households engaged in diverse livelihood activities.

While this study took on the Ellis' rural livelihood conceptualization, it should be noted that Ellis' understanding was also an amalgamation of attributes from traditional frameworks like those adopted from Scooner and Cornel (1998) and DFID. Ellis categorizes five different assets or capitals: natural capital, physical capital, human capital, financial capital, and social capital (2000, p. 31).

**i. Natural capital**

Natural capital includes environmental resources like land, water, and biological resources utilized by people to generate means of survival. These environmental resources are never static, and their availability is enhanced under human control to increase productivity. Within the natural capital, there are both renewable and non-renewable resources (Ellis, 2000). Renewable resources like fish, water, and trees can replenish over time and regenerate. The non-renewable resources, on the other hand, include extractive resources like metals, ores, oil, and gold that cannot regenerate. By implication, a community with available extractive resources can initiate other livelihood activities as a way of adaptability. "Rural livelihoods, however diverse they are, depend of course, on access to natural resources and to the management regime that regulates such access" (Ellis & Freeman, 2005, p. 370). Even when such resources replenish, people will look for other available natural resources to sustain their adaptive capabilities.

### ii. Physical capital

Rural households are partly constructed by the availability of enabling physical assets like rural infrastructures (Ellis, 2000). Physical assets entail producer goods that facilitate the production processes. Goods such as buildings, irrigational canals, roads, tools, machines, and others (Ellis, 2000) are considered essential requirements for people to engage in livelihood activities. Some unproductive physical assets like houses for rent can generate income flows to support the household. Infrastructural assets like roads and power lines, water supply, telecommunications networks, available solar panels are considered essential assets for livelihood diversification. In this study, the availability of processing mills for both food and cash crops, and the presence of agribusiness shops to extend both plants and livestock inputs are essentials for livelihood support. Roads are physical assets, but the availability of fairly good public roads is still concentrated in some few rural town centres. Electricity is also considered to be a public good, but many rural households still lack access to electricity. The government's drive towards rural electrification avails farmers with an opportunity to take their produce to processing plants. Also, the new solar revolution has extended solar services targeting rural dwellers, which explains increasing solar connectivity in many rural households. This supports mobile phone integration in different livelihood activities.

### iii. Human capital

Human capital is the actual labour used to engage in productive activities. Ellis refers to human capital as "the chief assets possessed by many in rural communities (2000). Human capital includes labour available in education, skills, and health (Carney 1998). Investment in education and training through skills enhancement is one way to increase human assets. Human assets are the most essential and readily available important resource among smallholder farmer communities. As emphasized by Øyhus, "in rural development, the most important and abundant resource is human beings themselves" (1992b, p. 2). This calls for any rural livelihood intervention to appreciate the power of human resources available within a given community. By implication, most household human capital is not static. Its size and availability will change over time, depending on demographic factors (like birth, death, marriage, children, divorce, and aging) (Ellis, 2000), capacity building, and education. Public education and health services are considered essential elements in developing a population's human capital. In this study context, organizations' efforts to extend digitalized content lies within this realization of increasing access to information and knowledge sharing amongst the rural farmers.

Human capital emphasizes skills availability and willingness to offer efficient labour to partake in different livelihood activities. The more the labour force available in a given household, the better the household will engage in livelihood activities. Moser (1998) claims the relevance of children and women labour in many vulnerable households. In her suggestive statement, "the entry of women and children in the labour market has not meant that men are not working. Household assets portfolios increasingly depend on multiple earners, complementing, rather than substituting for, male income" (p.9). In a study assessing the vulnerability of poor people in four communities of four developing countries, Moser observes that the education levels of a particular household are linked to household income, as the less educated households were more likely to be below the poverty line (Moser, 1998). This means that the more educated members the household has, the higher the chances of such a household to productively use the skills and knowledge gained in most livelihood activities.

However, this knowledge is not limited to scholarly knowledge since possession of indigenous knowledge facilitates engagement in livelihood activities. This implies that, even when people have the farms, with the presence of good roads, if they lack adequate knowledge to use the available assets around them, such assets will not be used to full capacity desired to address livelihood challenges. This study on mobile technologies and learning for livelihood support addresses the need to uplift farmers' skills through knowledge enhancement.

**iv. Financial capital**

Financial assets include available "stock of money which households have access to… [in terms of] savings and access to credit facilities in the form of loans" (Ellis, 2000, p. 37). Whereas micro-credit facilities have penetrated many developing regions, their availability is in rural areas still limited (Roy, 2018). This lack is sometimes not only related to the lack of financial facilities but also to the fact that many rural people in most African countries still save money in the form of livestock and plantations (Ellis & Freeman, 2005). Money is determined by the number of available livestock, poultry, and the size of plantations. Most importantly, microcredits through group lending support financial capital for many rural households (Ellis, 2000). Accordingly, one needs to understand that even when access to knowledge is prioritized, the lack of financial means to use the acquired knowledge will still not support many activities of the smallholders. This study's emphasis on finance capital was that even when communities gainfully appreciate the human capital, the lack of or limited access to finance affected smallholder livelihood activities. Paper 5 points to how the lack of finance capital constrained adoption of new knowledge.

### v. Social capital

Social capital includes "community and wider social claims on which individuals and households can draw by virtue of their belonging to social groups " (Ellis, 2000, p. 36). Such social claims include localized interactions based on morals and trust within the same group. Like Moser (1998) notes, social capital is central in building and supporting relationships that enhance social cohesion and change, as it supports reciprocity within and between communities and households. Emphasized by Putman (2001), social capital entails "that networks and the associated norms of reciprocity have value for the people" (2001, p. 1). Distinguishingly, social capital propagates informal and organized reciprocal networks of trust and norms embedded in social organizations of communities visible in hierarchical and horizontal structures (Putnam, Leonardi, & Nanetti, 1994). Such networks can out show in both horizontal and vertical relationships.

Horizontal social groups such as associations, clubs, and voluntary agencies bring individuals together to pursue one or more objectives of common interest by those involved (Putnam et al., 1994). But this selection based on social ties can limit the participation of many in some livelihood activities. Therefore, while social capital can be a strong resource base that can support and sustain people working together, it can also 'close door' or opportunities for others who are not part of the group. For instance, "the processes that create 'insider and outsider' with respect to social capital are complex and difficult to unravel, but clearly such divisions do exist, and they sometimes result in the 'social exclusion' of particular groups within rural communities" (Ellis, 2000, p. 37).

Nonetheless, defining such relationships in hierarchical and horizontal structures does not blind us from looking at the relevance of social relationships within households and between households - a more micro-level. The way households engage in different livelihood activities corroborates with social cohesion within households. Social relationships are bound by time and resources that sustain and nurture such networks. As such, the available social ties within a given community are never static, so is with other assets (Moser, 1998). "The more assets people have, the less vulnerable they are, and the greater the erosion of people's assets, the greater their insecurity" (Moser, 1998, p. 3). In this study, social capital was instrumental in facilitating mobile learning among smallholder farmers, although some relationships hindered others from joining the farmer groups. Below is an explanation of activities as defined in rural livelihoods context.

### 2.5.2 Activities

Activities, according to Ellis (2000), include all engagements people undertake to earn an income. In most rural communities, livelihood activities include farming and farm-related activities, occasional periods of wage work, engagements in non-farm work like trading, and remittances from urban and abroad (Ellis, 2000). The main income sources can include "cash and in-kind contributions in the form of livestock sales, wages, rents, remittances for cash, and consumption of own farm produce like food, and transfers of exchanges on items between households (for both with rural or urban households)" (Ellis, 2000, p. 11).

Ellis (2000, p. 11) describes three categories of income: farm income, off-farm income, and non-farm income.

i. Farm Income - refers to income generated from one's farming, whether on personally owned land, land accessed through cash, or land where the tenancy is shared. Farm income from most rural communities includes income from crops, livestock and any other activity on the land that can generate income.
ii. Off-farm income - includes wage or exchange of labour on other farms (but within agriculture context). It can be labour payment in kind like harvest share system and non-wage labour contracts. Off-farm income can also entail other income sources like firewood, charcoal, house building materials, wild plants, trench construction, tree cutting, among others.

iii. Non-farm income - refers to incomes from non-agricultural sources. Examples include non-farm rural wage, non-farm rural self-employment, rental income obtained from leasing out land or property, domestic urban to rural remittances, and international remittances arising from the cross border and oversee migration.

Rural people in most developing regions take part in varied activities. Farming is not the only source of income, but just part of it (Fan, Brzeska, Keyzer, & Halsema, 2013). Rural livelihood diversification is a "process by which rural households construct an increasing diverse portfolio of activities and assets in order to survive and improve their standards of living" (Ellis, 2000, p. 15). For instance, during rainy seasons, some farmers opt for seasonal crops like maize and beans. Rainy seasons present with numerous employment opportunities which partly explains why some household members opt for farm labour in search of extra income. This means, livelihood activities by most smallholder communities in sub-Saharan Africa are not just non-farm but are non-rural in character (Ellis, 2000). Consequently, while Ellis's categorization of activities might not capture the new activities rural households engage in, the study has considered all other activities beyond this categorization.

### 2.5.3 Access

Access to innovations like knowledge sharing through mobile technologies is aimed at improving human capital of many farmers within rural areas. In this regard, the lack of education (limited access to learning opportunities) limits options for people to expand their opportunities in life (Ellis, 2000). Limited access to learning opportunities is a critical constraint inhibiting better livelihoods (Ellis, 2000). In this study, the mobiles for development projects availed access to actionable information on mobile phones, which prompted the need to understand organizational polices as mediating factors in extending and influencing information and mobile access to smallholder communities.

Organization policies as mediation mechanisms are critical access points to many rural households. Livelihoods are partly determined by the available rules and customs defined by institutions and policies, impacting how communities interact with assets and activities. In this study therefore, as delimitation, there was no focus in defining and explaining this mediation relationship. Instead, due diligence was to analyze M4D projects whose policies, rules, and norms influenced farmers' use of mobile technologies in different livelihood activities. Adversely, it should be noted that some organization formal rules and codes of behavior constrain human interactions (Ellis, 2000). For example, in this study, it was evident that some organizational policies like having land and being a local resident hindered farmers from joining the mLearning network in some case studies.

### 2.5.4 Synthesizing livelihoods and the study

In fusing the relationship between mobile technologies, learning, and livelihoods, the lack of access to knowledge and skills implies low human capital that stampede effective engagement in livelihood activities. In this study, the availability and use of mobile technologies for learning help farmers to engage in different activities, earn a living, and raise household incomes. Mobile technologies are considered actor tools used to enhance learning for better livelihoods. This means that, increasing knowledge access strengthens human capital, improves agricultural productivity, and facilitates resilient capabilities among smallholder communities. Relatedly, the absence of natural capital like good rains and fertile soils that support farming can affect livelihoods even when people have the necessary farming knowledge. The presence of social capital in form of constructive bonds and networks also facilitates livelihoods. But this only happens in a context that enables equitable access to institutional services and where people engage in different activities. Therefore, while the study intention was not to use a livelihood framework, this section is intentioned to explore the interactions between assets, access, and activities in the smallholder farmer's context. In addition, it aimed to show how livelihoods entail social, cultural, and political aspects, highly mediated by the available institutional policies to support development.

## 2.6 Context of Smallholder Farmers

Globally, smallholder farmers in sub-Saharan African and Asia occupy 70-80% of the total global farmland, producing 80% of the food that is consumed in developing countries (Beyer, 2018; FAO, 2012). Smallholder farmers "play a crucial role in supplying food to the continent's population and bringing about economic transformation in rural areas" (Anderson, Learch, & Gardner, 2016). Women smallholders account for 50% of the agricultural labour force of developing countries; thus, they offer productive resources as men on different farmlands (FAO, 2012). Smallholder livelihoods are dependent on agriculture as a predominant activity. The agricultural sector has a development contribution in reducing poverty than non-agricultural growth, given its strong linkages to the rural economy (Lybbert & Sumner, 2012). This means that smallholder farmers play a significant role in "meeting the future food demands of a growing and increasingly rich and urbanized population" (Fan et al., 2013, p. 1).

Whereas they support food production systems, smallholder farmers everywhere struggle for their survival since their livelihoods are significantly hampered by unfavorable government policies. Disenabling are the diverse weather conditions like droughts, floods, hailstorms, and heavy rains, given their reliance on rainfed cultivation (Ngwira, 2014). Small as they may appear, most smallholders face food insecurities, unstable income sources, lack access to resources, inadequate markets, and limited access to new agricultural technologies. Thus, as Beyer notes, their responsibility is still large because; "there is nothing "small" about smallholders. Not in their numbers, not in the challenges they face, and not in the outsized contribution they can make towards helping achieve the UN global goal of Zero Hunger by 2030" (Beyer, 2018).

It should be noted that smallholders are not a homogenous group given the "diverse set of households with varying household characteristics" (Fan et al., 2013, p. 1). The term smallholder is interchangeably used and can imply small scales, resource poor, and peasant farmers (DAFF, 2012). The Food and Agricultural Organisation (FAO) explains a criterion that depicts a clear conceptualization of what smallholder farming entails. To FAO,

> "Smallholders are small-scale farmers, pastoralists, forest keepers, fishers who manage areas varying from less than one hectare to 10 hectares. Smallholders are characterized by family-focused motives such as favoring the stability of the farm household system, using mainly family labour for production, and using part of the produce for family consumption" (FAO, 2012).

In this study, smallholders encompass all farmers owning small plots of land, engage in the growing of subsistence crops, cash crops, and animal rearing, exclusively rely on family labour, using simple traditional technologies. However, such a definition does not qualify smallholders in one categorical set, since within them lies individual differences that determine the magnitude of resilience in case of shocks. Thus, "smallholder farmers differ in individual characteristics, farm size, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold and household expenditure patterns" (DAFF, 2012).

In most developing regions like Africa, smallholder farmers are often illiterate with inadequate technological skills to absorb the new knowledge needed in this changing environment (Baloyi, 2010). Their prevalent characterization is that majority are challenged with "poor access to land; lack of on-farm and off-farm infrastructure; lack of access to finance for production inputs; lack of access to mechanization, transport logistics, extension, and research support services; and limited access to high-value markets" (Baloyi, 2010, p. 22). For rural smallholders, the situation is even worse than their counterparts operating in town centers. The majority lack collective efforts, are distanced from markets, credit facilities, and even lack updated information. As such, technological penetration and diffusion hardly reach them, given the resource-constrained settings within which they operate.

Adopting new technologies is among the ways smallholders' farmers in developing regions can ably address their livelihoods challenges and stay resilient. The need for farmers to take up new technological interventions in the form of improved techniques and practices is one way to stimulate growth in agricultural output (Mwangi & Kariuki, 2015). Whereas understanding agricultural technology adoption for smallholder farming communities varies and is varying (Mwangi & Kariuki, 2015), in this study, the observance of technology adoption is at two levels. First, the adoption of mobile technologies, and second, adopting the new and improved farming practices shared as knowledge on mobile phones. For the former, because mobile phones have content about farming, this is also an innovation in agriculture extension which can be classified as agricultural technology adoption. The next section gives a brief on smallholder farmers in Uganda.

### 2.6.1 Smallholder farmers in Uganda

Uganda is an agrarian economy, with agriculture supporting 75 percent of its population (McCole 2014). Over 80 percent of Uganda's population is involved in subsistence agriculture, also referred to as smallholder farming (UBOS 2012). Agriculture contributes to 45% of GDP in the country, supporting up to 75 percent of the labour force (AfDB 2010). Uganda's agricultural sector is dominated by the smallholder farmers who mainly grow at subsistence level as their composition is two-thirds of those engaged in agriculture for livelihoods. These engage in crops, livestock, and fisheries, and some even engage in export markets depending on the activities, ecological zones, and availability of strong bridges and networks within their communities. Majority rely on family labour, coupled with simple farming tools and methods. Most developing regions are experiencing extremes in climatic changes. Observed by Lybbert and Sumner (2012), diverse climate change impacts are severely felt in developing countries, yet with low capacity to adapt to such chnages. For example, in Uganda, the country's situation was in double jeopardy in the 2017 and 2018 economic and famine crisis that hit the country.

Amidst the climate change challenges affecting most communities in Uganda, smallholder farmers face challenges in accessing relevant information about good quality seed and storage facilities in adapting to climate variability (Watuleke, 2015). Increasing and ensuring efficiency in national-wide extension services, improvement of infrastructure like the feeder roads, and widening access to market opportunities are among strategies to support smallholder farming (Kasekende, 2016). Despite smallholder farmers being diverse groups, for this study, rural smallholders were a focus. This means that interactions happened with smallholder farmers in rural areas in the districts of Bushenyi, Ibanda, and Kabale, all in western Uganda; where majority engage in crop farming, with few livestock activities. Most crops were subsistence in nature like plantain, cassava, potatoes, rice, millet, vegetables, maize, and few cash crops like coffee and cotton. Several attempts have been put forth to support smallholder communities in Uganda, specifically in the agriculture sectors. For instance, the growing mobile technology infrastructure in Uganda has seen several mobile-related initiatives to support different groups of people. For example, internet connectivity has helped many farmers to share relevant information and support one another.

Whereas the concept of smallholders denotes those in rural areas, the trend in this mindset is changing. For example, in Uganda, there is a young generation of graduate smallholder farmers who opt for farming for survival. Over 80 percent of the Ugandan population are youths aged 16-35 years, of which 60 percent are below 28 years. Presential unemployment has forced many to join farming as a business. These are increasingly using mobile applications to support marketing, consultancy, farm record management, and information sharing.

This study falls within the general framework of agriculture extension because of its focus on improving efficiency in farmers' access to agriculture information. In Uganda, the National Agricultural Advisory Services (NAADS) ensures that the agricultural extension service reaches all farmers.  The role of agricultural extension and advisory services is to build capacity among farmers to better advance diffusion of agricultural knowledge for improved yields. However, NAADS has failed to reach this expectation. Agricultural extension services are under constant pressure to be responsive to the ever-growing challenges of food security. The ratio of farmers-to-extension workers in most commonwealth countries is 1: 2,000 to 1:25,000 (Balasubramanian, 2013). In Uganda, it is reported to be 1: 18,000 (McCole 2014). There have been public cries on the inaccessibility of extension services in some places, and as such, most rural smallholder farmers do not access extension services. NAADS has adopted a single spine extension system with more extension workers to support communities (Ongu, 2014). Presently, the extension to farmer ratio stands at 1:1800, as opposed to the global benchmark of 1:500 (Bwambale, 2020).

Mainstreaming agricultural extension requires more time and mega investments. Thus, to reduce such expenses and the immediacy to reach as many smallholders as possible, adopting a mobile technology strategy that employs mobile phones can partly support agriculture extension. More so, as Øyhus (1992) argues, within professional extensionism, there exists a 'public zonal distance' gap between extensionists and farmers. However, this gap can be reduced through communication changes facilitated by mobile phones (Nampijja, 2017). The use of non-formal education through task-oriented methodologies can support the transfer of information to support smallholder activities (Rivera, 1998). Therefore, in this study, the focus on non-formal mLearning for livelihood enhancement befits agricultural extension. While extension education is the responsibility of states' agricultural development department, increasingly, other public and private institutions are taking on the lead to transferring agricultural information, education, and technology (Rivera, 1998). This explains why Grameen Foundation, USAID, and Commonwealth of Learning are international funders supporting agricultural development in the selected case study sites.

Lastly, no actor can act alone in transforming smallholder livelihoods. Supporting smallholder agriculture needs an ecosystems approach with various key actors and networks like policy, extension services, infrastructure, markets, land rights, rural electrification, subsidies on solar technology, mainstreaming gender in agriculture, and rural financing. But most importantly, governments have to respect the provision of public goods where smallholders are considered primary beneficiaries and stakeholders in this support. No single organization can change farmer livelihoods. Instead, a consortium of organizations acting in coordinated and efficient systems is relevant to support smallholder agriculture and improve farmers' livelihoods.

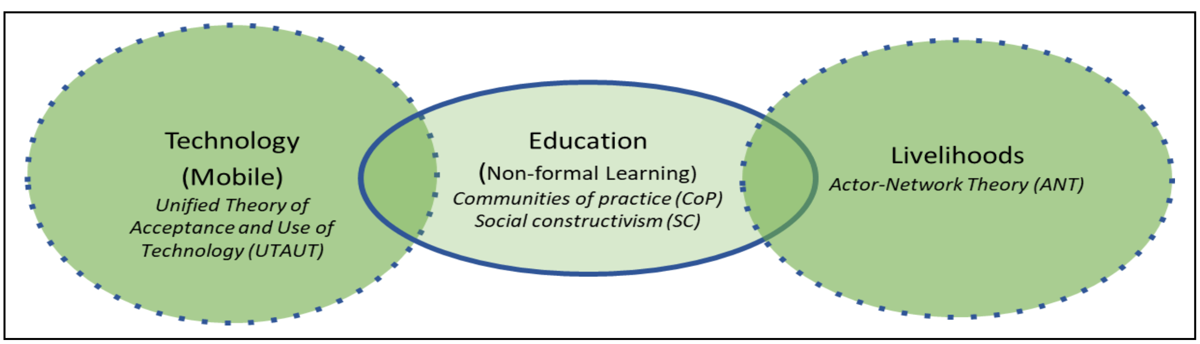
This chapter has presented literature related to mobile learning, non-formal learning, and livelihoods in the smallholder farmers context. Whereas some gaps have been identified in presenting this chapter, it should be noted that mobile learning research in non-formal settings is limited. Hence, the discussed literature offers concrete insights into understanding how mobile technologies can enhance learning for livelihood support. The next chapter highlights the theoretical orientations used in this study.

# 3. Theoretical Framework

The theoretical framework entails a combination of ideas and concepts that guided this study. The interdisciplinary nature of the study largely influenced the choice and selection of a theoretical framework to use. Understanding mobile technologies and learning for livelihood support places the study in technology (mobiles) and education, with specific reference to non-formal learning. The livelihood consideration brings to light that farmers' learning presupposes knowledge sharing for a particular cause. Therefore, finding a single theory to explain the different study concepts was rather challenging. Hence, a blend of different theorizations was deemed necessary to exploit the opportunities each had in situating the study (see Figure 6).

This study integrated four theoretical lenses; the Actor-Network Theory (ANT), Unified Theory of Adoption and Use of Technology (UTAUT), Community of Practice (CoP), and Social Constructivism (SC). The use of multiple theories helps to fill in missing links in some theories to give the study a comprehensive analysis. Moreover, a well thought process of theoretical lens integration provides a more in-depth understanding of the concepts being studied (Thapa, 2012). Besides, mobiles for development and mobile learning are relatively new fields whose theorization is still in the development phase (Crompton, 2013; Kaliisa et al., 2017). This explains why the suggestive integrated theories bend towards education and social sciences.

**Figure 6: Theoretical perspectives used in the study**




While explicit use of multiple theories might not fit the constructivist paradigm in this thesis, it should be noted that theoretical integration did not influence data collection, but rather used at analysis level (see role of theory in Section 4.1.1). Moreover, this being a paper based PhD, there was much influence from editors on use of theory in all papers. Nonetheless, I was critical in this whole integration process. Additionally, while the use of UTAUT (positivist grounded) could raise ontological and epistemological contradictions, in Section 3.2.1, I analyze this limitation and how the study integrated UTAUT constructs to explore mobile technology adoption amongst smallholder farmers.

To understand how mobile technologies supported livelihoods in resource constrained settings like rural locales, the Actor-Network Theory was used to analyze both human and non-human actor-networks and their relationships in technology development interventions. To situate how available M4D projects integrated mobile technologies in different rural locales, exploring farmer's acceptability and use of these technologies was relevant. The Unified Theory of Adoption and Use of the Technology (UTAUT) was considered suitable for this purpose. The Community of Practice (CoP) designated smallholder farmers as a community. CoP guided how learning occurred with mobile technologies as tools used to support livelihoods. However, CoP was not strong at situating learning in the non-formal learning contexts. Therefore, a complete understanding of the nature of learning and assessment among smallholders was supplemented by Social Constructivism.

All the theories were used in the submitted papers. For example, the use of ANT in paper 1 guided analysis of the socio-technical discussion of the farmers' mLearning actor-network. UTAUT was used in paper 3 to explain factors that influence the adoption and use of mobile technologies for learning among smallholder farmers. The use of CoP in paper 4 and paper 6 facilitated an understanding of the role of mobile technologies in supporting learning in non-formal contexts. The use of social constructivism in paper 4 helped to analyze the nature of learning and assessments among smallholder farming mLearning practice. Details about each theory are explained below.

## 3.1 Actor-Network Theory (ANT)[5]

Understanding the local and contextual challenges before identifying and implementing any technology to use in the farmer's livelihood context is critical. The Actor-Network Theory (ANT) helps to understand human networks and how these (networks) support information sharing and use among smallholder farmers. The advantage of using the ANT is the realization that networks are crucial for such communities employing mobile technologies in resource-constrained settings like rural communities. These networks keep changing as they may be stable or unstable (Latour, 2011), which points to an implication in practice and the use of mobile technologies for livelihood support.

> "ANT provides a framework of ideas for describing the process of technology adoption and developing stories which explain technology take-up. ANT suggests that technology is as much a product of social construction as of technical innovation. Technology adoption results from the build-up of fluid networks of heterogeneous associations between actors (both human and non-human)" (McBride, 2003, p. 266).

Developed in the 1980s by Bruno Latour, Michel Callon, and John Law (Latour, 2011; Law, 1992), the Actor-Network Theory emphasizes both human and non-human actors. Research exploring mobile technologies for development mainly focuses on non-human actors (mobile phones and mobile content), with less focus on people (human actors) who make use of these technologies. The rationale of ANT in this study lies in its emphasis on how to re-echo the role of humans and their cultures in the technology adoption process. Social processes are as important as technological processes in understanding events (McBride, 2003). In this regard, to ANT, the social as well as technical aspects of any entity are inseparable (Walsham, 1997). ANT does not only identify the human networks to be analyzed but instead provides possibilities of understanding and analyzing the social life of human networks (Mol, 2010).

Walsham (1997) categorizes ANT as a theory and a methodological tool. As a theory, ANT supports and facilitates the analysis of technical and social explanations of human technology interaction (McBride, 2003). ANT belief lies in the ability to move, generate, transform, translate, enrich, and to portray both human and non-human processes that lie

[5] This section is extracted from paper 1

underneath a particular organization setting (Law, 1999). The theory helps in creating and maintaining networks of human and non-human elements (Walsham, 1997). As a methodological tool, ANT suggests several concepts like the actor, actor-networks, macro actors, obligatory point of passage, and translations (problematization, interessement, enrolment, and mobilization) as described in Table 1.

**Table 1: Key concepts in the Actor-Network Theory**

<table>
<tr><td>Actor (or Actant)</td><td>Actor-networks</td></tr>
<tr><td>Actors imply doing, acting, or engaging. Actors are both human (people) and non-human (mobile technologies). Human actors have interests, desires, strategies, with the ability to enroll others in the network (Rhodes, 2009).</td><td>These are heterogeneous networks of aligned interests of people, organizations, and standards (Walsham, 1997). Networks explain how relations are organized and networked (Rhodes, 2009). Networks explain how actions are allocated and located (Latour, 2011). Networks are open with no clear hierarchical relationships to depend on, as they keep changing: hence stable or unstable (McBride, 2003).</td></tr>
<tr><td>Obligatory passage point (OPP)</td><td>Translator/macro-actor</td></tr>
<tr><td>OPP is the initial stage that forces people to converge and act. It is the solution to the problem of a particular entity that affects future alliances and controls resources needed to achieve the actant's outcome (Rhodes, 2009, p. 5). OPP allows local networks to set up negotiation spaces for future interactions in the networks. It is central to future operations of the network, and once ill-defined, it will affect interactions of actors.</td><td>A translator or micro-actor can be an individual or group of individuals that act as representative spokespersons - also named macro actors. To Rhodes (2009, p. 5), macro actors create new OPPs and<ul><li>become the spokespersons for the entities they constitute, such as land, equipment, people, processes, and technology;</li><li>express the desires, secret thoughts, interests, and mechanisms of the entities;</li><li>provide an initial definition of roles, distribution of roles, as well as delineate a scenario; and</li><li>map out the geography of necessary points of passage for those elements that wish to continue to exist and develop.</li></ul></td></tr>
<tr><td colspan="2" align="center">Four Translation moments</td></tr>
<tr><td>Problematization</td><td>Interessement</td></tr>
<tr><td>This is where the macro-actor defines the identities and interests of other actors that are consistent with their interests (Rhodes, 2009, p. 6). To Rhodes, actors can be persuaded,</td><td>This is a process where macro-actors use devices to convince actors to accept their point of view through translating, compromising, and persuasion (Rhodes, 2009). Emphasis is on the</td></tr>
</table>

| | |
|---|---|
| frightened, and cajoled to join this alliance of interest to solve a problem. Problematisation poses knowledge as a problem, and here, people are given the knowledge to solve a particular problem at hand. | use of devices to strengthen the associations between actors and structures within the network. |
| **Enrolment** | **Mobilization** |
| Successive outcomes from problematization and intressement lead to enrolment (Rhodes, 2009). This involves "creating a body of allies, human and non-human, through a process of translating their interests to be aligned within actor-network" (Walsham, 1997, p. 469). Here, actors enroll others in the network. To Rhodes (2009), translating the purposes of entities and establishing themselves as spokes persons, strengthening connections through political persuasions, maintaining stability and alignment through constant attention, and using humans and machines like mobile phones, radios, and televisions as enroller; are strategies used in enrolling others. | This last phase advocate for commitment to problematize cause of action (Rhodes, 2009), to ensure that the problem is solved and actors working towards a common cause. The legitimacy of the macro-actor is highly emphasized to strengthen the network. More allies are enrolled to join the network. |

The 'Actor' analogy in ANT implies acting or doing or engaging, and here, the theory helps to understand what people do, how much they do, and how the 'doing' affects those around them. Actors are critical stakeholders in the network who impact on the activities of a particular entity (McBride, 2003). Actors are both human and non-human, the latter being technological artifacts (Ibid). Considerably, not all who are named 'actors act,' since acting largely depends on the ability of the available technology to be aligned along with the interests of the actors and other stakeholders in the network (McBride, 2003). To understand the 'network' analogy, "actors are afforded by their ability to act by what is around them" (Mol, 2010, p. 258). Mol continues to assert that actors do not act alone; they afford each other's existence and capabilities. The environment and the surroundings afford what people do and how they do it; thus, the urgency to explore such networks and understand their social organization. Networks explain how actions are allocated and located (Latour, 2011). Networks are open with no clear hierarchical relationships to depend on, as they keep changing, rendering them stable or unstable (McBride, 2003). Law (1992) advocates for heterogeneous networks where society, agents, and machines, are generated through network patterns that grow and elucidate one another. Actors are enacted and adapted by their associates in the enacting process (Mol, 2010).

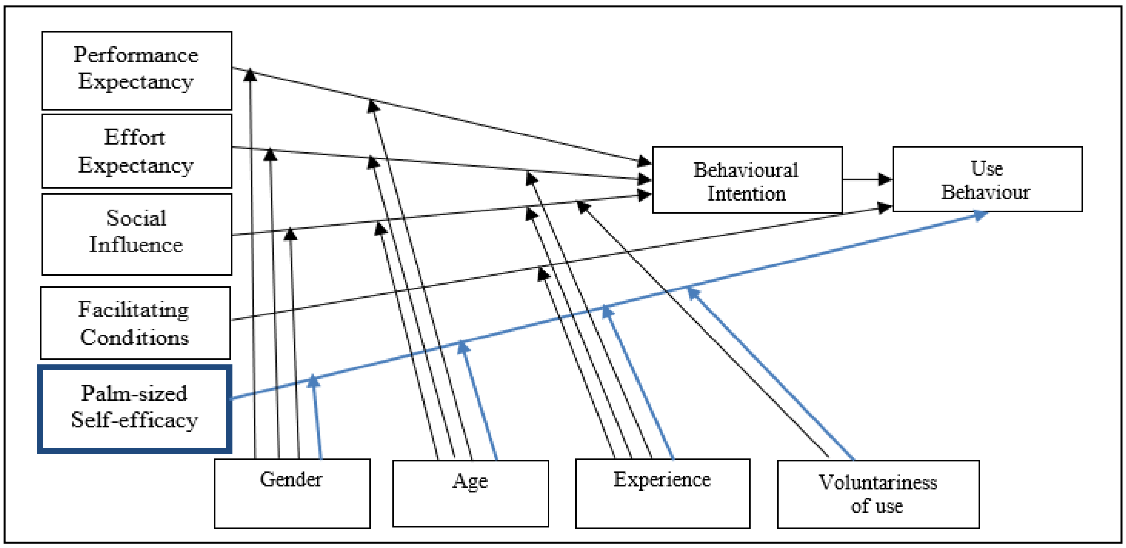
In paper 1, actors, both human and non-human and their networks are explored. A socio-technical discussion on how aligning smallholder interests to technological initiatives is analyzed. Farmers' narratives on how mobile technologies impacted on their livelihoods was guided by ANT. A critical discussion on the mobile learning actor-network formation process is explained in Section 6.2.1. The translation moments of problematization, interessment, enrolment, and mobilization explored how the mobiles infrastructure was sustained in rural Uganda. Therefore, ANT provided lenses on how to visualize networks of human and non-human actors in any technology related development intervention. Most importantly, it accentuated the relevance of fronting actants' primary needs in availing contextualized technological initiatives. Such contextual mindfulness facilitates quicker mobile adoptions as advanced by UTAUT.

## 3.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

To theorize the adoption and use of mobile technologies, the Unified Theory of Technology Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) was employed. UTAUT is considered a theory to unify the terminology of variables of different models and theories of technology acceptance. It is grounded on eight conventional models in the field of information technology acceptance research that is; Theory of Reasoned Action (TRA - Fishbein & Ajzen, 1975), the Technology Acceptance Model (TAM - Davis, 1989), the Motivational Model (MM – Davis, Bagozzi, and Warshaw, 1992), the Theory of Planned Behaviour (TPB - Azjen, 1991), the combined TAM and TPM (C-TAM-TPB, Taylor and Todd, 1995), the Model of Personal Computer Utilization (MPCU - Thompson, Higgins, & Howell, 1991), the Innovations Diffusion Theory (IDT - Rogers, 1995), and the Social Cognitive Theory (SCT - Bandura, 1986). The assumptions behind the unification of the above theories and models is premised on the realization that information technology won't be effective if not well adopted and used by the intended beneficiaries.

UTAUT is founded on four theoretical constructs representing the intention to use, and four moderators of key relationships (Venkatesh et al., 2003). As visualized in Figure 8 below, these constructs are Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating conditions, while the moderating variables that influence intention to use of information technologies are Gender, Age, Experience, and Voluntariness of use (Ahmad, 2014).

**Figure 7: Unified Theory of Acceptance and Use of Technology**




(Adapted from Venkatesh et al., 2003)

The moderating variables are determinants of a person's Behavioural Intention (BI) to use a new technology in a voluntary setting (Venkatesh et al., 2003). Thus, "UTAUT has distilled the critical factors and contingencies related to the prediction of behavioral intention to use a technology and technology use primarily in *organizational contexts*" (Venkatesh, Thong, & Xu, 2012, p. 157). Whereas the initial use of UTAUT was in controlled organizational settings, the theory has been adopted and used even in non-organizational settings (Ibid).

Using UTAUT in this study is not only to benefit from the unified models that explain the adoption and use of new technologies but also to expound on how such technologies are used in resource-constrained settings where access to newer technologies like mobile technologies is a challenge. UTAUT unifies several theories that have explained the adoption and use of new technologies in different contexts; thus, its application benefits the study in exploring different dimensions. Although the mLearning context is quite different from the traditional IT context, Pedersen and Ling (2003) suggest the need to extend or modify UTAUT when applying it to the adoption and use of new technologies like mLearning among smallholder farmers. This study has included the palm-sized computer self-efficacy to broaden intention to use mobile technologies (Wang & Wang, 2010) in the farmers' learning context.

Most importantly, within the UTAUT theorizations, "performance expectancy, effort expectancy, and social influence are theorized to influence behavioral intention to use technology, while facilitating conditions and palm-size computer self efficacy determine technology use. Individual difference variables, like age, gender, and experience, and voluntariness, are theorized to moderate various UTAUT relationships" (Venkatesh et al., 2012, p. 159). The theoretical constructs are explained hereunder.

***Performance Expectancy (PE)***

Performance Expectancy "is the extent to which an individual believes that utilizing an information technology will assist in attaining gains in job performance" (Venkatesh et al., 2003, p. 447). From perceived usefulness, a key element in performance expectancy derived from the Technology Acceptance model, people will tend to use the technology to an extent they believe will improve job performance (Davis, 1989). The importance of extrinsic motivation signifies the ultimate utilitarian value people gain from using a technology (Venkatesh et al., 2012). In the mLearning for farmer's context, farmers will use mobile technologies if there is a substantive utility of learning new knowledge beneficial to increased farm yields. Gender and age are essential moderators to determine performance expectancy and intention to use technology (Ahmad, 2014). In the study context, men and women, old and youth farmers were essential categorizations in analyzing intention to use mobile phones for learning.

***Effort Expectancy (EE)***

Effort Expectancy is the "extent of ease to use associated with the use of the system" (Venkatesh et al., 2003, p. 450). The adoption and use of mobile technologies for learning among farmers mostly depend on the perceived ease to use of the mobile phones. For example, if the mobile learning system installed on smartphones is hard to navigate, farmers will find it hard to use the technology for learning. Gender, age, and experience are critical moderating factors to determine effort expectancy and intention to use mobile phones (Ahmad, 2014). For the latter, if farmers have gained enormous experience in navigating through the mobile technology, there are higher chances that they will continuously use the technology while showing a great need to keep it safe for future reference.

***Social Influence (SI)***

Social influence is "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451). Social Influence has an effect on individual behaviors in terms of compliance, internationalization, and identification, which in turn determines technology acceptance (Ahmad, 2014). Age, voluntariness of use, and experience are vital moderating factors under social influence. Studies have shown that women are more compliant and sensitive to the opinions of others; thus, social influence will be more influential on women more than men (Ahmad, 2014; Venkatesh et al., 2003; Wang & Wang, 2010). In the mobile learning farmers context, smallholders will use the technology if they believe that the 'majority others' feel it is worth to use the technology for livelihood support.

***Facilitating Conditions (FC)***

Facilitating Conditions is the "the degree to which an individual believes an organizational or technological infrastructure exists to support the use of the system" (Venkatesh et al., 2003, p. 453). This is where individuals get organizational scaffolding to use the information technology sustainably. Age and experience are moderating factors determining intentions to use. For example, as experience increases, there will be greater use of information technology (Venkatesh et al., 2003). In the mLearning farmers' context, facilitating conditions are central in determining the intention to use mobile phones. All three M4D projects operate in rural settings where infrastructure development is still inadequate. Providing organizational support, both administrative and technical, is instrumental in sustaining the adoption and use of mobile technologies for learning.

***Palm-sized computer self-efficacy***

Palm-sized computer self-efficacy is “a summary judgment of one’s capability to engage in some specific computer-related activities through a palm-sized computer” (Wang & Wang, 2010, p. 419). In their study on user acceptance of m-Internet, Wang and Wang (2010) observed that palm-sized computer self-efficacy played a critical role in determining intention to use mobile systems. In the mLearning farmers' context, farmers who are comfortable using a palm-sized computer (mobile phone) are very likely to have an intention to use of the technology. Actually, in this resource-constrained setting where smartphones are still scarce, farmer’s familiarity with smartphones had an impact on the intention to use the technology. Age, experience, and voluntariness to use the mobile system influenced the intention to use mobile technologies for learning.

### 3.2.1 Critique and limitation of using UTAUT in the study

While the study adopted UTAUT to cultivate its grounded constructs and moderating variables, the study was aware of the several critiques levelled against UTAUT. For instance, the model is mostly employed to investigate users’ technology adoption in a voluntary environment (Chan et al., 2010). Although this is a genuine critique which limits analyzing adoption in non-voluntary settings, the mLearning farmers' study context was in a voluntary setting. Farmers who had access to mobile technologies (smartphones and laptops) willingly shared mobile content with other groups of farmers amid scarcity of smartphones within their reach. More so, the three case studies used in this thesis were analyzed within a controlled organizational setting, corresponding to original UTAUT.

Bagozzi critiqued the model and its subsequent extensions, stating that “UTAUT is a well-meaning and thoughtful presentation, but that it presents a model with 41 independent variables for predicting intentions and at least 8 independent variables for predicting behavior,…with some independent variables being left out” (Bagozzi, 2007, p. 243). UTAUT has been criticized for being less parsimonious given the several moderating relationships and key study constructs (Ibid). It becomes expensive and time-consuming to analyze all these variables in a given study, which questions the appropriateness of the theory.

More so, the UTAUT view of social influence has been too deterministic, neglecting the user from the social dimensions of technology. For instance, Lorenz & Buhtz cautions future Technology Adoption (TA) research to posit social influence as “the multi-level interaction of three dimensions: user, social referents, and technology. The interaction between the focal user and their social referents determines the direction of social influence, which may be reciprocal and multidirectional rather than just unidirectional” (2017, p. 2341). Alternatively, as a way forward, to aptly gain the fullest from the previous technology adoption theoretical constructs, the key is to dissect the essential requirements, add, propose, and test more constructs to broaden technology adoption studies (Lorenz & Buhtz, 2017).

Another strong critique and limitation for using UTAUT in this study relate to its use of constructs and variables language, making the theory fit for quantitative studies. While this is true, the use of UTAUT in this purely qualitative study was mindful of this limitation. For instance, UTAUT choice and selection for this study was after data collection to guard against the collection of biased data. The theory constructs were integrated to offer supportive explanations regarding farmers’ mobile adoption and use experiences. The intention was to analyze farmers’ narratives and keep within the socio constructivist ontology that guided this study. Moreover, several qualitative studies have explored the use of UTAUT in analysing technology adoption and use in different settings (Barrane, Karuranga, & Poulin, 2018; Gruzd, Staves, & Wilk, 2012; Jayaseelan, Kadeswaran, & Brindha, 2020).

It should, however, be noted that the above levelled critiques about UTAUT can equally explain why the theory has attracted several reviews. As a theory that amalgamated many constructs and moderating variables, UTAUT has undergone several reviews, adding and subtracting some variables to increase its utility. For example, UTAUT 2 has added hedonic motivation (enjoyment), price value, and habits as key predictors for behavior intention to use technology in consumer technology use context (Venkatesh et al., 2012). Additionally, the ultimate intention of UTAUT2 was to extend the generalizability of original UTAUT from an organizational to non-organizational settings like for instance, consumer context (Ibid). Whereas UTAUT2 additions of hedonic motivation, price value, experience, and habit pose a limited significant relationship to mLearning in the farmers' context, I strongly insist on using original UTAUT since UTAUT2 context is tailored to consumer technology use contexts.

### 3.2.2 UTAUT Extensions and the study

The UTAUT2 extension on *hedonic motivation* explains how the pleasure gained or enjoyment of using technology influences technology acceptance and use (Venkatesh et al., 2012). Within the mobile technologies for learning context, farmers with organizational smartphones used the phones for enjoyment. While some youth farmers used to engage in online social interactions on WhatsApp and Facebook through sharing photos and political debates, technology use in this setting was purposely for work. In one case study (Grameen Foundation CKW project), only four farmers (one female) reported about the use of mobile phones for games and fun. Concerning gender and age as moderating variable for enjoyment, male and youthful farmers seemed to have explored the hedonic motivation dimension. The detectable level of fun was among some youth farmers who shared information on the WhatsApp group platforms. This sharing turned out to be unpleasurable for some older farmers who considered the group to be specifically for work and not fun.

The UTAUT2 extension on *price value* did not seem to have a strong relationship correlation within this study. Price value denotes bearing monetary cost to use the technology (Venkatesh et al., 2012). The incurring of costs within an organizational setting was not felt in this study. For instance, Grameen foundation provided monthly allowances in the form of internet bundles to help farmers get access to updated agricultural information. Other platforms like pool calling to contact resource persons in case of need for more information were well catered for by the organizations. Thus, the price value was insignificant. However, in another case study (Lifelong Learning for farmers), farmers in pursuit of expert information incurred consultation costs, which affected technology acceptance and use. Although “the price value is positive when the benefits of using a technology are perceived to be greater than the monetary cost” (Venkatesh et al., 2012, p. 161), this did not influence mobile phone use. For instance, even when some felt the need to access expert information, very few ‘called’ to ask about it. This finding confirms that even when the value of information supersedes the cost of calling and SMS, farmers sought support from those around them, hence an indication of how price value can limit intention to use. In another context where price value can explain behavioral intention to use is when Grameen foundation stops supporting farmers with monthly internet subscriptions. But because the study focus was to explore adoption practices within on-going organizational activities, ascertaining this influence will call for another study.

UTAUT2 last extension relates to *experience and habit* (Venkatesh et al., 2012). For some behaviors to become habitual, they must have an influence on prior use to gain automaticity (Ibid). While technology adoption experts believe that habit influences behavioral intention to use (Chan et al., 2010; Venkatesh et al., 2012), in this study, given that the mobile technologies (smartphones) were introduced to farmers before prior use, the aspect of habit was less significant as most farmers owned smartphones for the first time in their lives. This, however, does not seem to imply that no farmer had prior experience in the use of smartphones. Owing to the inception period of Grameen activities in 2008, smartphones were limited. The available smartphones at that time were less sophisticated with limited functions. Out of fifty farmers in Grameen CKW and USAID CC projects, only two reported prior use. These two farmers had limited challenges with use of the new smartphones from Grameen unlike the first time users.

Interestingly, to check on habit, once actions are repeated and activated, attitudes and intentions will always guide a behavior (Venkatesh et al., 2012). For instance, even for farmers with no prior use of smartphones, repeated use to access agricultural content on mobile phones become a developed habit that influenced adoption and intention to use. Such repeated use enters the conscious mind of the user and reinforces continuous action. However, to clearly demystify how habit influences behavior intention to use, given the blossoming integration of mobile technologies to work for most development initiatives, studying these same farmers in the context of other mobile applications can have a significant relationship on experience and habit of use. Further mobile adoption and use experiences among farmers are guided by the Community of Practice theory whose centrality is on collaboration and social learning.

### 3.3 Community of Practice

The Community of Practice (CoP) was first coined to explain learning based on the apprenticeship model (Wenger, 1998). The concept originated from Etienne's work with Jean Lave (Lave & Wenger, 1991), who at that time challenged long-standing instructionist learning approaches and agitated for learning as a social process highly situated in a cultural and historical context. The learning theory has evolved to include aspects of collaboration and social learning. The community of practice refers to groups of people who share common passions and learn how to do better as they regularly engage (Wenger, 1998). The theory puts to perspective the concept of knowledge and learning and how groups can support one another in different learning environments. Such groups encompass relationships that strengthen and support members' activities to achieve similar goals. "Communities of practice are the basic building blocks of a social learning system because they are the social 'containers' of the competencies that make up such a system" (Wenger, 2000, p. 225). For this study, analyzing the possibilities of mobile learning in areas with limited technology resources in a community of practice lens was vital to contribute to an understanding of how mobile technologies can support learning among smallholder communities.

The CoP has been widely used and adopted in education, organizations, associations, international development, governments, and the social sector (Wenger, 2015). In this study, the CoP role in education and international development is profound. Exploring opportunities for extending farmers' learning with the aid of mobile technologies is an educational contribution. Moreover, CoP has been used as an avenue for inclusive education in places where education and learning marginalize some community categorizations (Farnsworth, Kleanthous, & Wenger-Trayner, 2016). The increasing knowledge challenges today demand extending learning opportunities to practitioners in a valued enterprise. The CoP comes in as a strategy to mainstream learning not only as a means to an end but rather, a means to an end product that is useful and applicable to communities (Wenger, 2015). Enhancing a more profound transformation among learning communities is essential to CoP. In the international development scene, current development challenges are not only financial but rather knowledge challenges. In this way, CoP facilitates knowledge building practices where development agencies' role changes from disseminating knowledge to just being conveners of such communities

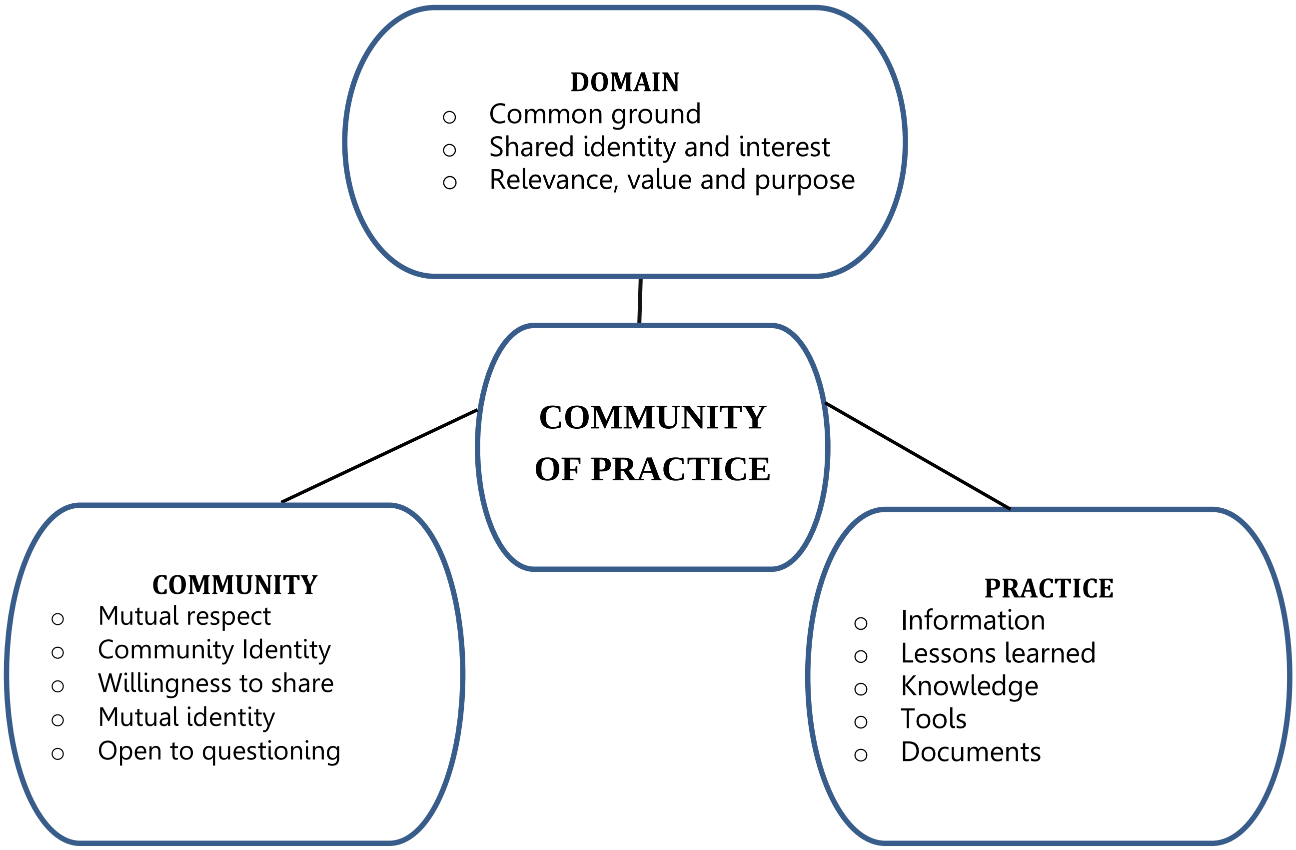
(Wenger, 2015). In this convening role, agencies are now spearheading efforts to initiate conversational points to help communities form and improve practice. Part of the role of agencies is to ensure that communities work in synergistic relationships to sustain learning of a given practice.

In CoP as a learning theory, individuals and social institutions are not a focus of analysis, but rather, communities of practice. To explain the theory in detail, Wenger explores the systematic intersection of learning components: community, practice, meaning, and identity, which provide a conceptual framework of analyzing learning as a social process (Wenger, 1998).

- Meaning implies our ability to experience the world as meaningful.
- Practice is about shared historical and social resources, frameworks, and perspectives that sustain mutual engagement in action.
- The community is a social configuration in which enterprise is defined, and where participation is recognizable as competence.
- Identity looks at how learning changes and impacts on members.

The above basic principles are indicative of learning desired for farmer communities since knowledge is generated through active and mutual engagements where competence building in a valued enterprise supports learning from one another. Presently, the centrality of learning to be a social and situated learning activity defines a CoP (Wenger & Wenger 2016). In Wenger's recent writings, the four concepts, meaning, practice, community, and identity, have been transformed into three constructs: Domain, Community, and Practice (Wenger & Wenger 2016). Implicitly, meaning and identity have been merged to form the Domain. Moreover, in meaning lie experiences of the everyday world and what learners produce (Wenger, 1998). The three CoP constructs are described in Figure 8.

**Figure 8: Community of Practice (CoP)**




Adapted from Walimbwa 2017

### 3.3.1 Domain

"The notion of community of practice does not primarily refer to a 'group' of people per se. Rather it refers to a social process of negotiating competence in a domain over time" (Farnsworth et al., 2016, p. 143). Thus, CoP is not about the community of friends and network connection between people, but rather, a practice of an identity defined by a shared domain of interest (Wenger, 2015; Wenger & Wenger 2016). A domain is an issue that matters to all individual members subscribing to a community, including a common ground, shared interests, identity, values, and purpose (Wenger, 2015). The social process of negotiating competence is primary to CoP, while the social relationships involved among people is secondary (Farnsworth et al., 2016). In domain lies valuing collective competencies and learning from one another (Wenger & Wenger 2016). In this thesis, the domain is the usage of mobile technologies in learning about farming. The shared identity relates to increased access to information and new knowledge to address farming and livelihood challenges. Usability and deployment of mobile technologies like mobile phones, laptops, and other assistive technologies to access and share knowledge are aspects that bind farmers together in search for new knowledge to enhance farming practice.

### 3.3.2 Community

In pursuit of the collective competence and desired domain, members share information and engage in joint discussions and activities to help each other (Wenger, 2015). Such joint discussions allow for mutual relationships, mutual engagements, and mutual sharing. Therefore, a community includes individuals that constitute the membership in a given domain and where individual members know where and from whom to find information (Wenger & Wenger 2016). Moreover, a community encompasses membership whose relations and ways of doing things are defined by mutual engagements (Wenger, 1998). A community only happens when members involved in a practice domain share information amongst themselves with spaces of interacting and learning together (Wenger, 2015).

Therefore, a community is not about a group, teamwork, or network; membership is not about a social category of belonging to an organization or knowing someone; neither does geographical proximity. The CoP reechoes engagements that support mutual interactions and learning from one another (Wenger, 1998). This mutual understanding happens in an enabling environment where diversity and partiality are emphasized. In this thesis, the focus of membership in this community is smallholder farmers using mobile technologies to learn about farming. The main aim of the community is to share and discuss best practices, design communication solutions, mentor practitioners, and advance knowledge (Walimbwa 2017). To sustain a community, commitment, and collaboration among members is vital for continuous performance and practice.

### 3.3. Practice

A community where members have similar interests does not translate into a Community of Practice; instead, members in CoP are practitioners with a shared repertoire of experiences, resources, and tools to address a shared problem (Wenger, 2015). Practice entails experiencing the world as meaningful. Practice includes developed, shared, and maintained knowledge, including information, tools, and documents (Wenger  & Wenger 2016). For this to happen, there has to be sustained interactions, mutual engagements, and the willingness to learn from one another in shared practice. In another perspective, Bannister (2015) defines practice as experiences and lessons learned by different practitioners at different levels. In this thesis, practice is non-formal, resource-constrained characteristic of limited mobile technologies, illiterate membership, and where agricultural extension does not meet the majority in rural locales. Learning about farming with mobile technologies was a practice contextualized to support knowledge access and use in a resource-constrained setting. In this case, practice becomes an act of engaging in an activity repeatedly to improve or master it (Wenger  & Wenger 2016).

### 3.3.4 mLearning Communities of Practice (CoP) among Smallholder farmers

Reflecting on the relationship between CoP and the study focus, communities of practice are everywhere, too informal and pervasive (Wenger, 1998). Mobile technologies support learning in the farmer's context to enhance farming practice. Learning is participation in the social world where individual experiences become integrated into the learning process, and where participation aims at achieving a common aim. As Mohammed and Josep (2014) note, mobile technologies can develop communities of learners, which in turn contributes to collaborative learning skills.

Similarly, communities of practice can support learning outside mainstream education (Wright & Parchoma, 2011). In CoP, most learning occurs informally when learners are connected and where their experiences are a central focus. In this study, attention is placed on farmer groups since all the three mobiles for development case studies used the groups approach in reaching out to farmers in different rural locales. Moreover, most programs and livelihood interventions emphasize group strategies to exploit group bonds and networks. For this study, whereas analysis of individual farmer's activities was one way to explain how mobile technologies have impacted on farmer livelihoods, much attention was placed on farmers in groups who, either by choice or organizational requirement, joined the farming groups to work as a team and achieve a common aim.

In explaining CoP as a framework of analysing mLearning for smallholder farmers, Wenger (1998, p. 232) describes five activities: events, connectivity, membership, learning projects, and artefacts that support learning in a given practice as depicted in Table 2.

i. *Events* entail activities that bring the community together. In the farmers CoP, farming, poultry, animal rearing, apiary, nutritional management, and village saving projects are activities that brought farmers together.

ii. *Connectivity* includes various contexts and media used. Mobile technologies (mobile phones and laptops), community radios, village meetings, social gatherings, and religious places entailed channels that allowed for stronger community bonds.

iii. *Membership* encompasses groups of learners involved in similar activities to achieve a common or shared aim. Among the membership in all the M4D projects, farmers, service providers, project staff, local leadership, and government officials were part of the large network that facilitated learning on mobile technologies.

iv. *Learning projects* include activities that explore or fill in gaps in the knowledge and practice of a community. Learning projects like farming sites, nutritional gardens, apiary sites, village saving schemes, sanitation and hygiene standards and family life schools increased the commitment of participating members in yearning to learn.

v. *Artifacts* include produced, gathered, and useful community activities that support reflections in CoP. Facilitation manuals, documentaries, farmers' records, village saving kits and farm field pictures supported farmers' reflections in their practice.

**Table 2: Activities in mLearning for Farmers’ CoP**

| mLearning Community of Practice | | | | |
|---|---|---|---|---|
| **Events** | **Connectivity** | **Membership** | **Learning projects** | **Artifacts** |
| Farming<br>Poultry<br>Animal rearing<br>Apiary<br>Village savings groups | Mobile phones (small end and smartphones)<br>Laptops<br>Solar equipment<br>Community Radios<br>Village meetings<br>Social gatherings<br>Churches | Community Knowledge Workers<br>Farmers (enrolled by projects)<br>Other farmers<br>Service providers<br>Projects staff<br>Local leaders<br>Government officials | Coffee farming<br>Banana farming<br>Nutritional sites<br>Apiary sites<br>Village saving schemes<br>Hygiene, sanitation<br>Food security and malnutrition<br>Family planning | Facilitation manuals<br>Learning sites<br>Documentaries<br>Farmers records<br>Farmers gardens<br>Group records<br>Village saving kits<br>Field pictures |

Communities of practice do not fall from heaven. There must be an initiator to start the process. These are called *champions* who create conversation points in the group (Wenger, 2000). These conversation points entail events in the form of activities communities engage in and are part of their day to day activities. The community champions interest other members at the level where activities become ‘natural’ and part of the community. The initiation point of any community has a start. In CoP, champions are part of the community whose livelihood activities are embedded in the community they live, which form the practice and domain attributes (Wenger & Wenger 2016). Whereas CoP insists on the initiator being part of the community, it gives leeway for an outsider to initiate a given practice with the community.

In line with all the study organizations, the initiators of these mobile technological initiatives were outsiders, who worked with local farmers to challenge existing practices and improve livelihoods. The role of CoP in international development is to have funders as conveners instead of knowledge givers (Wenger, 2015). In this regard, funders in mobiles for development projects provided and facilitated platforms (mobile technologies) where farmers supported one another to share information about farming. In this way, a CoP of farmers using mobile technologies was created and supported by international organizations.

Within CoP lies diversity of membership, both experienced and inexperienced in an identified practice (Walimbwa, 2017). This categorization of membership works together to produce an outcome beneficial to the entire community. Thus, it is in this guise that this study looked at farmers using mobile phones as a domain working towards enhanced farming practice. Additionally, in the CoP, there is centrality on the identification of members and the creation of learning communities that enable knowledge and skills sharing in a given practice problem. Emphasis is not only limited to bringing new knowledge but rather, helping the growth of knowledge needed within a specified practice. In CoP, to allow others to contribute to this learning network, the focus is not only for the experienced to bring knowledge, but a practice where learning networks can be established to build and sustain a given practice. Therefore, "practitioners with more experiences must be active participants with a willingness to form a core cohort that mobilizes and brings aboard other practitioners" (Walimbwa, 2017, p. 122).

Relatedly, in CoP, all practices are local (Farnsworth et al., 2016). Activities and other interaction begin locally, that is contextualized to fit within defined community domains. This means that communities have local geography of competence that has to be reflected in mutual engagements. Therefore, the need to appreciate such local complexities within negotiations of competence is essential for learning in the community. This appreciation of local complexities helps to situate learning in authentic environments responsive to local community needs. Therefore, to ensure the sustainability of knowledge sharing processes, there is a need to localize communities of practice. Further, in CoP, learning is partly a localized social activity, highly facilitated through peer interactions (Wenger, 2009). The peers support newcomers to socialize and learn different processes and activities in the community, which broadens the mobile learning network. Within the mLearning farmer groups, some farmers termed as non-project farmers were not initial group members. But through socialization and the need to learn, these joined different farmer groups and were even more committed than original group members. A detailed explanation about different farmer participation levels is discussed in Chapter 7 (section 7.2.2).

The point of contention from this analysis is that technology plays an instrumental role in maintaining and sustaining CoP. Mobile technologies have the potential to strengthen communities to achieve their common purpose and aim. Connectivity and willingness to share resources within a given practice is privy to CoP (Wenger, 1998). Whereas this study analyses how mobile technologies support learning about farming, the same technologies have equally supported connectivity amongst group members. Hence, the mobile phone not only acts as an information giver but also a connection point that supports farmers' interactions. This connectivity (not just limited to mobile phones) is essential in resource-constrained locales where this study was conducted. Particularly, the mobile phones were not the only connection points used, but other connectivity platforms like community radios, village meetings, and other social gatherings where deemed instrumental in helping communities get updates about the different events within the farmer's mLearning CoP.

Wenger's Community of Practice theory emphasizes learning as competence building in a socialized perspective. The gist is to place learning as a social activity highly embedded in social interactions and mutual relationships. Quite notably, communities of practice are not only communities where learners share information about shared goals, but rather, communities where learners learn to learn from one another (Nampijja, 2017). The learning processes are continuous, where all learners agree and accustom to learning from each other (Walimbwa, 2017). Most importantly, in CoP, learning is not for learnings' sake. Learning is participation in the social world and problem-solving in nature (Farnsworth et al., 2016; Wenger, 1998). Learning ends up in a practice-based context that embraces livelihood support. In line with this study, smallholder farmers' learning for livelihoods aims at meaningful action, use, and change in practice (Wenger, 1998, 2000). This learning fits in non-formal categorization where learning aims at solving farmers' immediate problems.

What defines a good theory lies in its ability to change form given the emerging lessons from different practitioners (Farnsworth et al., 2016). Currently, CoP is looked at as a social theory of learning. However, this study did not get further in exploring these social dimensions to learning with the farmer communities. Besides, in the farmer's valued enterprises, learning was not entirely a social activity. Thus, to get a broader dimension of how learning revolved, the social constructivism theory was integrated to offer this study complete learning and assessment processes within the farmers CoP. A profound departure from the two approaches to learning is how social constructivism highly regards learners' personal experiences. While CoP looks at experienced learners as members to spearhead community learning processes, social constructivism looks at all learners, whether experienced or not, with valued expertise to bring to the learning process.

Nonetheless, some principles within the CoP are still applicable to social constructivism. Like Jing (2017) notes, social constructivism has enormously contributed to the development of CoP thinking. The next section explains social constructivism and how it was used in this study.

## 3.4 Social Constructivism (SC)

Conventional learning theories are strong determinants in shaping how participants achieve the intended learning outcomes in any learning activity. Mobile learning frameworks being adopted in most education and learning processes have not changed the learning theories but have influenced the learning process. Learning for livelihood support in this study encompasses participants' engagement in non-formal learning contexts. This study relied on social constructivism learning theory to situate and understand mobile learning for livelihoods amongst smallholder communities. The rationale for social constructivism is that most of its attributes like collaboration, learner autonomy, social context of the learners, and reliance on learner experiences are characteristic of learning in the non-formal contexts.

The constructivist notion of learning seeks to understand how people create their knowledge and what these imply on their thought processes (Adams, 2006). Constructivist ideas categorized "under the umbrella term 'constructivism,' describe not a coherent set of proposals or features, but rather a series of ideas that can be thought of as sharing some family resemblance: [where] learning is an active process of constructing knowledge to make sense of the world" (Adams, 2006, p. 245). Constructionists view knowledge as highly generated and constructed by the learner.

Among the typologies of constructivist learning, social constructivism is one that can well represent learning about farming in non-formal contexts. Social constructivism relays on the premise that learner construction of knowledge is a product of social interaction, interpretation, and understanding (Vygotsky, 1962). In social constructivism, people are active learners in the process of knowledge construction with regard to the deployment of materials through the manipulation of social interactions (Schunk, 2000). The theory agitates for the shared creation of knowledge with others. It further embraces respect for human existence to be part of the social influence of knowledge creation, where learning becomes a process of active knowledge construction. This means that the learner constructs meaning making in the process of trying to understand the world around him/herself. Goodman 1986, cited in Prawat & Floden, echoes that in social constructivism, "knowledge is developed by a dialectical interplay of many minds, not just one mind" (1994, p. 37). This reciprocal interaction and interplay of knowledge is a social product highly negotiated with others in the community disclosure (Ibid).

Most importantly, in the social lies the learner's vast field of experiences, cultivated to become part of the knowledge construction process. The ability of learners to blend their learning with previous learning experience is central to social constructivism. The relevancy of the learners' phenomenological field of the past experiences offers learning spaces about learning for livelihoods. Therefore, experience is prime to social constructivism where the learner becomes the central actor. Amidst the social co-creation of meaning, the learner has the personal responsibility to predict socially agreeable interpretations to judge the veracity of meaningful knowledge (Adams, 2006). This agreeable interpretation of knowledge requires negotiation through compromise and consensus building for those involved in the knowledge co-creation process to understand one another. Such negotiations can denote a skill of overcoming a learning challenge (Prawat & Floden, 1994). To obtain a socially recognizable and appropriate form of knowledge, the aim of learning in social constructivism is to help learners become "aware of the realities of others and their relationship with and to one's own" (Ibid, p. 246).

This awareness and respect of others' ideas explain why in social constructivism, agreements and disagreements in the form of opposing and supporting the 'others' views allow for critical and insightful learning (Jing, 2017). Negotiations in learning take place in an environment that allows for collaborative learning. Likewise, the teacher plays an instrumental role in managing the negotiation activities with due fairness for those involved in the learning process. To further emphasize how knowledge is socially constructed, Adams suggests some principles which have guided social constructivist pedagogy (Adams, 2006, p. 247).

i. Focus on learning not performance.
ii. View learners as active co-constructors of meaning and knowledge.
iii. Establish a teacher-pupil relationship built upon the idea of guidance not instruction.
iv. Seek to engage learners in tasks seen as ends in themselves and consequently as having implicit worth.
v. Promote assessment as an active process of uncovering and acknowledging shared understanding.

Traditional instructivist theories mostly emphasize the amount of learning attained in the learning process. Instructionists view learners as vessels to reproduce knowledge being deposited by the teachers. This view of learning is contrary to social constructivism, to be more specific, even learning in non-formal contexts. In non-formal learning, the learner controls the learning process, and the teacher becomes the facilitator. The danger of controlling learning in the name of ensuring good grades and increased performance is detrimental to active learner engagement. Once learning becomes performance focused, innovativeness and creativity will be restricted among learners. Thus, "performance orientation removes the locus of control from [learners] since [facilitators] become the focus for success" (Adams, 2006, p. 248). This does not seem to imply that learners (including farmers) do not strive for improved performance. Like any learning, (including learning in the non-formal), all efforts are geared towards better output. However, there is a need to be mindful of the process to discourage rote learning (Bjørke, 2014) and enhance farmers' sustainable learning practices.

Learners are active co-constructors of meaning and knowledge. Active co-construction of meaning by the learners is highly vested in the power of the mind in social constructivism. As picked from the term construction, social constructivism puts emphasis on learning as a mindful activity that incorporates social and cultural factors in the formulation of the learners' understanding (Adams, 2006; Nawaz & Kundi, 2010). This active co-construction of meaning presupposes the role of others in knowledge construction where learning is primarily a social process of meaning making (Vygotsky, 1962, 1980). The influence of cultural factors on human cognition is fundamental in constructivism. Thus, it is in such cultural attributes where lies the social since the human mind has the capability to emulate from the surroundings. Prawat and Floden (1994) clarify the potency of social influence in integrating the here and now experiences of the learner. This incorporation of here and now and other cultural attributes support knowledge generation and strengthens deep learning where focus goes beyond memorization of ideas.

The strengths in social constructivism lie in its emphasis on learning as "a process of personal understanding and the development of meaning where learning is viewed as the construction of meaning rather than as the memorization of facts" (Nawaz & Kundi, 2010, p. 31). This personal understanding and development come from a shared effort to co-construct meaning and mutual understanding between learners, peers, and facilitators. The learner to learner and learner to facilitator interactions increase spaces for collaboration and scaffolding where learners can reconceptualize from their everyday practice. Learner's daily reconceptualization of meaning justifies why social constructivism is fit to understand learning among smallholder farmers. The farmers' non-formal context emphasizes co-creation of knowledge to achieve a shared aim.

Further, in social constructivism, the teacher and learner relationship is built upon the idea of guidance and not instruction. Instructionist pedagogies like behaviorism posit the teacher's exposition in a top-down relation with learners as passive recipients of knowledge. In social constructivism however, the role of the teacher is to mediate, guide, and facilitate the learning process. In this relationship, the learner becomes an active constructor of knowledge, while the teacher an organizer and source of information (Adams, 2006). Whereas the teacher-learner relationship changes in social constructivism, this does not imply the less significance of the teachers or facilitators in learning activities. Instead, the teacher role necessitates providing "a safe environment in which student knowledge construction and social mediation are paramount" (Adams, 2006, p. 250). A further description of this teacher-learner relationship relates to motivation and commitment to intellectually engage. Here, even when rewards in terms of task accomplishment are essential, learners' understanding is nurtured towards personal growth and intrinsic motivation to understand the meaning of tasks ahead. Thus, in social constructivism, motivation is intrinsically developed. Learners strive towards commitment and persistence to meaningful understanding (Adams, 2006). This understanding of common knowledge is facilitated in an authentic environment where learners can engage with their everyday life experiences through negotiating with others in their socio-cultural space (Jing, 2017).

Similarly, learning tasks have implicit worth. The social constructivism approach to learning seeks to engage learners in tasks seen as ends with implicit worth (Adams, 2006). This means that "a sense of purpose and the way a task situates a [learner] are that which provide meaning, and increases motivation (2006, p. 251). Whereas learning extrinsic reward systems provide and influence motivation, they can simultaneously undermine interest and demotivate learners, most especially if they attack a learner's intrinsic self-worth. Although reward systems can increase the quality of learner behaviors in working with peers, mindful commitment to learning, purpose, and a deep sense of self-awareness might be minimal (Gentile et al., 2007; Jing, 2017). Therefore, a mindful commitment that cultivates interest in learning is nurtured in an environment that seeks to engage learners in tasks that are of implicit worth. Similar to the mLearning farmer's contexts, such tasks require learning environments that address real-life challenges and cultivates learner's socio-cultural spaces in authentic environments.

Lastly, social constructivists view assessment as an active process of uncovering and acknowledging shared understanding. Teaching, learning, and assessment are essential aspects of education, the latter being a key determinant to examine whether learning has occurred. In traditional pedagogy, learning is synonymous with good grades attained from assessment, which alludes to extrinsic motivation (Shepard, 2000). Conversely, in the social constructivist orientation, assessment is integrated into teaching and learning processes (Adams, 2006). In this guise therefore, assessment is construed as a reward given to those involved in learning. Similarly, good assessment is synonymous with good instruction (Shepard, 2000). If learners through a process of scaffolding are given useful instructional tasks, most likely, good assessment will be obtained. This means that "within a social constructivist perspective, assessment seeks to consider how and why [learner] positions do not successfully mediate into the social domain; that is, how and why [learner] responses do not ‘fit’ with current socially agreed interpretations” (Adams, 2006, p. 252).

Therefore, the discursive teacher-learner relationship plays a significant role in ensuring that learning happens within the learner’s confines with tasks of great worth. The above characterizations of learning and performance, learners as active co-constructors of meaning, learning relationship built on guidance, learning tasks of implicit worth, and assessment as shared understanding were significant to the study findings as discussed below.

### 3.4.1 Relating Social constructivism to the study

Within the confines of social constructivism, socially meaningful activity is as important as human consciousness. The social environment influences cognition through tools like mobile technologies (Schunk, 2000). The rationale is that change results from a combination of tools (like mobile technologies) in social interactions and from internalizing these interactions. Peoples’ interactions of mobile technologies and social events resonate constructivism because of its emphasis on peoples’ involvement in learning. This section elaborates how social constructivism relates to the farmers’ mLearning activities.

*First is learning vs. performance measurements*. The need to focus on learning rather than performance is necessary for understanding how learning revolved among smallholder farmer communities. Facilitator control is sometimes detrimental to active learner engagement. Moreover, once learning becomes performance focused, innovativeness and creativity will be restricted (Adams, 2006). In the non-formal farmer’s context where learning is for personal growth and development, the control of the learner was visible in some instances. For example, in Grameen CKW projects, farmers’ efforts are measured on their ability to use the information, which is performance measurement. But because some other factors constrained farmers in using the information, this does not mean that no learning occurred.

Whereas performativity is a locus in non-formal contexts, given the contextual challenges within which farmers operate, we cannot conclude that learning did not happen. Hence in this perspective, I affirm with social constructivism that sometimes, learning and not performance is essential to understand the knowledge attainment processes. Moreover, in social constructivism, “at the heart of these performativity orientations lies the need to ensure that [learners] exhibit behaviors that can be credentialized (i.e., graded and celebrated) with externally moderated marking procedures” (Adams, 2006, pp. 248-249). This implies that any external assessor of learning can observe learner behaviors to measure what learning has occurred. Besides, amid resource-constrained restrictions in the farmers’ setting, assessments ought to appreciate the contextual limitations within which farmers operate. A more detailed analysis of farmer assessments in the study is discussed in Chapter 6 (section 6.3.1b).

*Secondly, farmers are active co-constructors of meaning and knowledge*. Social constructivism appreciates the role of the mind in the construction of knowledge. Here, learners and facilitators take part in a dual-centric shared knowledge construction activity, incorporating the social and the cultural worlds (Adams, 2006). This joint construction of meaning is not only limited to learner facilitator relationships, but learner to learner constructions are equally significant. Thus, in this theory, learning is a dual-centric activity where learners and facilitators co-construct meaning by offering support to one another. The discursive nature of learning in social constructivism puts relevancy on the role of scaffolding from not only facilitators but also fellow learners. In the farmers' mLearning context, while content on mobile technologies availed new knowledge, farmers' discussions in authentic environments facilitated the construction of meaning. Such interactions supported individual farmer reflections to control and pace their own learning. Thus, in this mLearning study, content on mobile phones was not the only source of knowledge since farmers had opportunities to construct meaning and knowledge relevant to their practice.

*Thirdly, the facilitator-learner relationship is built upon guidance*. In social constructivism, learning environments facilitate self-controlled and socially collaborative learning tasks (Nawaz & Kundi, 2010). Learners have more freedom and liberty in the knowledge construction process, where the facilitator becomes a guide than an instructor.

In this guiding position, the teacher sets a favorable environment that nurtures self-worth and growth and becomes a potential source of information (Adams, 2006). The practicability of social constructivism lies in appreciating learning in highly authentic, collaborative, and problem-solving environments where facilitators act as learning enablers. Facilitators provide a safe environment that supports knowledge construction and social mediation (Ibid). Moreover, as Vygotsky (1980) clarifies, the process of scaffolding the learner journey is a central [facilitator] prerequisite in social constructivism. In line with this study, the Community Knowledge Workers (CKWs) and lead farmers in different locales were facilitators who interacted with farmers and learned from one another in peer to peer support relations. The facilitators guided farmers on different farming challenges in a shared problem-solving manner.

*Lastly, is farmers' assessment as shared understanding*. Assessment as an active process of uncovering and acknowledging shared understanding was sought necessary to analyze how farmers used the knowledge shared on mobile technologies. Whereas assessment is less famous in non-formal learning contexts, based on established practices by the mobiles for development projects to measure learning among the farming communities, I found assessment worth discussion. Assessment typologies like assessment of learning and assessment for learning are vital aspects to consider in this study. Social constructivism is premised on assessment for learning where assessment is an integral activity in teaching and learning. This requires an exploration of what the learner can or cannot do. To juxtapose with Vygotsky's Zone of Proximal Development (ZPD)[6], an appreciation of support from significant others (who can even be peers) avail rich opportunities for teaching and learning. Assessment for learning redefines assessment as a dynamic and integral on-going part of learning. In the "proximal" lies the skills that the learner is "close" to mastering. This dynamic discursive process in assessment does not only call for the teacher intervention as peers too are central in assessment activities. Relatedly, as Adams clarifies, "the ZPD opens up possibilities for peer assessment, whereby [learner] communities of practice provide opportunities for and requirements to share thought processes" (Adams, 2006, p. 253).

[6] ZPD is the difference between that which a learner can do independently and that which can be achieved with the support of a more significant other (Vygotsky 1980).

In the mLearning farmers' context, assessment for learning becomes a conversational requirement that provides opportunities for self and peer assessment through collaborative learning activities. The Grameen CKW project used the language of adoption, which literary meant farmer assessment of whether the shared knowledge was used. The assessment was integrated into on-going farmers activities. In regard to the ZPD, proximal zones were evident where the less knowledgeable farmers were supported by the knowledgeable and experienced farmers in possession of smartphones. However, it should be noted that while most farmers gained knowledge about modern farming practices, the lack of means to use this knowledge affected knowledge uptake. Nonetheless, since assessment in social constructivism looks at learning and not performance, a conclusion can be made that learning happened amidst constraining factors that stampede farmer's use of the attained knowledge.

## 3.5 Synthesizing the Theoretical perspectives to mLearning Farmers Practice

Relating the Community of Practice to the Actor-Network Theory, ANT recognizes the need to have an initiation point that brings the community together, so is the CoP where champions have to initiate conversational points for the community to engage in a given practice. This initiation in ANT language is the Obligatory passage point (OPP), where members of the community agree to work on what they deem is a critical problem to address. This OPP is the real problem affecting the farmer communities, and once learning activities tap and fit within people’s experiences, such activities influence community actions. ANT suggests four translation moments: problematization, intressement, enrollment, and mobilization, which suggestively claim for a needs assessment to address the OPP. However, even when both theories point to the need to have an action point - the problem/need that causes the community to emerge, this initiation point discussion can either be internal or externally reinforced. ANT refers to this as the macro actor, one who initiates an idea and uses the four moments of translation to make people understand and join the community of learning. Wenger (1998), however, claims that even when the action points can be externally reinforced, the real needs must come from within the community. Therefore, while CoP appreciates the role of outsiders (like funders) in convening groups to address a shared problem, the bottom line is that champions should be core and active members in the community of practice.

Similarly, the Unified Theory of Acceptance and Use of Technology (UTAUT) comes in to explain whether people are passive or active consumers of technologies. Like ANT analyses, farmers can be active or passive depending on whether the technology is useful to their livelihoods. Moreover, CoP appreciates that once farmers do not comprehend the use of resources like mobile technologies, they will stay at the periphery of the network which certainly distances them from the practice. Likewise, in the technology adoption language, UTAUT makes a claim about performance expectancy that once technological integration is viewed as of high relevance to community needs, farmers will adopt and use the technology. Facilitating conditions, ease of use the technology, and voluntarism can explain technology adoptions and use in farmer's day to day activities. For instance, if farmers consider technologies and information given as being hard, they will stay at the periphery since actions within a given practice are not in line with their domain (farming).

Equally, social constructivism principles entail social collaborations, mutual support, and interaction essential in enabling practitioners to use mobile learning as a platform to access and share actionable knowledge among farmer communities. mLearning embraces learning that is personalized, contextual, situated, authentic, and problem-solving in nature (Sharples, 2005; Sharples et al., 2005; Sharples, Taylor, & Vavoula, 2010). These streamlined principles of mLearning are reflective in the CoP and SC. ANT and UTAUT explain activities that define levels of participation in different communities, so is CoP. Moreover, ANT cautions us about the black box notion where activities of a group become a norm and where people cease to see challenges. This to CoP are little fortresses that hinder group creativity and innovativeness. Thus, ANT and CoP calls for opening up established networks (groups) to allow for new ideas and membership in the learning groups.

Considering that this was a multi-disciplinary study with technology, learning, and livelihoods, identifying a single theory would not offer an exclusive explanation to support the study analyses. The proposed frameworks worked in synergistic relationships to contribute to a general conceptualization of mobile technologies and learning for livelihood support. Table 3 offers a summary of the different theoretical perspectives, their rationale for use, and how each supported the analysis of the study research questions.

**Table 3: Summary of the chosen theoretical perspectives**

| Theoretical perspective | Nature of Explanation | Rationale for perspective choice | RQs |
|---|---|---|---|
| (1) Actor-Network Theory | This perspective helps to explain networks available in mobile for development projects. It further describes the social and technological constructions in relation to technology uptake by smallholder farmers. | - Explicitly addresses the importance of both human and non-human actors in technology adoption processes<br>- Gives an opportunity to explore human actors and their needs, which aspect is often under emphasized<br>- Useful to explain the active-passive continuum in situating actual participation of farmers' use of mobile technologies<br>-Advances the four moments of translations (Problematization, Interessment, Enrollment, and Mobilization) that can explain technology use processes in resource-constrained settings | RQ1<br>RQ2<br>RQ5 |
| (2) Unified Theory of Acceptance and Use of Technology | The perspective facilitated the exploration of factors that explain the adoption and use of mobile technologies for learning among smallholder farming communities. | - Gives an opportunity to explain performance expectancy, effort expectancy, social influence, and facilitating conditions as factors that influence behavioral intention to use mobile technologies.<br>- Useful to explain moderating variables like Gender, Age, Experience, and Voluntariness of use that influence intention to use of mobile technologies<br>- Works well in adding contextual factors that explain | RQ1<br>RQ2<br>RQ5 |

| | | | |
|---|---|---|---|
| | | the adoption and use of a mobile technology | |
| (3) Social Constructivism | Social Constructivism helped to analyze non-formal learning activities ingrained in the farmer's daily practices. | - Advances how knowledge is socially constructed and heavily grounded on learner experiences.<br>- Useful to explain how farmers learn through joint co-construction of knowledge.<br>- Focuses on the learning process rather than performativity.<br>- Explores how the facilitator-learner relationship is premised on guidance rather than instruction.<br>- Proposes learning that engages farmers in authentic tasks that are problem-solving in nature.<br>- Credits assessment as an integral activity in farmers learning | RQ3<br>RQ5 |
| (4) Communities of Practice (CoP) | CoP supported an understanding of different activities regarding the formation and processes of farmers' mobile learning practice in rural areas. | - Useful to explain learning as a social process through analyzing intersection points of meaning, community, identity, and practice<br>- Gives an opportunity to explore how mobile technologies do not create the farmers' practice but offer support to maintain and sustain learning interactions.<br>- Acknowledges the differences in farmer's participation levels in the mobile learning community of practice. | RQ3<br>RQ4<br>RQ5 |
| RQ1: What are the perceptions among smallholder farmers on the use of mobile technologies for livelihood enhancement? | | | |

RQ2: What are the smallholder farmers experiences regarding the adoption and use of mobile technologies for learning purposes?
RQ3: What are the possibilities and constraints of applying mobile technologies for learning in livelihood projects?
RQ4: What mLearning capabilities can support food security systems among smallholder farmers in rural communities?
RQ5: What mLearning conceptualization can support smallholder farmers' livelihoods?

# 4. Methodology

This chapter offers a detailed description of key strategies that the study employed to collect data and answer the research questions. The section accounts for the philosophical positions, research design and offers a justification for the individual connecting parts that give context to the study methodological orientation. Methodology alludes to “choices we make about the cases to study, methods of data gathering and other forms of data analysis … [in] planning and executing a research study” (Silverman, 2005, p. 99). In this study, such choices included making judicious decisions about the multiple-case study sites, the actual region where the study was conducted, and methods under which data was collected and analyzed. An account of how quality was streamlined in the study, ethical considerations, and the general reflexivity in the research process were considered.

## 4.1 Ontological and Epistemological Positions

Philosophical positions are inherent in the research process as they determine how a researcher understands the world. These include beliefs, assumptions, interpretations, and meaning the researcher brings to the study. Put more clearly, how the researcher understands ‘being in the world’ (ontology) and ‘the nature of knowing’ (epistemology) shapes the methodology that is adopted for the study (Somekh & Lewin, 2011). Bryman (2012) argues that although most qualitative studies are distinguished from quantitative studies in the form of numbers, other categorizations like inductive, epistemological, and ontological ideas can explain the distinction better.

The epistemological approach to research in this study is interpretivist, given the interest in understanding and listening from people about their views on how mobile technologies enhance learning for livelihood support. In the interpretivist paradigm, “human action is seen as a collection of symbols expressing layers of meaning…but how one interprets depends in part on the theoretical orientation taken by the researcher” (Berg, 2001, p. 239). In this paradigm, there is an empathetic understanding of human actions rather than the forces that deem it (Bryman, 2012). Similarly, “as people grow up, interact, and live their daily lives, they continuously create ideas, relationships, symbols, and roles that they consider to be meaningful or important” (Neuman, 2007, p. 43).

Ontologically, my view of reality is constructivist. Here, social realities are outcomes of the changing interactions between individuals to generate concrete meaning (Bryman, 2012). The constructionist orientation believes that social phenomena and meaning are being continually accomplished by social actors. Individuals develop the "subjective meaning of their experiences…, leading the researcher to look for the complexity of views rather than narrowing meaning into a few categories of ideas" (Creswell, 2014, p. 8). Participants' contextually driven narratives are grounded in cultural attributes and language that influence meaning-making. A study attempting to understand how mobile technologies can facilitate learning for better livelihoods, analyzing smallholder farmer's constructions of mobile learning realities in their context helped to generate reliable interpretations of social phenomena. This philosophical orientation guided data collection, analysis, and documentation of the study conclusions.

### 4.1.1 Role of theory

The theoretical foundations presented in Chapter 3 partly guided on data collection and analysis. The Actor-Network Theory, Unified Theory of Acceptance and Use of Technology, Social Constructivism, and the Community of Practice offered insights through which data was interpreted and analyzed. While theory plays a central part and avails valuable insights, Walsham (1995) notes a danger that researchers may use theory in rigid ways limiting new exploration of emerging issues. In line with this affirmation, I tried to be open during data collection to allow for emerging insights. The constructivist ontology allowed for the gathering of issues from smallholder farmer's constructions. The theoretical integration was at the level of data analysis by matching with what participants had identified as crucial experiences about mobile learning realities in their context.

### 4.1.2 Role of the researcher

Qualitative studies are premised on the fact that interpretive researchers do not report facts, but instead, report interpretation of other people's interpretations (Walsham 1995). As emphasized by Geertz (1988, p. 9), "what we call our data are usually our own constructions of other people's constructions." To ably ascertain the credibility of people's constructions, interpretive researchers have to explain some details of how they arrived at the study findings/interpretations to help the reader keep track of the methodological processes (Walsham, 1995).

With this interpretivist position, the researcher's involvement becomes sustained and intensive with the study participants (Creswell, 2014). By implication, in this study, establishing a good and close relationship between the researcher and those studied was emphasized. This relationship goes beyond accessing participants to focusing on how to ethically gain the right information that answers the study questions. "Conceptualizing your relationship entirely in terms of rapport is problematic because it represents a single continuous variable rather than emphasizing the nature of the relationship" (Maxwell, 2013, p. 91). Therefore, reflecting on how participants perceived me sustained this relationship.

To further assess people's constructions and filter through different opinions, interpretivist researchers take two roles: the outside observer and the involved researcher (Walsham 1995). The outside observer creates a distance from the study processes and is not part of the system. The involved researcher, on the other hand, is a participant observer who takes part in ongoing research activities. In either outsider or insider positionality, the collection and interpretation of data in interpretivist research involves the researcher's subjectivity (Walsham 1995). While Walsham claims for the researcher's interpretation, Råheim et al. (2016) believes that the community being studied is also active in data collection and analysis. In this way, participants are not passive as research processes are negotiated between the researcher and the researched. Thus, deciding what knowledge counts is not a sole privilege of only the researcher, as participants, too, have the responsibility to bring their agenda into the research situation. Discussions about insider-outsider relationships have tended to focus on how researchers look at themselves in the research process. However, as Milligan (2016) advances, 'insiderness' and 'outsiderness' entail balancing between the position the researcher takes and how others (participants) perceive him/her in the study.

Whereas this distinction helps to position the researcher, it is imperative to view the type of research involvement as a spectrum, whilst acknowledging their changing roles over time (Walsham & Sahay, 2006). Deciding on insider/outsider relationships depends on the research purpose and the need to collect sensitive information that enhances the actuality of circumstances (Walsham, 1995). My role in this study changed from being an outside observer to an involved researcher. I began by conducting key informant interviews with the organizational staff of the three M4D projects. In this outsider position, I keenly observed and followed how mobile phones and laptops supported information access and sharing. With this role, the benefit lied in participants' openness to ideas and willingness to share without reservations since my involvement was not harmful to their practices. In fact, they perceived me as a researcher learning from their mobile learning practice. Besides, my first encounter with farmers using mobile phones to learn about farming largely influenced this outsider positionality. Råheim et al. (2016) asserts that closeness often generates openness and permissiveness which avails learning opportunities to both the researchers and the researched. Agreeably, I was learning from farmers' interactions with mobile technologies.

Although this outsider position facilitated some learning, I was later constrained from understanding the underlying assumptions of mobile integration for learning. As Walsham (1995) notes, being an outsider observer leaves out many issues that would contribute to an understanding of the context from the inside as an involved researcher. First observing the knowledge sharing interactions between organization staff and farmers helped to identify issues that needed clarification. To gain further understanding of how farmers used mobile technologies, my role changed to that of an 'involved researcher.' This position offered opportunities for getting involved in the day-to-day farmers' interactions with the mobile content. In the Grameen Foundation CKW project[7], with consent from the National coordinator and Community Knowledge Workers (CKWs), I gained access to the project mobile phones, joined the CKWs WhatsApp groups, and participated in on-site farmer meetings.

This insider involvement availed an opportunity to participate in authentic learning sessions. I established close contacts with some farmers, which availed a platform to identify and interact with non-adopted farmers, while exploring why they did not make use of the shared knowledge.

This insider involvement can come with some risks. For instance, participants may act more closed if they notice that the researcher has vested interests. Also, the researcher

[7] The case study where I strongly got involved as a researcher having spent more time with the participants compared to the other two case studies (USAID CC and L3F).

might overly identify with the research participants and lose a fresh outlook and critical attitude of the situation (Walsham & Sahay, 2006). In this study, participants were open to sharing as many gave feedback and shared experiences on how mobile phones had impacted their lives. Some participants over-identified with my presence thinking that I would take their pleas for more funding to Grameen Foundation. They looked at me as a link to avail more opportunities for their farming challenges. Very often, most sessions would conclude with "*we need money as startup capital, we need markets for our produce*." With this, I spelled out my role in this research but also got emotionally involved since some farmers looked at me as a network node to people in Kampala capital city where they could access markets for their plantain (locally termed *Matooke*). With this closeness in qualitative studies, there is a need for researchers to avail emotional care depending on the circumstances of the researched (Råheim et al., 2016). Even when the research purpose was clearly articulated, this did not deter me from getting emotional in their circumstances. Further, being involved in the farmer's daily routines allowed me to capture context and understand farmer characteristics which supported data analysis and writing of the study conclusions.

Both outsider and insider positions facilitated authentic co-construction of knowledge and meaning. The dichotomy and polarity in these positions is unreal and still contestable. A new concept, "the 'inbetweener' recognizes that researchers can make active attempts to place themselves in between" (Milligan, 2016, p. 248). That is, choose both outsider and insider positions with ease depending on the uniqueness of the research.

## 4.2 Qualitative Case-study Design

The general approach to this study is qualitative, given the interest in understanding and listening from people about their views on how mobile technologies support learning. Qualitative studies allow studying people in their natural setting where social life is viewed as an unfolding process and sequence of interlocking events that study people, events, and institutions. This process, to Maxwell (2013, p. 475), is "tacking back and forth in the research design." This way, mobiles as central technologies in this study were analyzed, farmers perceptions and adoption practices explored, and the learning impact of using mobile technologies analyzed. The study aimed at understanding participants' interpretations and causal relationships that supported mLearning conceptualization for livelihood support.

This study employed a case study design. Case studies are among the most treasured qualitative methods that yield rich, thick, complex, and contextual evidence. A case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context…” (Yin, 2009, p. 18). In such case studies, the researcher immerses him/herself into the study to interpret and understand reality in people’s contexts. A multiple case study typology was best fit for this study given the fact that multiple case studies help in understanding the differences and similarities between cases, where evidence gained is viewed as strong and reliable (Baxter & Jack, 2008). The choice for multiple cases was determined by actors, setting, and processes unique in each case (Yin, 2018). The researchers’ ability to explore differences within and between cases justify multiple case selection (Yin, 2009). Moreover, multiple case studies “create a more convincing theory when suggestions are more intensely grounded in several empirical evidence” (Gustafsson, 2017, p. 3).

Given the uniqueness of studying mobile technologies for learning in the farmers’ context and the fact that fewer studies have documented mobile learning among smallholder communities, an exploratory case choice was used. Exploratory case studies offer options for researchers to study and document what is happening in a context where not much is known (Yin, 2018). Further, to examine phenomena, a deliberate attempt to study aspects within the cases becomes an option. For instance, in this study, given the multiple case approach, identifying critical aspects in line with the research objectives was a viable option. This meant that not all cases were studied in-depth, but rather, aspects that explained process and outcome helped reduce the mega data that would come with studying all cases in depth.

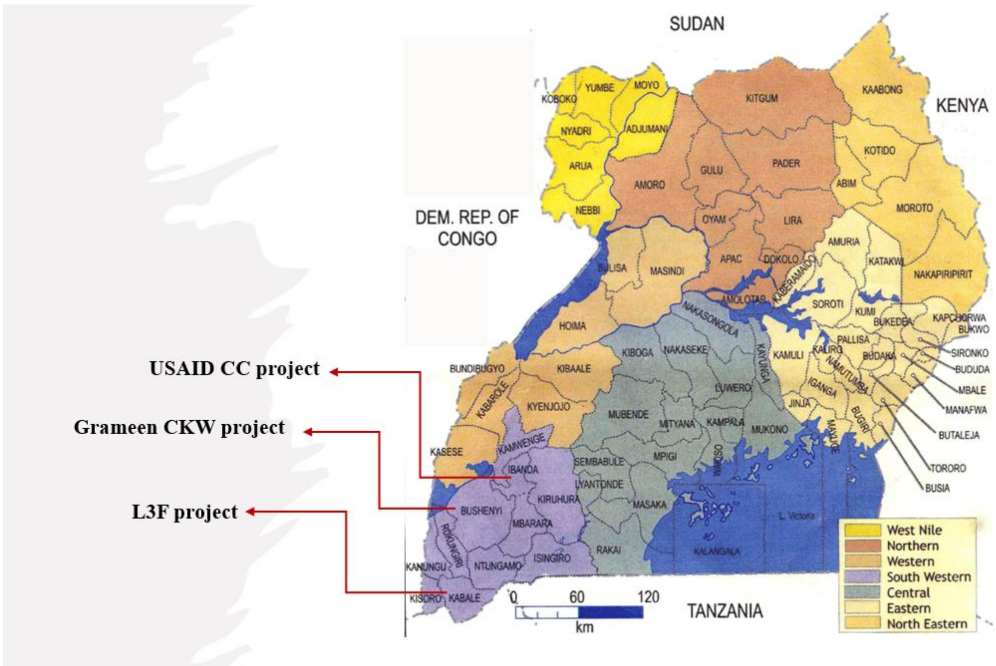
Case studies are not methods but rather a field of investigation (Yin, 2009). In this study, while the how and why questions to mobile use were important, understanding farmers’ opinions and constructions about mobile technologies use to gain greater depth of meaning-making was significant.  Thus, in using case studies, “asking yourself the following questions can help to determine what your case is; Do I want to “analyze” the individual? Do I want to "analyze" a program? Do I want to "analyze" the process? [and] Do I want to "analyze" the difference between organizations?" (Baxter & Jack, 2008, p. 546). To answer these questions, and in a multiple case study approach, I analyzed the activities of three mobiles for development organizations (Grameen Foundation CKW project, USAID CC project, and Lifelong learning for farmers project). These three M4D projects were considered representative cases since some of their practices were cited in academic literature. More so, access to these organizations was also another focus of choice of multiple cases.

Whereas the choice of multiple case approach can be for theoretical replication (Yin, 2018), in this study, theorization did not inform case selection. The choice of selection was not meant for direct replication, but rather, for contrasting situations (Ibid). Contrasting situations like the different ways each project uniquely employed mobile phones to support farmers' access to learning availed analytical conclusions. Each project had a unique approach to mobile technologies' use, which justifies the exploratory multiple case study approach. A detailed analysis of the multiple cases is explained hereunder.

## 4.3 Research Sites

The choice of research sites entailed a reflection on the research questions and an analysis of which groups or individuals would be involved to answer the research questions. Prioritizing a case requires that the locale has salient features that will meet the study purpose. With regard to mobile technologies and learning, the choice of representative cases influenced the study locale. Purposefully, three M4D organizations, all located in Southwestern Uganda were selected for this study. As depicted in Figure 9, each project was situated in a different district. For example, (1) Grameen Foundation Community Knowledge Worker project (Bushenyi District), (2) Lifelong Learning for Farmers (L3F) project (Kabale District), and (3) USAID Community Connector (CC) project (Ibanda District). This selection was by reference to on-going organizational activities that offered opportunities for learning (Stake, 2005).

**Figure 9: Map of Uganda showing study Districts and M4D projects**




Source - Nations Online Project (2020)

To understand how learning evolved with mobile technologies, following up on-going project activities to situate actual learning and technology use was necessary. Whereas it would have been more convenient to work around the central region (my area of origin), after a reconnaissance, I established that Grameen Foundation and L3F project activities had phased out from the central region. Correspondingly, prioritization of the three organizations as multiple case studies does not allude to a comparative study. Visible diversities in selected organizations availed great depth of how each uniquely employed mobile technologies as tools to support farmers' livelihoods in rural areas. Besides, independent analytical conclusions from multiple cases are more powerful than those from the single case (Yin, 2018). Likewise, this purposeful selection of study sites and participants helped to obtain information in line with the qualitative decisions.

It should be noted that at the start of fieldwork, the Grameen CKW and L3F projects were a focus. But towards the end of data collection, another M4D project, the USAID CC project where Grameen foundation CKW was a partner, came to my attention. The need to explore mobile technology activities used in this project became pertinent for this study.

Moreover, data from the two projects had highlighted the need for holistic approaches to livelihood, an approach used by the USAID CC project. Thus, this third case became an embedded case guided by research question 4 about mobile learning capabilities for food security. This explains why analysis and reporting in multiple case studies do not generalize. In the study analysis, I allude to a case-by-case observations to explore unique activities inherent in each organization. Besides, analysis in this study was not about districts but selected organizations. Figure 9 gives a snapshot of the actual location of the three case study sites.

### 4.3.1 Grameen Foundation Community Knowledge Worker (CKW) Project

Grameen Foundation, in partnership with agricultural research institutions and extension services use digital technologies like mobile phones to revive agricultural extension in many developing regions (World Bank, 2016). Grameen Foundations' goal is to help the world's poorest people reach their full potential through connecting their determination and skills with the resources they need. In Uganda, Grameen Foundation's Community Knowledge Worker (CKW) project was launched in 2009 with an aim of serving farmers in remote communities through a network of peer advisors. The initiative combines mobile technology and human networks to help smallholder farmers get accurate and timely information to improve their businesses and livelihoods. The CKW initiative aims to build a cross-country network of trusted information intermediaries in Uganda.

Grameen Foundation saw the proliferation of mobile phones in Africa as a way to get information and services to and from poor communities in rural Uganda who would otherwise never have had access to this information (Grameen Foundation, 2015). The project considers phones as powerful two-way communication devices to collect and disseminate information. After needs assessment in Uganda, the Community Knowledge Worker (CKW) initiative was started within Grameen-AppLab in partnership with Google and MTN[8] to develop relevant information products for the poor. Through the initiative, a CKW meets a farmer and registers a farmer in his/her android phone loaded with a data-collection application. He/she records some brief demographic information to capture and

[8] MTN (Mobile Telephone Network) is a South African telecommunication company and the biggest in Uganda that hosted CKW applications on mobile phones. It provided voice calls and internet that facilitated Grameen tools.

establish the farmers' levels of poverty and, thereafter, tracks the impact on farmer's life over time.

Working closely with and complementing existing government agriculture programs, CKWs are trusted local intermediaries serving farmers who hardly access up-to-date information on best farming practices, market conditions, pest and disease control, weather forecasts, and a range of other issues[9]. The CKW model is designed to improve farmers' lives by increasing access to information they need to improve yields and penetrate lucrative markets. Upon request from a farmer, a CKW will use a cell phone to access actionable information to address the farmers' need.

Most of the farmers live outside of the coverage of Ugandan cell networks. The phones are powered by batteries that can be recharged using solar energy and bicycle charging. The phones use GPS satellite signals to record the exact time and location of each query with a farmer. When the phones return to a location with Wi-Fi or cell coverage, data about different queries are uploaded to a central server. Using Google Maps, Grameen Foundation can create maps showing crop disease outbreaks, the impact of farmer's adoption, recommended disease control methods, and other important information for farmers and scientists.

### 4.3.2 Lifelong Learning for Farmers (L3F)

The Lifelong Learning for Farmers (L3F) project helps rural communities to receive, use, and deploy appropriate technology using open and distance education initiatives to improve livelihoods. The project responds to a critical need that enables farmers to use ICT, particularly mobile technology, to access information from agricultural research and development, which rarely travels the last mile to villages where it is most needed (Atieno 2013). L3F mobile phone application allows farmers to share information among themselves from their own direct experience and tackles the disconnect between scientists, extension officers, and farmers (CoL, 2013). Traditionally, government's agricultural extension service was the main source of information for farmers in Uganda. However, at

[9] Grameen Foundation website on http://www.grameenfoundation.org/what-we-do/agriculture/community-knowledge-worker

the time of L3F inception, the ratio of extension workers to farmers in the country was 1:24,000 (Balasubramanian, Thamizoli, Umar, & Kanwar, 2010), rendering the service ineffective.

Initiated in 2009 as a pilot in Kabale District, L3F is supported by Commonwealth of Learning (CoL), in partnership with Makerere University Agricultural Research Institute Kabanyoro and local organizations. As a model of operation, L3F is implemented by Agriculture Innovations Systems Brokerage Association (AGINSBA), formerly Open and Distance Learning Network. AGNSBA is mandated to support marginalized and isolated farming communities to realize their potentials through mitigating challenges from globalization and climate change that drastically impact on farmers' livelihoods, amidst dwindling government support (L3F Uganda, 2016). L3F employs a multi-stakeholder approach that builds on existing farmers' groups and local organizations to realize their potentials through mobile technology. Once the social enterprise is identified, the three-legged L3F model focuses on mobilizing social, human, and financial capitals to help develop value-added farming practices that enhance household food security and increase capital through strengthening the self-directed learning processes among women and other vulnerable farming communities. The assumption is that farming communities possess community knowledge systems that require different forms of capital to boost their enterprises and effectively challenge the market requirements. This model is applied to Small Help Groups (SHGs), where the save, learn, and loan approach is emphasized[10].

L3F SMS and audio mobile information system registers farmers' mobile numbers in its database, where information is disseminated bi-weekly. The information system is developed in consultation with farmers and covers an array of topics including; best agricultural practices, market information, fertilizer use, natural resource management, financial management, plant spacing, and disease control. The content is translated into farmers' local dialects and edited into bite-size chunks and distributed via SMS and audio. The SMS system also allows farmers to retrieve content, using keywords, from a simple database populated with agricultural information. For example, a farmer can punch "potato diseases" into a phone and send it to code 6868, at a cost. The farmer receives an

[10] L3F Uganda Reflection report.

instant response with relevant information. The voice-based system (mainly for illiterate farmers) allows farmers to receive audio content whilst directly interacting with agricultural specialists at a cost.

### 4.3.3 USAID Community Connector (CC) Project

The USAID Uganda Community Connector (CC) project is a USAID funded Feed the Future's initiative designed to reduce undernutrition among women and children and improve the livelihoods of vulnerable communities in 15 districts in Northern and Southwestern Uganda[11]. The project aims to improve nutrition and hygiene; increase access to more diverse and quality foods; increase household assets and incomes; introduce appropriate technologies that improve food productivity and post-harvest handling; improve risk management techniques; and integrate gender analyses to improve nutrition and livelihood (Fhi360, 2016). USAID partners with agencies like FHI 360, Grameen Foundation, Self-help Africa, Village Enterprise, BRAC Uganda, Community for Development Foundation, and Mbarara university to offer services through a multi-sectoral approach.

The CC project works closely with districts, community leaders, and farmers to define desired household interventions that would contribute to better nutrition, food security, and improved financial security. Through consultative meetings with different stakeholders, the 10 Community Connector standards were designed to measure the livelihood progress of a given household. The CC 10 standards include Saving with a Purpose (SWAP); Water Sanitation and Hygiene (WASH); Homestead compound clean and neat; Vegetable garden; Fruit trees; Poultry in a homestead; Income-generating activity; Productive assets; Food stocks (garden and granary); and Signs that family supports each other (USAID Community Connector, 2015). Family Life Schools, nutritional sites, and livelihood project strategies support household adoptions of the CC 10 standards. The family life schools target parents, primarily mothers, to access

[11] USAID Community Connector Technical Notes Series No. 3 on https://www.fhi360.org/projects/usaiduganda-community-connector-cc-project

nutrition-related information, learn together, and support each other to reduce infant and maternal mortality.

Further, the CC project uses an integrated approach to gender dynamics, nutrition behaviors, farming as a business, savings, and income generation. Nutrition activities mainly target marginalized and poor women/children, while most agriculture/livelihood activities target active farmers with the ability to link to markets. In livelihood projects where men are integrated into CC activities, farmers work in groups and are supported with grants to support the financial stability of an initiated livelihood project. The availability of Community Connector Officers (CCOs), Community Knowledge Workers (CKWs), service providers, and community promoters facilitate continuous learning processes to help households adopt the 10 CC standards. Both the family life schools and livelihood projects entail learning sites that support people to learn together. The backbone of a learning site is an agricultural enterprise in which participating members are interested. These enterprises may include beekeeping, growing onions or groundnuts, multiplication of passion fruit or potato seeds, or keeping of local chicken or goats. Here, interested farmers meet weekly or monthly during a learning/cropping season under the guidance of the CKW, agricultural specialist, and CCO. A learning site accommodates between 100 and 140 households and is located at a central place in a group member's home or near a church, health facility, or school (Fhi360, 2016).

In Ibanda district (southwest Uganda) where this study was carried out, the CC project operates in four sub-counties (Kicuzi, Nyamabele, Nabuhikye, Kihangara), given the severity of food insecurity challenges that hit the region around 2012. This study being qualitative, Kicuzi sub-country with its three parishes of (Irimya, Kicuzi, and Kanywambogo), which make up 31villages, was a focus. Each parish had two (2) CKWs, each with a smart android phone equipped with localized content connected to the GPS, under the close supervision of the CCO. The CC project uses mobile technology (smartphones) and volunteer networks to combine project integrated data collection/ reporting and provide accurate, timely agriculture and nutrition extension messages to different households. Whereas the project worked in partnership with other agencies, the focus was to understand the Grameen Foundation CKW mobile phone related activities in a multi-sectoral setting. Particularly, the projects' focus on enhancing food security in rural communities through mobiles to extend actionable information was a key motivation for this case. Thus, research question 4 on Food security realities was answered using the USAID CC project.

#### 4.3.4 Study sites analysis

This study, in its multi-faceted case study design, entailed different levels of analysis even when all study sites were conducted in rural locales. While the study was conducted in three different districts, the analysis was reduced to parishes, and later to villages where farmers interacted with mobile phone related activities. A village in this context comprises different ethnic groups that engage in activities that correspond to a group. In Bushenyi district (Grameen Foundation CKW), the Banyankole are the dominant group known for cattle keeping and farming (coffee and plantain locally termed '*Matooke'*). Other groups like the Bafuruki are immigrants, mostly involved in farming, and the Baralo as cattle keepers. In the L3F project, farmers from Kabale district are known for potatoes growing and just recently, for apple growing given the high altitude in the area. In Ibanda district (USAID CC project), most farmers are Bakiga and Banyankole who engage in growing special plantain for local brew (locally termed '*Embiire'*). An understanding of these central activities in line with different ethnic groups helped the study to justify why some farmers chose not to belong to the mobiles for development projects.

The villages were in different sizes, layout, and composition. Some were sparsely populated, clustered, and others densely populated. The clustered villages are those known to be village trading centers with several activities like coffee and maize stores, retail shops, small food stalls, mobiles related businesses, local cinemas, bars, and different organizational offices. Such rural town centres host weekly mobile markets[12] on different days. The structure of houses within these villages was modest iron-roofed houses. A noticeable number of households have large plantations of coffee, plantain (both for food and local brew), cassava, cotton, tomatoes, and maize, all dependent on prevailing

[12] Mobile markets are temporal markets, often operating along the roadside where farmers and traders coverage to sell their produce in rural town centres. These markets take place on a single day in a week while shifting to other locations.

seasons. The plantations in different households partly signify the strength of the family in the community, as land in Uganda is an essential livelihood asset.

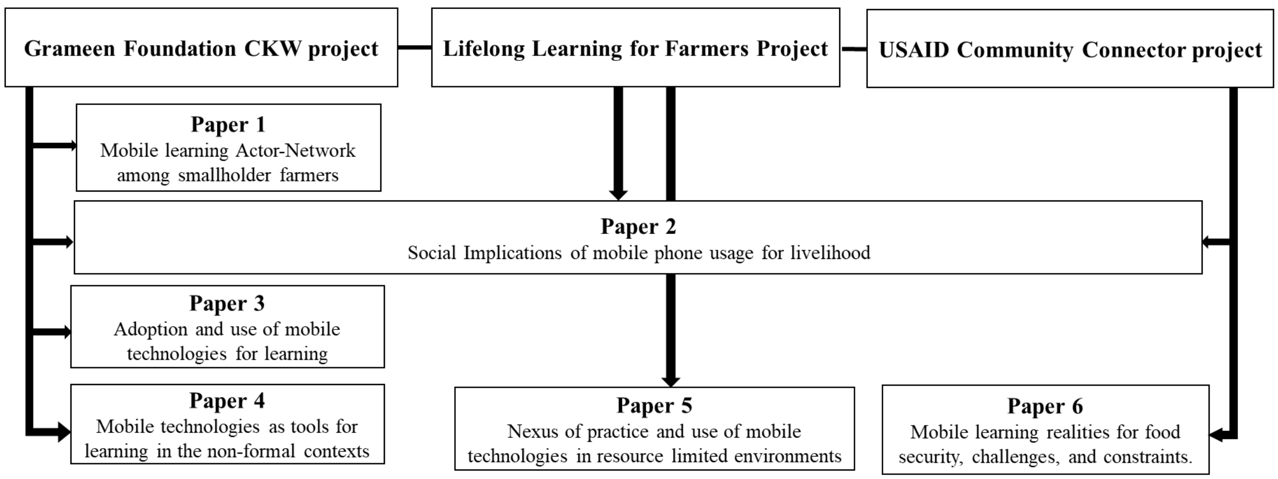
Analysis at the village level was still general for such a qualitative study. Thus, a household-level analysis was adopted to understand the variations in farmers' use of mobile technologies. It should be noted that unlike the USAID CC project that targeted the entire community, not all households were registered to take part in the Grameen CKW activities. To analyze the impact of Grameen to rural livelihoods, households not part of the project were included in this study. The intention was to understand how they cope with limited access to new knowledge and whether they find mobile phone usage relevant to their daily practices.

The L3F project was not adequately analyzed compared to other cases given the approach of sending personalized mobile information to different farmers. Literary, the farmers were 'everywhere.' Besides, at the time of data collection, the organization had paused disseminating both audio and visual messages due to internal audit processes. Nonetheless, the few identified farmers were among those whose groups were still active with ongoing livelihood activities like coffee marketing, potatoes selling, grapes, and apple management. The focus of this case was to analyze the implications of using personalized traditional small end farmers' phones to support learning activities. As the organization name reads, 'it was lifelong learning for farmers.'

### 4.3.5 Multiple case study methodological reflections

In the three case study sites above, there were methodological implications in terms of data collection, analysis, but also in the presentation of study findings and discussion. Figure 10 portrays a diagrammatic representation of the link between the case study sites to different paper publications. For instance, most fieldwork activities were with Grameen Foundation CKW project since it was the first and highly prioritized project for this study. This explains why this case helped the study achieve three paper publications (paper 1, paper 2, and paper 4). After interaction with this project, there was need for another dimension to understand mobile for development in a more traditional setting. The L3F project employs traditional phones to extend actionable information to the farmers' personalized mobile phones. The fewer research activities within L3F is linked to the limited interaction with the study participants. Also, during the process of data collection, L3F activities were under project review, with notable challenges like lack of funding to facilitate information sharing on mobile phones. This case site helped the study achieve two paper publication (paper 2 and paper 5).

**Figure 10: Linking case study sites to the research publications**




On approaching the end of data collection, another CKW related project - the USAID Community Connector project came into focus. Grameen foundation CKW project was one of the agencies in the USAID CC project responsible for mobile technology integration. Interaction with staff and farmers in the project was limited to only activities within Kicuzi sub-county and only lasted for one month. Although the CC project worked with a network of other organizations, interest was in understanding the CKW activities concerning food security interventions in Ibanda district, one of the nationally declared food insecure districts with the highest prevalence rates of stunting in children under 5 in southwest Uganda (USAID, 2014). In this regard, the case was embedded since the study only prioritized CKWs mobile phone engagements with farmers groups. USAID CC project guided paper 2 and paper 6 publication on food security realities among smallholder communities.

Another salient observation was that all these projects were in Western Uganda. This is partly because, unlike in the central region, most farmers in the western region are rural based who practice agriculture on a large scale. Yet, the majority have limited access to extension services. Also, as pointed out by many key informants during data collection, most farmers in these districts were committed to farming as a practice. Moreover, many M4Ds and other agriculture-related NGOs are driven by measuring activity impact, which was possible with such farmers. However, whereas the farmer's organization was a facilitative factor that explains the presence of M4Ds and other NGOs, the availability of land and political factors can partly explain this observation. For instance, the current ruling regime (president and most cabinet ministers) comes from the western part of the country where infrastructure like roads and telecommunication services are relatively developed. The available social networks with government officials that coordinated NGO and donor projects were significant. That notwithstanding, the visible poverty levels and inadequate extension services, and food security challenges facilitated M4D presence in rural areas of Southwestern Uganda. Thus, paper 2 guided the study in understanding the social implications of mobile phone usage for livelihood support in all the three case study sites (refer to Figure 10).

## 4.4 Study Population and Qualitative Sampling

### 4.4.1 Study population

The selection of the study population from which data was collected in the three study sites depended on the ability to answer the research questions. Each case study site had unique study participants. For instance, in the Grameen CKW project, the study participants included Community Knowledge Workers (CKWs)[13], smallholder farmers, local leaders, religious leaders, youths, organization staff, key informants like NAADs personnel, police officers, and non-project farmers[14]. In the L3F project, the participants entailed project staff (Project administrator, IT officer, and field officer), farmers, and local leaders. Lastly, in the USAID CC project, the project personnel, CKWs, smallholder farmers, and women were part of the study participants. The selection of different study

[13] CKWs are smallholder farmers who possessed smartphones with digital content.
[14] Non-project farmers are farmers not enrolled into Grameen CKW activities.

participants was intentioned to gather different meanings about mobile learning realities since understanding phenomena does not seek for "the best explanations, but rather a collection of interpretations (Stake, 2005, p. 63). These varied interpretations help to yield multiple realities that contribute to thick descriptions (Geertz, 1988). Supported by Ssentongo (2015), the thick descriptions help to gauge the study's credibility through availing context under which the study was carried out.

The choice of participants instead of informants was to look at respondents as part of the study. While this was not an action study, I interacted with farmers in their authentic learning processes. The smallholder farmers were in a participatory community of practice and looking at them as respondents was to subdue their collaborative activities. In all the three cases, smallholder farmers categorization constituted middle-aged men and women, and some elderly aged 50 - 60 years above. It should be noted that age categorization was not a determining factor since smallholder farmers part of the M4D projects was the study focus. However, in selecting CKWs to interview (both in the Grameen project and USAID CC project), age was highly prioritized since the intention was to analyze mobile technology use versus age. As explored in section 3.2 of Chapter 3, age is an essential moderator to determine the use of mobile technologies. Also, in prioritizing smallholder farmers not part of the M4D projects, reaching out to the elderly farmers was essential to understand how they access farming related information.

### 4.4.2 Qualitative sampling

Qualitative studies do not focus on "numerical representativeness but rather on prospects of in-depth information" (Ssentongo, 2015, p. 42). The rich personal understanding and accounts of the situation is vital in qualitative research. To achieve personal understanding, there was no predetermined sample size in the study since the sample was cumulatively obtained. Whereas the number of key informants to participate in the study was planned, during fieldwork, based on interactions with study participants, there were emergent key informants[15]. Also, in interviews, data collected led to newer insightful

[15] Emergent key informants included referred participants who were not part of the initial study population but emerged in the process of interacting with participants. The agricultural service providers in USAID CC project and the model farmers in the Grameen CKW project were part of this category.

directions that were not thought through. As explained in section 4.1 (about the flexible research approach), data collection and selection of participants was flexible depending on the need and ability to answer emerging insights. The study population categories were identified, and it is from these that the sample size was drawn.

The study employed non-probability sampling techniques like purposeful sampling, convenient sampling, and snowball sampling. Purposeful sampling helps to identify people who have independent knowledge by virtue of their position or experience (Hennink, Hutter, & Bailey, 2015). In this study, participants with subject matter about a phenomenon were purposefully selected. For instance, key informants in all the M4D projects like project directors, organization staff, local leaders, CKWs, service providers, model farmers, and non-project farmers were purposefully prioritized. To identify smallholder farmers, convenience sampling was used. Given that some informal or ad-hoc interviews were conducted, convenience sampling was an option given its flexibility in choosing available study participants (Bryman, 2016). In circumstances where gatekeepers and some participants referred to individuals, snowball/chain sampling was used. To follow up referred participants, clear information about how to locate them was obtained. Categories like less active CKWs, non-adopted farmers, and non-project farmers were obtained through chain sampling.

This multiple case study design employed the embedded approach to precisely analyze what needed to answer the research questions. This means the case study sites did not take an equal number of sample sizes since selecting who to participate relied on case site uniqueness. For example, in the Grameen CKW project, following up CKWs and their farmer groups was pertinent. In Bushenyi district, while the project worked in several places, we purposefully selected CKW activities in Mitooma sub-county and Katerera sub-county to be part of the sample. Mitooma, for instance, was near to the district headquarters while Katerera was far with less developed infrastructure like roads, electricity, and town centres. Exploring comparisons and differences regarding farmers' use of mobile technologies even within similar sites yielded greater insight for the study.

Further still, in the two sub-counties, while all the CKWs with smartphones were interviewed, not all CKW farmer groups were interviewed. In Mitooma, to gather farmers' views, snowball and convenient sampling were used while in Katererera, because the gatekeeper came from this sub-county, there was a purposeful selection of farmer groups. For example, there was a careful selection of CKW groups with farmers who had adopted[16] and CKW group of farmers regarded as non-adopters. All this was intended to understand the underlying factors why some farmers used, and others failed to use information shared on mobile technologies. These evident semantics justify why the Grameen CKW project sample size is the biggest with 55 participants, as depicted in Table 4. In the L3F project, convenient and purposeful sampling was used to interview the farmers and the available project staff, respectively. This is because, during data collection, most field activities were not operational, which meant accessing those available. Thus, the sample in this project was 13 participants. Lastly, in the USAID CC project, 22 participants were part of the sample. Here, purposeful sampling, snowball, and convenient sampling were used to identify the CKWs, service providers, farmers, and women groups. The limited time for field interactions and the fact that the identified gatekeeper was my former student helped to quicken data collection. In total, 90 participants took part in this study as exemplified in Table 4.

With no predetermined sample size in this study, the participants were added until similar responses were obtained. Glaser and Strauss call it the saturation point, "the time in research when you really do think that everything is complete and that you are not obtaining any new information by continuing (Davison cited in Ssentongo (2015, p. 43). Among smallholder farmers not part of the project, saturation was attained early in the research process. By the time I reached the seventh farmer, there was no new information emerging. In the L3F and USAID CC project, given the limited interaction with study participants in these cases, there was no saturation level obtained. However, in the Grameen CKW project, where no new information seemed to emerge from most research questions, I noticed incidences of saturation.

[16] Adopted was used to mean farmers who used mobile content shared knowledge in their gardens. Non-adopted meant farmers who did not use the information.

**Table 4: Study population**

| **Grameen CKW Project** | | **L3F Project** | | **USAID CC Project** | |
|---|---|---|---|---|---|
| National Coordinator | 1 | National Coordinator | 1 | Community Connector Officer | 1 |
| District Coordinator | 1 | Project Administrator | 1 | District Agricultural and Nutritionist Officer | 1 |
| Project Officer | 1 | Field Officer | 1 | NAADS Officials | 2 |
| NAADS Official | 1 | Information Technology Officer | 1 | Service Providers | 2 |
| Village Leaders | 3 | Chairman Information platform | 1 | BRAC Loans Officer | 1 |
| Religious Leaders | 2 | District Community Development Officer | 1 | Community Knowledge Workers | 6 |
| Police officers | 2 | District Agricultural Officer | 1 | Farmers (7 Females, 2 Males) | 9 |
| Community Knowledge Workers | 11 | Savings and Loans Officer | 1 | | |
| Farmers (15 Females, 8 Males) | 23 | Farmers | 5 | | |
| Non-project farmers (5 Females, 5 Males) | 10 | | | | |
| **Total Sample** | 55 | | 13 | | 22 |

The total number of study participants is 90

## 4.5 Field Entry Procedures

"A researcher's success in gaining access will have a significant effect on the nature and quality of data collected" (Ssentongo, 2015, p. 45). This section explains procedures taken to get access to the case study organizations and the study participants. To access all study sites, with an introduction letter from Makerere University and from the University of Agder, I met organization directors and explained the purpose of choosing their projects. Given the intention to work with ongoing projects, several active project sites were introduced, with the majority in the western part of the country. All organizations issued letters of introduction to access the study sites. In each district, regional project officers and project resource persons were contacted since the leadership of all the three projects was in Kampala. Reconnaissance started by joining the project teams on different activities to understand project contexts and activities related to smallholder farmer's use of mobile technologies. Another motive was to gain entry into the community, establish trust, and identify the gatekeepers.

In the Grameen CKW project, Kato and Luke[17] were the selected gatekeepers to help in data collection. In the L3F and USAID CC projects, my former students at Makerere University, Ronald and Julius, supported the entry procedures. Stake (2005) recommends the need to find people who are part of the study sites, and most importantly, those who can identify good sources of information. In this study, the selected gatekeepers were not only vast with the social connections in the area but were also part of the M4D project activities.

Kato was a Makerere University Business School graduate with a diploma in Business Administration while Luke possessed a diploma in Forestry Management. These academic qualifications put them at a higher level compared to other CKWs who were ordinary school leavers. While the purpose was to help me translate into English, most participants spoke English and Luganda (a common native language spoken by the Baganda ethnic group). It is only on fewer occasions that farmers did not understand Luganda. The elderly farmers, for example, purely interacted in 'Runyakole'[18] with some little Luganda. In such instances, I followed part of the conversations. Being part of the CKWs groups, the two gatekeepers raised some ethical issues. But beforehand, there was an attempt to explain what they needed to capture. Their willingness to work was not only financially motivated, but the two had worked on several research activities in the area, given their educational background and the fact that both doubled as change agents and leaders in different groups. The above characterization explains why they were in a better position to understand the rural setting and knowing who was (or was not) part of the CKW projects.

In the L3F project, Ronald connected me to farmer group leaders in Kabale and availed information on who was in charge of the different project activities. In the USAID CC project, the Community Connector Officer (CCO) Julius was a former student whose assistance came as a gesture of appreciation. Whereas the power relations issue would

[17] The use of actual names was consented since they did not have any problem being referred to in the study.

[18] Native language spoken by people in Bushenyi District.

arise by taking advantage of Julius, this was explained before his acceptance. Besides, Julius wanted to prove how his community development skills had transformed communities. Additionally, the adult education philosophy of 'sameness' for both facilitators and learners supported interactions with the two students. With this, I gained access to USAID activities since Julius, the focal person in Ibanda project, knew which study participants would answer the research questions. This also had ethical implications regarding the selection of the study participants. However, since participants interacted with mobile phone content, the influence of his presence on what they said was minimal. Besides, having previous knowledge with the Grameen CKW project helped me to understand CKW activities in the CC project with ease. Also, the CC project only had 6 CKWs, which made interaction a little easier.

Before data collection, the study objective was explained to the participants, after which consent was obtained. All sessions would begin with self introductions and in-depth interactions about Kampala, Makerere, and the villages. In follow up meetings and data sharing sessions, the gatekeepers guided the field processes as they knew who was where and why. The ability of gatekeepers to know the social setting helped to trace participants. For instance, on market days, community days, including social gatherings, I interacted with farmers to understand the rural systems. Subsequently, this helped in comprehending the study analysis.

## 4.6 Data Collection Methods

Methodologically, the methods used in the field are those that allowed for in-depth discussions and interactions amongst participants. One-to-one in-depth interviews, both semi-structured and informal interviews, Focus Group Discussions (FGDs), participant observation, informal online interactions, and documentary review were the methods employed in this study.

### 4.6.1. One-to-one in-depth interviews

The qualitative nature of this study, highly grounded in constructivist ontology, required that open-ended questions be administered to gather farmers' constructions on how mobile technologies impact on their livelihoods. One-to-one in-depth interviews, both semi-structured and informal, were used to solicit personalized accounts of how mobile phones supported learning. Moreover, in-depth interviews offer qualitative depth by allowing interviewees to talk about the subject regarding their frames of reference (Henn, Weinstein, & Foard, 2006). While interviews are used to solicit sensitive information, in this study, there was no sensitivity to any issue being studied.

#### 4.6.1.1 Semi-structured interviews

To allow study participants to express their viewpoints while adding themes, semi-structured interviews were used. The rationale for choosing to conduct one-to-one semi-structured interviews was to allow for addressing research questions properly and obtain in-depth information from the participants on the issues addressed. With reference to Bryman, “if a researcher is beginning the investigation with a fairly clear focus, […] it is likely that the interviews will be semi-structured ones so that the more specific issues can be addressed” (2008, p. 439). The semi-structured interview process was flexible and gave the participants leeway to reply to questions. This semi-structured design allowed to probe into emerging themes that were previously not part of the research instrument. Similarly, having a specific structure to the interview guide was important. It guided the study in bringing out key themes vis-à-vis cross-checking with information from the various informants. Moreover, study participants, like key informants, asked for interview questions to get prepared and feel more comfortable during the interview process.

In-depth semi-structured interviews were conducted with key informants, farmers in the three study sites, and farmers outside organizational operations. Given the multiple case study approach, each organization attracted unique categorization of study participants, as depicted in Table 5. The Grameen CKW project attracted more key informants because this was the main organization for this study investigation. Among the key informants, local leadership like Local Council III chairperson, sub-county chiefs, Local Council 1 chairpersons, police officers, and religious leaders were participants.

**Table 5: Composition of One-to-one in-depth interviews**

| Grameen CKW Project | Interviews | L3F Project | Interviews | USAID CC Project | Interviews |
|---|---|---|---|---|---|
| Grameen staff | 3 | L3F staff | 5 | CC staff | 3 |
| Key informants | 8 | Key informants | 3 | Key informants | 3 |
| CKWs | 11 | Farmers | 5 | CKWs | 6 |
| Farmers | 10 | | | Farmers | 8 |
| Non-project farmers | 10 | | | | |
| **Total Interviews** | **42** | | **13** | | **20** |

The total number of interviews is 75.

The Grameen CKW project staff included; National project coordinator, District champion, and Project officer. The CKWs, farmers, and non-project farmers were other categories interviewed. For the L3F project, key informants encompassed the project staff like the National coordinator, project officer, Information Technology personnel, and chairman of the Innovation Platform[19]. Government officials like the Senior Community Development Officer and District Agricultural Officer were part of the informants. Farmers with proof of mobile phone messages from L3F were also interviewed. In the USAID CC project, as noted earlier, while the project was multi-sectoral, the study focus was to follow up Grameen Foundation mobile phone-related activities within the project. The key informants included District Agricultural and Nutritional Officer, NAADS[20] extension officers, BRAC Loans officer, Community Connector Officer, and Service providers. The CKWs and farmers in family life schools and livelihood projects were among the categories of interviewed participants.

#### 4.6.1.2 Informal interviews

Informal meetings happened in authentic locales, especially for women, as most were responsible for other family chores given their multiple roles in a household. In rural areas, you would rarely find a woman seated. Most were busy in the kitchen, in gardens, or nursing babies. Because disassociating them from their daily routines would interfere with their everyday activities and affect the quality of information generated, the study adopted

[19] An Innovation Platform (IP) is a multi-purpose cooperative society that brings farmer groups together to save and share information.
[20] National Agriculture Advisory Services (NAADS)

an ethno approach of reaching where women were and sometimes participating in what they were doing. This allowed for spontaneity of ideas as sharing became an embedded process of deeper interactions. Besides, a study to appropriate mobiles for livelihoods had to observe activities related to mobile phone usage authentically. Sometimes, given the busy nature of farmers, markets were also used as meeting points to conduct some informal interviews. As a researcher, mother, and a fellow woman, it was easier to engage in a feminine conversation, with talks ranging from the uses of mobile phones and how mobile content supported women agency in a given household.

Market days interactions entailed visiting farmers' market stalls and monitoring how farmers used mobile phones. For example, a couple of traders and farmers used mobile phones as calculators for monetary transactions. The availability of several active mobile money booths where youths guided people to complete financial transactions was an avenue for analysis. Moreover, such days also extended other mobiles related business activities like selling of mobile phones, airtime, and others got opportunities for transacting using mobile money at cheaper rates. These conversation spaces availed opportunities to meet farmers who had failed to adapt to the use of new information shared on mobile phones and were never active in the different groups. In the USAID CC project, informal interviews were used with women in the different family groups and the community promoters who showed the different projects established in the area. The in-depth interview methods allowed for reaching a shared understanding of issues being discussed. This shared meaning was not for yielding the same points per say, but rather, for understanding concepts from the respondents' point of view (Ssentongo, 2015). However, informal interviews did not apply to the L3F project since it was hard to trace individual farmers given the approach the organization used to disseminate mobile content.

The developed interview schedule was a tool that supported the gathering of interview data. The interview schedule was indicative of questions depicting the emerging themes within the study research questions. The interview questions were partly informed by literature review knowledge gaps and identified patterns after reconnaissance. Important themes within mobile technologies and learning for livelihood discourses were also part of the research questions. But most importantly, I observed some flexibility in the need to generative new findings and anchor the study participants' constructions about mobile learning realities. Before data collection, the research instruments were given to supervisors who gave feedback on the necessary adjustments.

### 4.6.2 Focus Group Discussions (FGDs)

This method is often used to "emphasize a specific theme or topic that is explored in-depth" (Bryman, 2008, p. 473). When working in a group, semi-structured interviewing is also feasible to 'ensure a modicum of comparability of interviewing style' (Ibid). Group discussions allow for observing how group members interact with each other, and whether they can identify a joint statement on the issue. Kamberelis and Dimitriadis (2005) refer to focus groups as 'staged conversations' that offer spaces for the proliferation of multiple meanings and perspectives during interactions. Within this multiple sharing of meaning, focus groups open up for arguing, thereby generating more realistic accounts of the phenomenon under study (Bryman, 2008, 2016). Compelled to be mostly a participatory method, FGD aided the gathering of general views and ideas on how farmer groups network and support one another in accessing and sharing knowledge on mobile phones. Focusing on group interactions availed opportunities to gather general communal feelings about mobile technologies and learning realities within the farmers' context.

FGDs were used to gather collective views on the perception and use of mobile phones in the community. This allowed the study to capture various beliefs and diversities that people felt about the impact of mobile phones in their context. The focused group setting was organized following different organizations and the availability of study participants in all three study sites. Since age and sex categorizations mattered in some contexts, some FGDs considered having same sex groups to avoid gender-based power dynamics that would interfere with natural sharing and information flow. For example, FGDs with the female CKWs and female farmers were conducted to obtain sensitive information regarding working with male farmers; vis-à-vis their roles as volunteers in the Grameen CKW project. In traditional societies, for cultural reasons, women tend to be less participative in the presence of men (Ssentongo, 2015); thus, their segregated engagement allowed them to interact freely. Paying attention to group size in FGDs is critical while planning for data collection. In this study, the size of a group was dependant on participant's expertise in each category.

Similarly, considering focus group size to be within a small number in the range of five to ten people allows for meaningful participation (Berg & Lune, 2004; Cohen, Morrison, & Manion, 2007). In total, ten (10) FGDs were conducted in the three case study sites, as shown in Table 6. Most group discussions did not exceed ten participants, although the farmers' groups attracted more numbers as they were highly attended. This is because such farmers were already in their farming groups and dividing them further would distort shared understanding and negotiation of meaning regarding new farming knowledge. For instance, in the Grameen CKW project, out of the two farmer groups, one had thirteen (13) participants, while another seven (7). To ably coordinate these interactions, through their consent, I sought permission to conduct video recording, which was granted through consensus by all. Video recording allowed me to observe ardent feelings that supported more follow-ups in form of personalized interviews.

To manage the big numbers, I employed community development skills given that this was not the first time to facilitate a big group. These skills helped to moderate, ask quiet participants of their opinions and as well control frequent interactions by the active members through polite means. Other FGDs in L3F and USAID CC projects had participants less than five (5) in each category. Part of the participants in these FGDs were not among the interview sample. This explains why the study sample is ninety (90).

**Table 6: Composition of Focus Group Discussions**

| Grameen CKW Project | FGD | L3F | FGD | USAID CC Project | FGD |
|---|---|---|---|---|---|
| CKWs | 2 | L3F staff | 1 | CKWs | 1 |
| Female CKWs | 1 | Farmers | 1 | Women group | 1 |
| Farmers groups | 2 | | | Service providers | 1 |
| | | | | | |
| **Total of FGDs** | **5** | | **2** | | **3** |

The total number of FGDs is 10

The FGDs were conducted in the local languages, mainly Runyankole and Luganda, to facilitate spontaneous discussions in the natural setting (Bryman, 2016). Because some people were not conversant with Luganda, the local interpreter, who was a CKW from a different parish, facilitated the discussion. The use of a CKW from a different location was helpful since he did not influence participants' opinions. Besides, as a practitioner helping other farmers to access information on mobile phones, guiding him about the research questions and the procedure of data gathering was easy. I credited from using him since he possessed two smartphones with actionable farming information from Grameen Foundation. This gave me a chance to interact with the mobile content as facilitations were ongoing. Even when mobile phone content was in English, it was good to let people speak in their natural language, a strategy to explicate more views.

The discussion groups took place in village trading centers and at host farmers' gardens[21]. Situating the discussion in highly authentic environments were deemed important locales for community discussions as this helped to garner on-site information that showed better integration of mobile phones related information in their day-to-day practice. These authentic engagements facilitated shared understanding through farmer negotiations about the best farming practices. At such spots, this study was able to identify diverging opinions where some farmers were not in support of some farming ideas shared on mobile phones. This helped the study to note that not all that came in as information on mobile phones was practiced and respected by all farmers.

Data from focused group meetings was collected on days and time the different groups met. This arrangement improved on member's attendance; thus, data collection was a case fit within ongoing learning activities. Such integration in farmers' daily routines availed enough time for participants to contribute and engage in critical reflections. This facilitated understanding of critical issues, perceptions, needs, expectations, and attitudes (Adams, 2006) concerning mobile technology use in their everyday activities. Moreover, on-site scheduling facilitated insider involvement to gather thick and meaningful descriptions.

[21] Host farmer gardens are gardens where group learning activities took place. As a norm, each farmer hosted a group meeting not only in the garden, but also availing space (shelter) where group members convened.

Interestingly, the choice of who to take part in group discussions partly based on prevailing conditions like the availability of participants. In L3F and USAID CC projects, as depicted in Table 5, having group discussions for project staff and service providers would question the reliability of the method in collecting technical information. Although these can be looked at as key informants, the discussions in this context aimed at soliciting their opinions about mobile technologies' role vis-à-vis extension activities. In these two organizations, farmers worked closely with extension workers to understand modern farming practices. Therefore, to capture their perceptions about whether mobile phones were not duplicating extension activities, this study sought to use group discussions. Also, their availability in different community gatherings availed the study of a golden opportunity to solicit views from such technical people.

For instance, in L3F, only four staff, mostly engaged in fieldwork activities, availed findings of community perceptions on the use of traditional mobile phones for learning. The farmers, who were also scattered given the nature of L3F operations (sending messages to individual farmers), were few in attendance (only 5). These shared roles as leaders in the different L3F groups and their availability in Kabale town was to participate in a leadership training workshop. To sum up the list in the FGDs, ten (10) might look big, but interactions with groups in L3F and USAID CC projects did not elicit enormous data. Some challenges faced during FGDs relate to dominant group members and late attendance by some participants. Also, mobile phone interruptions with loud ringtones in meetings affected concentration. Using the facilitation expertise, I was in a position to maintain the discussion focus in all group discussions.

### 4.6.3. Participant observation

Participant observation is a “flexible open-ended opportunistic process and logic of inquiry through which what is studied constantly is subject to redefinition based on field experience and observation” (Jorgensen, 1989, p. 23). In participant observation, the researcher interacts with people in their everyday life to collect rich, conflictual, problematic, and diverse experiences while creating constant relationships through trust (Jorgensen, 2015). To a greater extent, participant observation was used not because the study employed some ethnographic methods like ‘being there at particular moments,’ but because, given the multiple case study context that explored mobile technologies' use for learning, it was a necessary technique that supplemented on other methods. In line with Bryman (2014), evidence from participant observation is a supplement to information gathered from interviews and FGDs, while lessening biases. For instance, to explore the impact of mobile phones use, understanding the learning processes and looking at how communities were using mobile phones required observing people's actions and listening to the said and unsaid in conversations. In view of Corbetta (2003) reflection, participant observation should be the center of ethnographic research. This observation didn't only focus on the subject matter, which is mobile technologies and learning. The context in terms of settlement patterns, vegetation and forest cover, householding, cultural practices, infrastructure, and area topography were equally relevant to understand the connexions in mobile phones use in the farmers' context.

To ensure quality, a flexible observation guide was used to guide this study in observing relations between people and mobile technological integration. This flexibility in the observation guide meant not restricting oneself to what was predetermined but instead pointing to key themes while open to observing more. Emergent aspects like learning during fieldwork were equally observed. A case in point is that through frequent interactions with the CKWs, I learnt how to identify an adopted farmers' plantation[22]. This was something unplanned for, but it emerged in the process of data collection. Therefore, interviews, coupled with participant observation, offer opportunities for researchers to learn while capturing complexities based on people's perceptions and experiences (Patton, 2002).

The rationale for the choice of participant observation was partly to ensure methodological triangulation through cross-checking with information gathered through interviews, FGDs, and document reviews. Even when interviews facilitated access to participants' descriptions, rationalizations, and reflections about their behavior, observational data made it possible to tap into non-rational behavior that was not disclosed in interviews (Bloor and Wood 2006). Observations facilitated access to what people do in addition to what they said they did. More detailed events were being captured most of which missed

[22] An adopted farmers' plantation is that garden where the farmer has put into use mobile phone knowledge. This garden among others, must portray good farming methods, depending on the farmer's registered gap.

during interviews and FGD conversations. Therefore, methodological triangulation unveils the weaknesses of each separate method, thereby supporting internal validity (Ssentongo, 2015). While it was good to obtain additional information from participant observations, it is also important to note their effects on the subject being studied. In light of Jones and Somekh's assertion, "observers always have some kind of impact on those they are observing who, at worst, may become tense and have a strong sense of performing, even of being inspected" (2005, p.40). Participants can be uncomfortable seeing you take notes to capture moments. In this study, at the start of the session, some CKWs felt uncomfortable about my presence during facilitation exercises. This, to Berg and Lune (2004), is the Hawthorne Effect, where the observed group feels uncomfortable with the researcher in data collection. This might be because they were not yet used to the researcher, or they felt someone might recognize their mess and evaluate them wrongly.

Therefore, to ensure the appropriate use of this method and reduce the negative happenings, context-specific measures were adopted to make study participants feel comfortable not only about their practice but about the entire data collection processes. For instance, while interviewing the Local Council III chairperson, extension officer, and sub-county chief in Katerera parish, I sought permission to observe what was happening during NAADS seeds distribution to farmers. Whereas this participation was entirely passive, I observed how farmers turned up in big numbers struggling to get seeds. This showed what farmers prioritized as educational activities offered by extensionists did not attract large audiences. Before observing interactions between CKW and mobile phones during farmer meetings, I sought permission from CKWs to participate and clearly explained how this involvement was harmless.

However, on other occasions, like during market days, church, and eating places, including moving in the community, I did not announce my status as a participant and direct observer. This invisibility helped capture the essence of the setting and participants without informing them (Berg 2001). Whereas invisibility, which relates to covert observation raises some ethical concerns in research, given the nature of this study, there was no harm to subjects. The intention was to observe people and how they used mobile phones to learn about farming. Besides, in Grameen Foundation and USAID CC projects, some CKWs and project farmers were used to visitors (researchers, officers, and evaluators) who occasionally interacted with them. Thus, my presence was looked at as one among those they experience.

Time and lengths of observations have always been a concern in studies using participant observation. There seems to be a consensus about how following up and understanding people's behaviors and events usually take longer periods as it requires time to negotiate entry (Bryman, 2016; Gerring, 2007; Yin, 2009). Similarly, to capture events and understand settings require some experience to gather a breadth of data using participant observation. While time and immersing oneself in study context are two critical factors to using participant observation, prior experience of the researcher, and familiarity with the subject matter have implications in practice. In this study, while community entry and access took longer than anticipated, the use of interpersonal skills like working with people, living, and dressing like them quickened data collection. Entry to the community took more time at the Grameen Foundation head office in Kampala since the National Coordinator was critical about PhD research interactions with the project participants. While reasons for the delay were not well articulated, to the National Coordinator, they were 'skeptical about what will happen to organizational information.' But after gaining access, it became easier to mingle with study participants at the village level. The initial rigidity in accessing the organization was partly because I did not have any contacts within my networks with knowledge about Grameen Foundation. This was not the case with L3F and USAID CC projects as both study gatekeepers were former students at Makerere University. This knowing quickened the process of community entry and hastened data collection processes.

Relatedly, familiarity with the subject matter facilitated the ability to immerse oneself within the study context (Ssentongo, 2015). In line with this study, my experience with using technologies for learning, coupled with adult and community education skills, facilitated an understanding of how CKWs and farmers used mobile phones. Besides, a reconnaissance in a similar parish of Kitagata offered knowledge about how CKWs worked with farmers in the different groups. In addition, the three M4D projects’ online coverage about mobile phone impacts and farmer testimonies availed insights to understand the projects in depth.

During observations, field notes were gathered in the field journal immediately after any event. Since farmers were familiar with smartphones, these helped to take notes and pictures. Generally, no audio and video recordings were taken during observations. This was to counter anxiety among study participants since naturally, people do not feel comfortable being recorded. Moreover, recording participants also raises ethical implications.

**4.6.4. Qualitative audio and Document analysis**

Documentary analysis entails a systematic procedure of reviewing and evaluating both print and electronic materials (Bowen, 2009). In qualitative studies, audio and documentary analysis in the form of secondary sources of literature helps to complement data from other sources. Moreover, secondary sources helped to provide context to this study while understanding the historical experiences of the mobiles for development projects. In this study, qualitative documentary analysis entailed a critical examination of existing relevant documentary sources and audio-visual recordings. Documentary sources on organization profiling of the three case study sites, mobile phone success stories, details of participants and groups using mobile phones, official documents like district reports, and mass media prints were among documents that complemented primary data from the field.

The audio recordings entail mobile phone messages, recordings from radio, and community talk shows about mobile phone use in farming, audio-visual sharing from the WhatsApp CKW groups, and YouTube videos were other aspects analyzed. This analysis also entailed understanding group and individual farmer documents (weekly updates about their adoptions levels), the CKW training manuals, CKW field reports, and monthly monitoring forms. In the L3F project, the documentary analysis included examining the content on mobile phones (both audio and text) and analyzing the key messages received by different farmers. Super CKWs in Grameen and USAID CC projects had laptops with audio-visual material that complemented the activities of mobile phones.

Thus, in this study, whereas the focus was to follow up with mobile technology-related activities, critical analysis of other media that supported mobile phone use helped to guide the study in understanding the key actors that make mobiles work in resource-constrained settings. The identification of relevant documents for review was guided by the research questions and issues that emerged during data collection. For example, in the Grameen CKW project, the constant reference to monthly adoption forms[23] by most CKWs raised curiosity about how the forms complemented mobile phone content during farmer meetings. In this way, I was in the position to match and follow up with what problem the farmer had registered during needs assessment and how this facilitated learning about farming.

#### 4.6.5. WhatsApp group interactions

Data collection was also a continuous process on social platforms like WhatsApp. Because most CKWs were connected and were already enrolled in online social groups, staying in contact with them while asking for clarifications helped this study. Such interactions contributed to the gathering of more information, offered clarity of ideas, field updates, but also aided an understanding of how social media platforms supported group collaborations and learning. I was enrolled on the general CKW group platform by the Bushenyi region team leader and later the Kateerera CKW WhatsApp group. Within these interactions, the intention was to focus on the social affordances and how farmers supported one another. Likewise, individual CKWs contacted me in private conversations which strengthened the researcher-researched relationship as some (farmers) were still in touch even up to the time of writing this thesis. This bonding is partly attributed to ethnographic methods where some farmers looked at me as an external bridge about university education and future markets for their produce.

In such online interactions, it is easy for research to bleach some ethical concerns of privacy and confidentiality. However, I was critical to exposing participants' ideas, including those with private matters affecting the group composition. The combination of all these methods facilitated methodological triangulation of data sources. Moreover, different methods allowed for obtaining different inferences regarding how mobile

[23] Monthly adoption forms are forms sent from Grameen offices every month to a CKW to monitor farmer progress. This form stipulates the name of the CKW, names of different farmers, and their farming gaps that needed adoption. This tool helps the CKWs to know what to focus on monthly while working with the different farmers since some had unique problems (gaps). Refer to appendix 10.

technologies support information access and sharing among smallholder farmer communities.

### 4.7 Data Interpretation and Analysis

In qualitative studies, discovering, recovering, and uncovering meaning are central elements in data interpretation. The data collection process involves gathering thick and rich descriptions and respecting the fact that all people are interpreters. The qualitative researcher's energy is thus vested in his/her ability to generate meanings and come up with ideal interpretations that acknowledge how such experiences can interfere or advance knowledge. This requires that data in qualitative research is analyzed in an iterative way for the researcher to make sense from it (Munkvold & Bygstad, 2016).

This study employed thematic analysis to generate meaning from data. Thematic analysis entails "identifying, analyzing, and reporting patterns (themes) within data" (Braun & Clarke, 2006, p. 79). The choice of thematic analysis lies in its flexibility to different research approaches and the fact that it helps to account for how you arrived at patterns in your analysis. This analysis method can resonate with the theoretical framework used, which is also cognizant of the paradigm influencing the study design. For instance, in this study, thematic analysis integrated both deductive and inductive approaches (Clarke & Braun, 2018), given the multiple case study approach. In thematic analysis, while the researcher intends to generate themes and patterns as they emerge from the data, some themes were deductively guided by theory and research questions. In the inductive approach, participants' conversations were treated within a given context to understand the breadth of the conversation. This meant focusing on the meaning of data and working from data to generate themes with the researcher actively engaged (Clarke & Braun, 2018). This analysis identified both semantic themes[24] and latent themes[25] for deductive and inductive approaches, respectively.

[24] The semantic level analysis is where semantic themes are identified within explicit or surface meaning of data (Braun & Clarke, 2006, p. 84). This excludes analysis beyond what the participant has said.
[25] The latent themes examine the underlying ideas and assumptions that inform semantic content of the data (Braun & Clarke, 2006). Such themes entail analysis beyond what the participants has said to include researchers' interpretation of their narratives.

Data from the interviews, FGDs, participants observation, WhatsApp group interactions, and qualitative audio and documentary reviews with salient features, recurring ideas, and patterns that link together were identified. Some interviews and all FGDs were audio-recorded, simultaneously transcribed, and translated in English. For informal interviews, participants observation, and document analysis, because the notes were in the field journal, the transcripts were just imported to NVivo 10 qualitative data management software for coding and analysis. While qualitative research analysis starts during data collection, before importing transcripts to NVivo, the initial coding guide was shared with the supervision team. Being a first-time user of NVivo, I noted how knowledge about manual coding makes it easier to work within NVivo.

Data analysis in this study was further guided by Braun & Clarke (2006) six-step guide that starts with familiarization of the self with the data and ends with producing the report. Using the six steps did not imply that the process was followed linearly. Qualitative studies are known for their flexibility in approach as following procedural steps limits groundedness in data. Therefore, in practice, even with the guiding steps, the analysis approach was not linear, but rather, a "more recursive process, where movement [was] back and forth as needed, throughout the phases" (Braun & Clarke, 2006, p. 86).

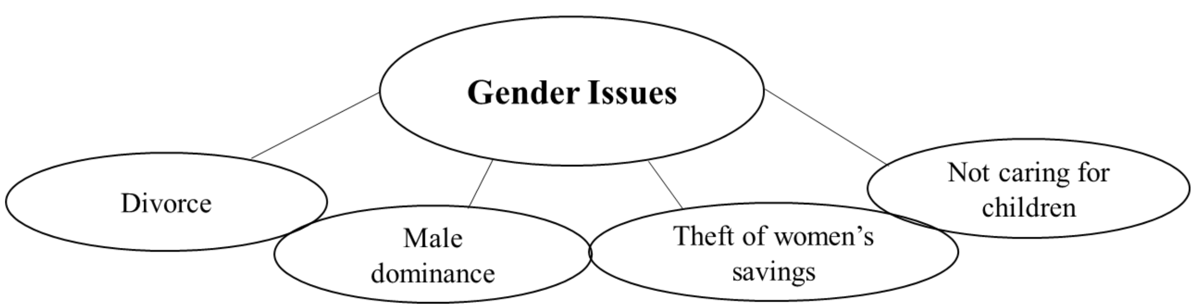
**Step 1 - Familiarization of the self with data**. There was total immersion with the data in this study. While I report about the research assistants, these came in during FGDs and in sessions where some participants only understood their native language. Moreover, these were fewer occasions. At this level, there was repeated reading and re-reading of the data sets to identify codes and repeated patterns. There was listening and re-listening from the original recordings to collate with the transcribed data. In essence, even with a focus on identifying semantic themes, effort was on data familiarization. Getting involved in data transcription on my part aided this familiarization process. In NVivo, this step necessitated naming and tagging the different respondent categorizations by creating individual and group identifications.

**Step 2 - Generating initial codes**. This step involved putting labels on the different data sets comprehensively and systematically. Coding entails pulling together material into some manageable order and structure by the ascription of category labels to pieces of data

(Cohen *et al.* 2007). All instruments were given equal attention to gathering more repeated patterns as they emerged. Here, the focus was also on identifying latent themes. Single words codes at this level were avoided as the initial codes were recorded with some sentences to capture context. Also, attention is placed on diverging ideas that depart from the story (Braun & Clarke, 2006). Diverging ideas that seemed off the general story like divorce, male patriarchy, and rigid religions were captured for later analysis. This helped to understand narratives and generate underlying meaning from the recurring patterns.

**Step 3 - Searching for themes**. After generating all the initial codes, sorting of the different codes into potential themes followed. Analysis of emerging patterns was essential to identify how codes combined to form overarching themes (Braun & Clarke, 2006). The use of open codes through reading the transcripts to identify common words and patterns such as communication, social identity, community belonging, mobile phone uses, learning, gender, patriarchy, information sharing, mobiles and divorce, food insecurity, are among others. Information from such word patterns was organized into different themes (with subcategories identified considering the key research questions), where the initial analysis was done within each theme. The themes were intentioned to drive further analysis through establishing their connections, disconnections, and consider alternative interpretations (Ssentongo, 2015). However, as exemplified in Figure 11, some initial codes ended up as themes, and others were categorized as sub-themes. At this level, other sets of codes that seemed not fit within the story were captured. But these were later put within the general study context and found hostage in other themes. Codes like male dominance, divorce, theft of women's savings, and not caring for children were later categorized as gender issues after understanding their latent interpretations.

**Figure 11: Code Categorization**



**Step 4 - Reviewing themes**. This level included refinement of the identified themes to ensure distinctions between themes. The validity of the identified themes was a concern here. Clarke and Braun (2018) typology of questions guided the refinement process. For example, Do the identified themes fit within a good characterization of themes? What is its quality? Does it have a boundary? and Does it relate to other themes? These questions helped in synthesizing what ended up as actual themes in this study. NVivo helped in generating the thematic maps that showed correlation within themes. Here, caution was also to avoid many level themes as this would segment the analysis (Braun & Clarke, 2006). It should be noted that this level involved several iterations where some themes with limited backing were left out. Reviewing and refining of codes was evident in identifying the best fit. Whereas codes entail an issue or opinion evident in the data, code development ends at the point of saturation where no more issues emerge from the data (Hennink et al., 2015). Several reiterations and analytical readings identified no unique patterns in the data sets.

**Step 5 - Defining and naming themes**. This marked the final level of concluding what themes to appear in the analysis. The connections and networks in the thematic map were given a detailed analysis. For instance, the focus was on how the individual themes fitted into the overall story and, most importantly, in line with the research questions. Attention was also paid to avoiding overlaps between themes. Subthemes were also identified here, with final theme names sorted to give the reader a clear account of the full story. To fit within NVivo categorizations, the open codes were turned into nodes. Nodes often "signify categories that draw codes together into a categorical framework, making connections between coded segments and concepts" (Ssentongo, 2015, p. 73). The nodes were guided by the research questions which allowed the coded data to answer the research questions systematically. Perceptions of mobile phone use, adoption issues, nature and type of learning, dangers of mobile phones, learning challenges, limitations to mobile phone usage, gender issues, and food security challenges are among nodes generated. Authentic citations can be used to improve trustworthiness (Elo et al., 2014). In this way, NVivo was used to manage the direct quotations through identifying and marking exceptional narratives from the transcripts. Verbatim quotations were used to reveal participants' depth of emotions to avoid distortion of people's accounts. A sample extract of verbatim quotations and what they coded is shown in Table 7.

**Table 7: Sample of coded items**

| Data Extract | Coded for |
|---|---|
| "We use mobile phones for communication, to send money to our friends, getting enough education tips, using WhatsApp to chat with other friends, you can also read the news, and know about when it will rain" (Female CKW, Grameen CKW project) | Perceptions of mobile phones<br>Uses of mobile phones<br>Nature and type of learning |
| "People stay poor because they are less informed. Our project targets all households, but some members are never present during sensitizations. Today you find a man, the next day woman alone, the other children alone. In the process, such families end up lacking information" (Community Connector Officer, USAID CC project) | Learning challenges<br>Adoption issues<br>Limitations to knowledge use |
| "Illiteracy among most farmers, network challenges, phone character restrictions, and phone theft are serious problems. But the good thing with L3F, farmers are in groups. So even if it is only two who receive information, those who receive share with others in what we call horizontal learning" (IT officer, L3F project). | Limitations to mobile usage<br>Nature and type of learning<br>Learning challenges |

The process of describing the choices made in coding needs to be explicit and accounted for by the researcher (Creswell & Poth, 2017). Coding and data categorization for paper 2 and paper 5 was guided by ANT, the CoP, and food security conceptualization. As earlier mentioned, while subjectivity is a virtue at the heart of any qualitative investigation, qualitative data analysis can be both deductive and inductive, where the choice of approach depends on the study purpose (Elo et al., 2014). The deductive approach tests or conceptually extends an existing theory and helps the researcher to narrow the research focus (Lazareva, 2018). However, this notwithstanding, while the theoretical lenses in these papers had suggestive frameworks, an understanding of the farmers' context allowed categories to flow from data. This made it possible to obtain a rich understanding of mobile technologies for learning in the farmers' context. The use of inductive thematic analysis guided the elicitation of latent themes, which allowed for the generation of themes beyond the theoretical lenses. For instance, latent themes like male patriarchy in controlling mobile phones and food, women's ability to use mobile phones as personal banks, and farmer's strong feelings of mobile phones being part of their lives were narratives that emerged in the process of analysis. This was one way to overcome the decontextualization of data not to lose conversation interconnectedness (Cohen et al., 2007).

With a particular emphasis on understanding farmers' narratives, it should be echoed that this study is premised on the constructivist ontology where meaning is constructed and negotiated. De Vos, Delport, Fouché, and Strydom (2011) outlines two typologies of interpreting data. First, the emic approach, where the researcher's interpretation relies on participant's emerging insights from the field. However, since the researcher is an object of analysis in qualitative research, all that is recorded includes his/her analysis based on experience and or theorization. This is the 'etic' approach to data interpretation (De Vos et al., 2011). In this study, these two approaches were used interchangeably since the constructionist orientation to knowledge allows the researcher to put forward personal interpretations (Ssentongo, 2015).

Similarly, thematic analysis falls in several research paradigms. The constructionist thematic analysis used in this study allowed to locate smallholder farmer's participation within the wider social, cultural, historical, and political-ideological contexts (Clarke & Braun, 2018). In other words, the words, patterns, and themes were not enough to deeply understand farmers' constructions about mobile technology use. Thus, accounting for the emerging narrative was significant in understanding context (in the form) of farmers' experiences, assumptions, expectations, challenges, and possibilities in negotiating and constructing mobile phone usage for livelihood support. The constructionist analysis allowed to tell a story and give a voice to participants' opinions, as documented in the findings chapter and the different research publications. This required being mindful of reflectivity by paying attention to how and what to report during data analysis.

**Step 6 - Producing the report**. This necessitated telling a full story through pulling themes together to generate the final report. To obtain vivid and compelling themes, there was the final arrangement of themes in line with the research questions, literature review, and theoretical framework. The write up did not only report on data, but it entailed personal analytical narratives that explained the underlying assumptions within data. As mentioned earlier, the use of authentic citations gave context to these arguments. However, the analysis in the report underwent refinement with comments from the supervision team and some study key informants. There was shared control during the analysis stage to arrive at the conclusive interpretations in the data, which process required going back to the original transcripts. This shared control to listen from what participants say about the study analyses was a quality control procedure, as explained below.

## 4.8 Validity Issues

Validity alludes to believability in scientific knowledge. Validity includes the accurateness of whether the views being expressed by the research participants reflect participants' experiences and opinions (Silverman, 2005). It highlights the credibility, legality, and strengths of scientific knowledge. For instance, for knowledge to be valid, it has to measure what it intended to measure and find out in the first place (Bryman, 2012). In qualitative research, validity relates to the trustworthiness, authenticity, and quality of the research process. Maxwell (2013) suggests two validity threats, (1) researcher bias, and (2) reactivity qualitative researchers need to guard against in their search for quality.

Firstly, with research bias, researchers tend to identify data that fit the existing theory and goals including data with unique stand out features. Such selection is too biased and unethical. Thus, validity in qualitative research " is not about indifference, but of integrity" (Maxwell, 2013, p. 124). In this study, the theories did not overly influence the study interpretations. As described in the role of theory in section (4.1.1), participants' interpretations furthered theoretical analyses. Also, to guard against biases, the researcher's position, ethical considerations, and reflectivity sections point to how bias was controlled in this study. All this was in pursuance that the collected data followed an authentic and trusted process.

Second is reactivity. This is about "the influence of the researcher on the setting or individuals studied" (Maxwell, 2013, p. 124). It involves controlling the setting to achieve the research objective. To avert this influence, the use of interpretivist epistemology and constructionist ontology offered lenses through which context and farmers' lived experiences were understood. Through taking on the outsider/insider positions, participants were studied in their natural farmer groups setting. Because of the initial outsider observer relationship at the start of fieldwork, the interaction with the project staff might have influenced what participants said. However, the insider position strengthened closeness and facilitated access to a more in-depth understanding of farmers' use of mobile technologies.

Validity checks like ensuring long-term involvement with participants in interviews and observations, gathering thick data descriptions, and use of the mirroring technique[26] were adopted. Participant's validation was used by identifying peculiar cases that availed discrepant evidence, negative cases, and uncoordinated information. A case in point was about the negative opinions about non-adopted farmers in the CKW and USAID CC projects. Varying opinions came from different CKWs as most looked at these farmers as failures in the projects. However, further examination with the non-adopted farmers helped to clear this bias as most had genuine reasons that explained non-adoption. In addition, triangulation using several data collection techniques to gather the same information to represent different sources was adopted. Subsequently, this supported saturation in some study objectives (1, 2, and 3). Other personal biases that were guarded against are explained in section 4.11.

## 4.9 Generalization and the Study

Generalization concerns extending the study results and conclusions to other settings similar to those being studied. Qualitative studies rarely make claims of generalizing findings since most rely on case studies using theories rather than probability sampling that attracts a large audience. Yin (2018) suggests analytical generalization when the intentions of case studies are to test a theory. Nonetheless, whereas it is not purposed for such studies to generalize, internal generalizability of conclusions within the case, setting, or group is possible in qualitative research (Maxwell, 2013). For instance, in this study, conclusions about smallholder farmers' use of mobile phones for learning can be internally generalizable to other smallholder farmers in similar physical contexts. This is generalization from one context to similar contexts (Davison & Martinsons, 2016). More so, in contexts where M4D projects operate, the multiple cases that explored locally distinctive beliefs and values of smallholder farmers increased on internal generalizability within similar contexts. Thus, understanding variations in the phenomena or group of people being studied is significant in internal generalizability (Maxwell, 2013).

[26] Technique used in qualitative interviews where the researcher uses words and phrases of the respondent in order to formulate subsequent questions (Myers & Newman, 2007). This allows for respondents' validation.

## 4.10 Ethical Considerations

Being morally trustworthy as researchers imply respecting and valuing the process of conducting research. In practice, this implies researching ethically by protecting individuals, communities, and the environment where studies are conducted. Israel and Hay (2006) caution researchers on the need to avoid causing suspicion and fear among research participants to maintain the trust of communities being studied. Therefore researchers are obliged to act following the best interest of research subjects to avoid harm (Israel, 2014). While the primary intention for researchers is to find out about happenings and understand events from those being studied, the later have considerations and expectations from this interaction. This calls for the need to strike a balance between the demand placed on researchers as professional scientists in pursuit of truth/knowledge while respecting the rights of the researched (Neuman, 2007).

For this study, several ethical considerations were upheld. The purpose and assumptions of the study was spelt out to the study participants. The study ethical considerations were guided by the Research Ethics Guidelines for Social Sciences, Humanities, Law, and Theology in Norway (NESH, 2016). Permission was sought from the Norwegian Social Science Data Services (Norsk Samfunnsvitenskapelig datatjeneste - NSD) to pay observance to data handling and management. For instance, issues of data anonymity, deleting all direct personal data, deleting digital audio and visual files, and indirectly rewriting personal data were important aspects applicable to this study. There were initial plans to seek ethical clearance in Uganda. But, after following the research ethics guidelines in Norway and the rigorous process of obtaining clearance from NSD, I thought that the same guidelines entail standards that were transdisciplinary and cross-cutting.

Prior to conducting a study, permission to conduct the study in the chosen locality was obtained from the authorities responsible. A research introduction letter from the University of Agder, Faculty of Social sciences, and Makerere University, Department of Adult and Community Education, was obtained to support the visualization of the study purpose. Introduction letters from Grameen Foundation and Lifelong learning for farmers organizations were obtained, and these acted as entry resources and gatekeepers to access the study participants. In conducting interviews, the purpose of the study was clearly explained to the participants and consent (verbal and written) for participating in the interviews, and FGDs was sought. It was explained that information collected would be treated with utmost confidentiality, to make study participants trust the research process.

Avoiding deception and not raising false expectations among the study participants was an ethical concern in this study. At the time of data collection, in all the three study sites, project periods were coming to an end. To some, field presence was hope for extending the project's periods. Excitement was evident as most presumed Grameen Foundation had sent data editors to follow up on project activities. This might have distorted information given that I had an introduction letter from Grameen. Similarly, the district project officer as a focal gatekeeper introduced me to super CKWs and other CKWs, which could have contributed to a false perception. But through several explanations and frequent interactions with some CKWs, a clear picture of the opportunities and challenges of using mobile technologies for learning was obtained. Thanks to the ethno - study approach that allowed for regular interactions with the CKWs during and after farmer's meetings. Besides, given the good interpersonal relations exhibited during data collection, the developed personal relationships with some CKWs facilitated further interactions that gave the study an in-depth understanding of the projects' impact on farmers' livelihoods.

Nonetheless, whatsoever clear we may be in stipulating our objectives, we need to offer something back to participants for being part of the study. A thank you note, sharing research findings with the communities, and giving gifts to some participants in the study was essential. Qualitative studies require deep immersions, in-depth interviews, and frequent follow-ups; thus, thinking about what to give in return becomes ethical. In giving back to the community, for this study, no cash payments were given but, sharing gifts like books, soap, pens, and other items that would deem essential for a category were given to participants. For the CKWs, because they had mobile phones, airtime and internet data was shared on their phones as a thank you. Given the rural terrains and long distances in some places, cash payments were given to participants who used 'boda-boda' (motorcycle) transport to engage in group discussions. Also, soft drinks and snacks were given to participants in group meetings since the interactions often took long hours of engagement.

Another way of giving back was by providing career guidance to the farmers' children who wanted to join Makerere University and other tertiary institutions. Up to the time of writing this thesis, farmers still consulted about professional guidance for their children. Although the study had anticipated increased costs in trying to give back, this was managed as group meetings were organized following the farmers' routines and schedules of meeting one another in different groups. This fitting within their calendar reduced intruders or outsiders since at some points, data collection was conducted with the Norwegian supervisor whose origin and presence in a rural area would be linked to donor support. Whereas his presence attracted attention, information stipulating the supervisors' purpose in the field was shared with participants.

## 4.11 Reflexivity in the Study

Recognition of the impossibility of detachment entails self-scrutiny by the researcher in the research process (Blaikie, 2010). Qualitative studies entail methodologies that uphold researching by seeing through the eyes of those studied. This invokes respecting participants' subjective experiences and cultivating empathy to understand them. As emphasized by Corbetta (2003, p. 25), this subjectivist position cannot adopt "the language of variables and empirical observation, but rather empathetic understanding [of] peoples experiences." This implies intuitively experiencing another persons' world as though it was your own. Reflexivity implies taking subjectivity seriously while still producing valid accounts (Silverman, 2015). Paying attention to personal opinions, face to face interactions, watching the non-verbal, and observing the 'unsaid' is essential. Myers and Newman (2007) call this 'managing artifacts' where hidden meaning and missing dimensions of collected data (like humor, sadness, body language) generate meaning.

Further, the principle of reflexivity requires researchers to be conscious about their position in the research process right from designing the tools, data collection to interpretation of the findings (Hesse-Biber & Johnson, 2015). By doing this, the researcher becomes aware of his/her influence on the study while acknowledging the baggage one goes with to the field. This helps one to present the personal biases plainly which enhances the credibility and authenticity of the research process (Ibid). Authenticity requires that the researcher pays attention to personal demographic attributes such as age, sex, gender, professional relationship, and the distance between the researcher and study participants (Shaw & Gould, 2001). From the inception of the research idea and throughout the research process, a reflexive journal was used to take note of the different occurrences in the form of beliefs, thoughts, and biases.

This study on 'mobile technologies and learning for livelihood support' arose several reflection points which might have shaped data collection and interpretation of study findings. First was the little experience in mobile learning among rural farmers. Although with experience in ICTD in rural communities, the eagerness to learn about how farmers used mobile technologies for learning might have influenced the qualitative methodological approach and selection of study organizations. Amidst pressure from the PhD funding to understudy and design technology solutions, I insisted on understanding what was available to contribute to knowledge and practice in the field of mobile learning in non-formal settings among farmer communities.

The second bias relates to the sustainability of ICT projects. Having engaged in research about ICTD projects where the majority have funding challenges, I was equally critical about the sustainability of the M4D project. During reconnaissance, while I wanted to work with projects within my native districts (Buganda region), most projects therein had stopped running given the less/no funding. Because I knew what to expect from such projects, I decided to engage in ongoing projects. Most importantly, my interest was not in the sustainability of projects but rather in understanding how smallholders use mobile technologies to learn about farming for better livelihoods. Therefore, without knowing, my data collection and analysis would have been influenced by such attitudes.

The third reflection concerns community perceptions about Grameen Foundation activities in central Uganda. While these projects were running in the entire country, farmers from the central region did not cooperate. Not only to me as a researcher but to Grameen itself. For example, during initial field visits, locating CKWs to work with was cumbersome. Some of them wanted money to engage in research activities. Besides, the organization reported how such CKWs were manipulating mobile phones to report about false farmer visits. Farmers themselves did not take heed of the knowledge shared as most were interested in incentives like money and inputs. Yet, these were communities from my ethnic group. Such perceptions prompted me to think that farmers from western Uganda are willing to collaborate and work for the good of their communities. To reduce these biases, the study opted to engage with farmers who seemed cooperative and willing to support the research activities.

During community entry, the use of the project personnel and CKW to access farmer groups might have had implications for some study findings. Besides, my status must have been interpreted as high rank since I introduced myself as a PhD researcher at the University of Agder and a lecturer at Makerere University. Kibira calls this “double face as native professionals” (2017, p. 80) where participants view you as not only a local researcher but also a professional in the learning practice. Specific to the Grameen foundation projects, most researchers who had interacted with these communities were international scholars at master’s level. My presence as a local researcher was something to identify with. The enthusiasm and willingness to learn more about how farmers use mobiles to support information sharing, coupled with my preconceived mindset about facilitating adult learning, might have influenced the choice of research questions and how the study participants were interviewed.

Further, the use of Community Knowledge Workers (CKWs) as research assistants and gatekeepers might have eased the process of identifying different study participants. Some of these had leadership roles within different parishes and other social responsibilities which made them more respectable and credible. Their prior knowledge about adopted and non-adopted farmers eased the process of data collection. Also, in identifying farmers not part of the projects, it was easy for the CKWs to share this information. However, because they were the facilitators themselves, they could have selected farmers who were their friends but also farmers whom they knew would give more knowledge about their practices. Whereas they were able to identify the non-adopters, selecting whom to reach out to was their choice. Also, as CKWs, participants might have covered up information about how they delivered their activities which might have distorted the study findings. But through several engagements with individual farmers and through sharing contacts, more in-depth information was obtained using participant observations.

The frequent interactions and ethnographic practices used in this study helped to build relationships and uncover weak narratives obtained at the initial phases of fieldwork. In Grameen CKW project, through several follow up interviews and dissemination activities, different farmers and CKWs availed more insights that furthered clarity of ideas. The use of acceptable social norms, greeting in their local language, dressing, and eating increased bonding. For example, training meetings were held at a farmer's homes, next to the adopted gardens where they would sometimes offer lunch in their local dishes. This bonding generated more networks and allowed for more probing. Personally, at the time of dissemination and saying goodbye, I felt emotional, which signified my attachment to this community. Up to the time of thesis writing, some farmers still contact me to find out about the progress of my studies. This closeness between the researcher and the study participants facilitates mutual sharing and collaboration where the researcher does not only become an investigator but instead create genuine relationships with those being studied.

More so, because of my established networks and deep engagements with the study participants, most of those who started with the project continued up to the end. Therefore, attrition, the rate at which participants drop out of the study (Remenyi, 2014) was insignificant in this study. This lack of attrition can not only be linked to how the study was exciting but, following up groups of farmers who were already working in teams helped to sustain interactions. Likewise, with Grameen projects coming to an end, some needed more external networks and new knowledge to enhance their farming practice.

Lastly, the presentation of study findings at national and international meetings, workshops, and conferences arose critical reflections for this study. At the national level, where practitioners would be expected to know activities of ongoing organizations, no one at the three conferences knew about Grameen Foundation and L3F activities. Likewise, at international conferences, many participants would not imagine how poor farmers would possibly use mobile technologies to learn about farming. Thus, most questions during such gatherings were not about improving the theoretical integration but rather questioning issues of electricity, money, network coverage, literacy/language issues, and gender. At some point, it looked unreal, yet this was something ongoing. I was uncomfortable as this portrayed how hard it was for poor people to use smartphones and access actionable information. This realization increased personal agency to agitate for mobile learning as an inclusive strategy to help those in resource-constrained settings to get access to information. More so, this gave me more justification to continuously share and disseminate the study findings through national and international outlets. But most importantly, I felt that this PhD has a contribution to make in the area of mobile technologies and learning for livelihood support.

## 4.12 Limitations of the Research Approach

To begin with, the few active Grameen projects were only in the Western part of Uganda. The initial plan was to engage with farmers in the Eastern or Central Uganda where I was conversant with the language. Because project funding had ended in those locations, it was hard to engage with such communities. Likewise, the initial project design was to focus on the sustainability of M4D projects. After reconnaissance, given the perceived biases, I noted that not much would be gathered as participants were interested in being paid for data collection, a prevalent norm in their area. However, biases notwithstanding, this study intention was to follow up with farmers who were using mobile technologies to learn about farming. This partly explains the less interaction with farmers in the L3F as the organization had an internal audit exercise. Therefore, left with less options, districts of Bushenyi, Kabale, and Ibanda all in western Uganda, helped the study to achieve its main objective.

Language also became a problem given that I was not a native of the different study communities. Although the mobile phone content was in English and some farmers understood basic English, capturing some moments during farmers' interactions in FGDs was somewhat challenging. However, with the help of a language interpreter, youth, and school-going children in some households, conversations were sustained. Moreover, most of the role model farmers possessed knowledge about the Baganda practices and spoke in simple Luganda which facilitated interactions. Nonetheless, the study did not miss out much on context as all CKWs spoke in English.

The limited time to analyze USAID activities given that its operation was multisectoral was a limiting factor. There was not enough time to access the actual mobile learning activities like it was with Grameen CKW project. Thus, the conclusions I make from the findings might have an implication on mobile learning practice with multisectoral organizational engagements. The rationale for selecting the USAID CC project was to understand how the initiative championed mobile technologies in supporting food security initiatives. Although all case study sites emphasize food security in their mandate, it was not clear about what food security attributes were supported. Thus, in the USAID CC project, it was easy to identify food security attributes. More to the choice of USAID was the fact that papers 1, 2, and 3 alluded to the need for more actors in an ecosystem approach to address livelihood challenges affecting smallholder farmer communities. From the findings, farmers' challenges went beyond ‘just’ lack of access to actionable information. Their livelihoods were not only built on human capital as other capitals like finance, social, physical, and natural capital supported their activities. Therefore, to select the USAID CC project was to analyze the mobile-related activities in a multisectoral setting that supported other forms of capital beyond knowledge access.

Network shadows in some places limited access to some study participants. Although the study sought to follow up CKWs who accessed mobile content, contacting them was challenging as mobile network was intermittent. This had implications on updating mobile content and submitting field reports by the CKWs. However, the farmers had unique spots (like under some trees) they accessed networks. In general, communities in such places were not adequately studied as most were in areas characteristic of mountainous terrains that contributed to inadequate transport facilities. For instance, during the rainy seasons, we got stuck in the field on several occasions which made movements in the different villages hard. Yet, it was in the rainy seasons that the study needed to capture moments of intensive interactions between CKWs and farmer groups. To further clarify more about study findings, the next section shows the different paper publications and how they answered the research questions.

# 5. Research Publications

This section offers a summary of the five interlinked research papers that formed the basis for presenting results in this study. The articles have been published in international conferences and journal outlets and are discussed following the study research questions. The publications are listed in (Table 8), and full records are presented in order of sequence. The paper presentation ignores the publication dates and instead follows a sequence that allows for a coherent study flow. Similarly, given the multiple cases employed in this study, each research question had a unique coverage of a given case study site. Thus, the presentation of the study findings followed the categorization of different case sites.

**Table 8: Research Publications**

| |
|---|
| (I) Nampijja, D., Øyhus, A. O., Webersik, C., & Muyinda, P. B. (2021). Access to Learning through Mobiles: A Socio-Technical Tale of Mobile Learning Actor-Network Among Smallholder Farmers. In *Perspectives on ICT4D and Socio-Economic Growth Opportunities in Developing Countries* (pp. 252-277). IGI Global. |
| (II) Nampijja, D. (2018). "If you take away my phone, you take away my life..." Community Narratives about the Social Implications of Mobile phone Usage for Livelihood Security. In *Interactive Mobile Communication, Technologies and Learning* (pp. 368-384). Springer, Cham. |
| (III) Nampijja, D. & Muyinda, P., B., (2016). Adoption and Use of Mobile technologies for Learning among Smallholder Farmer communities in Uganda. Proceedings in *Interactive Mobile Communication, Technologies and Learning (IMCL), 2016 International Conference on* (pp. 83-87). IEEE |
| (IV) Nampijja, D. (2017). Mobile Technologies as Tools for Learning in Non-formal Contexts. Experiences with Smallholder Farmers in Resource-Limited Settings. Conference proceedings in *"Smart Universities: Education's Digital Future." (Pages 107-115), λογος* |
| (V) Nampijja, D. (2017). Mobile learning in Non-formal contexts. Exploring the nexus of practice and use of mobile technologies among smallholder farming communities in Resource limited environments. Proceedings in the *9th International Conference on Education and New Learning Technologies Barcelona, Spain. 3-5 July 2017. ISBN: 978-84-697-3777-4 / ISSN: 2340-1117.doi: 10.21125/edulearn.2017.* IATED |
| (VI) Nampijja, D., Øyhus, A.O., Webersik, C., Muyinda, P.B. (Under review). 'It is not only about food, but food of nutritious benefit'. Mobile Learning Possibilities for Food Security among Smallholder farmers in Uganda. Paper submitted to Springer Journal - Agricultural and Food Economics |

The results reported in the individual publications are guided by the five research questions (Table 9). Research questions 1, 2, 3, and 4 are answered in the thesis publications, while research question 5 conceptualizes mobile learning for livelihood support (detailed in Chapter 7). The rest of this section presents and summarizes the study publications.

**Table 9: Research Questions (RQ) addressed by the Papers**

| Research Questions | Publications |
|---|---|
| RQ1: What are the *perceptions* among smallholder farmers on the use of mobile technologies for livelihood support? | 1, 2, 6 |
| RQ2: What are the smallholder farmers' *experiences* regarding the adoption and use of mobile technologies for learning purposes? | 3 |
| RQ3: What are the *possibilities and constraints* of applying mobile technologies for learning in development projects? | 4, 5, 6 |
| RQ4: What *mobile learning capabilities* can support food security among smallholder farmers in rural communities? | 6 |
| RQ5: What *mLearning conceptualization* can support smallholder farmers livelihoods? | Conceptualization in Chapter 7 (section 7.4) |

## 5.1 Paper 1: Access to learning through Mobiles: A Socio-technical tale of mLearning Actor-Network among Smallholder farmers

The rationale for this paper was to kick off with an exploratory analysis of how mobile technologies can act as means to increase access to learning among smallholder farming communities. The notion of increased access to learning was after realization that smallholder farmers lacked access to actionable agricultural information to improve their farming practices. To further explore how learning supported by mobile technologies can function in this respect, the paper articulates an understanding of the central actors in the mobile learning network. The Actor-Network Theory (ANT) is used both methodologically and theoretically to map and understand connections and networks involved in farmers' mobile learning practice. An ethno study covering fifty farmers in the Grameen Foundation CKW project was conducted to obtain primary data. ANT central concepts like actors, actor-network, Obligatory Passage Point (OPP), macro-actor, and four moments of translations, are explained in the paper. These key concepts are applied within the context of smallholder farmers and Community Knowledge Workers in the Grameen CKW project. All actors and their roles are explained in the paper.

The paper also alludes to a socio-technical tale discussion about how aligning smallholder farmers' interests to technological initiatives supported mobile adoption. Customizing mobile phone content to farmers' learning needs availed learning avenues, which increased adoption practices visible within farmers' practices. This finding resonates with how mobile technology for livelihoods is a product of social constructions more than a purer technical involvement. Narratives about how farmers perceived mobile technologies are evident in the paper. The paper contributes to methods and the general conceptualization of how access to learning through mobiles can impact smallholder farmer communities. Through an exploration of the critical actor networks and how these interacted to support learning, ANT offered possibilities of intervening and unpacking the taken for granted assumptions of thinking that once technologies are appropriated, they will lead to change in livelihoods. Thus, this paper advances the discussion that introducing ICTs like mobile phones to support smallholder activities is not just a matter of availing the technology. It is vital to consider the actants' primary needs in this network and, most importantly, to appropriate contextualized technological initiatives. This requires actors to work collaboratively, negotiate different realities, and appreciate the local challenges communities experience in enhancing their livelihoods.

### 5.2 Paper 2: "If you take away my phone, you take away my life…". Community Narratives about Social implications of Mobile phone usage for Livelihood security

In this paper, the empirical exploration was performed as a qualitative study applying multiple case studies of three mobiles for development organizations - the USAID CC project, the Grameen Foundation CKW project, and the Lifelong Learning for farmers (L3F) project. This paper addressed two main questions: 1) What is the nature and type of available mobile phones among smallholder farmers? 2) What are the community narratives about the social implications of mobile phone use for livelihood support? Findings from the study point to an increase in mobile phones in most rural areas, citing network infrastructure availability and the fact that it is a social fit to have a mobile phone.

The commonest mobile phones used are small end phones (traditional non-smartphones). Rural livelihoods are defined by farmers' ability to engage in a multitude of activities. Limiting them to one aspect of livelihood is unrealistic as their livelihoods are determined by several engagements in other life opportunities. The social benefits of mobile phones included communication - calling friends and relatives, learning about farming, elevating social status, employment opportunities, mobile money transactions, enhanced socializing, and increased productivity in marketing and access to weather updates. These benefits can corroborate farmer's narratives like *"if you take away my phone, you take away my life,"* "*I feel disarmed without my mobile phone. My phone is my business*," all signifying personalized attachment to mobile phones.

To explore technologies as disruptive to societies, the negative social implications were also analyzed. The phones have facilitated and increased burglaries and theft, supported murder activities, vandalism, thereby threatening peoples' safety in communities. A significant number of respondents echoed how mobile phones had affected marital relationships making attribution to increased marriage breakdowns. The paper offers a discursive strand of how mobile phones are used in a magnitude of ways by smallholder farmers. In this, mobile phones are actor tools that carry content which makes people afford them in varying ways. It offers an understanding that for mobile phones to impact livelihoods, development practitioners ought to embrace their central roles in supporting livelihood viability. And for development projects to only address one aspect of rural livelihood is not sustainable given the diverse activities smallholder farmers engage in. While most studies have showed the positive benefits of mobile phone usage, this paper explored the negative social implications regarding mobile phone use. Thus, the study advances earlier findings and suggests strategies for using mobile phones for livelihoods security.

## 5.3 Paper 3: Adoption and Use of Mobile technologies for Learning among Smallholder Farmer communities in Uganda

Paper 3 illustrated how the adoption and use of mobile technologies supported learning for livelihood support. Whereas Paper 1 considered community knowledge workers as central actors in the mobile learning network, this paper explains what influenced the adoption and use of mobile phones for learning in resource-constrained settings. To theorize this analysis, the Unified Theory of Technology Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) was employed. Using UTAUT was not only to benefit from the unified models that explain adoption and use of newer technologies, but to expound on how such technologies are used in resource-constrained settings where access to modern technologies, like smartphones, is a challenge. The Grameen Foundation CKW project was the case study site for this paper. The project sees the proliferation of mobile phones in Africa as one way to get information and services to and from poor communities in rural Uganda. A total of 40 smallholder farmers and ten key informants was used in the study. The sampling of informants was purposeful in the sense that only farmers operating as CKWs possessing smartphones equipped with updated agricultural content were selected.

The paper findings show that smallholder farmers learn through face to face both in individual and group meetings and online interactions. Mobile phones carry agricultural content that CKWs use to ignite face to face conversions. Phones also act as digital libraries thereby facilitating a spiral effect in information access and sharing. Social learning among peers and significant others like school children was considered essential in supporting learning. Organizational scaffolding, social influence, peer support, immediate learning impacts, and increased farmers' output were crucial factors that aided the adoption and use of mobile technologies for learning. Due to ease in usability, mobile technologies became part of the organization’s requirements to measure learning and higher performance. However, studying the adoption and use of mobile learning when a project is ongoing may limit deeper insights in analyzing the adoption and use practices when the project pulls out its support to the rural community. Consequently, the paper recommends the need to explore factors affecting the adoption and use of mobile phones for learning when the Grameen foundation stops funding the CKWs. This will help identify critical issues that can be leveraged in sustaining mobile learning adoption and use practices among smallholder farmer communities in developing regions.

## 5.4 Paper 4: Mobile Technologies as Tools for Learning in Non-formal Contexts. Experiences with Smallholder Farmers in Resource Limited Settings

This paper largely contributes to how learning on mobile technologies transpired among smallholder communities. The concept of mobile technologies is clarified in this paper. Whereas the study findings indicate how mobile phones were used to support learning, an appreciation of other mobile technologies like laptops given to 'super CKWs' in the different sub-counties was relevant. Limiting analyses to only mobile phones would have limited exploration of other affordances in the form of mobile applications embedded within mobile technologies. In this study, multiple case sites of the Grameen CKW project in Katerera and Mitooma parishes in western Uganda were adopted. To obtain primary data, interviews and FGDs with fifty farmers and ten key informants, including CKWs, farmers in the CKW groups, and farmers not part of the project were conducted. The Community of practice (CoP) framework guided on approximating the nature and type of learning on mobile technologies. Although all farmers wanted to benefit from the mobile technology affordances for learning, the findings revealed that the project only worked with farmers who, during the needs assessment, registered to work with the CKW project. Besides, the CKWs who were central change agents in extending actionable information enrolled farmers within their network. This meant that other farmers in remote locations and with a distant relation to CKWs were left out. Nonetheless, other farmers who were not part of the network became peripheral participants in the farmer's groups. This analysis is adequately detailed in Chapter 7 (section 7.2.2).

Whereas this paper makes affirmation on possibilities of how mobile technologies are upfront in ensuring increased access to learning opportunities among smallholder farmers, some negative experiences like unstable weather patterns and mobile phones creating more digital divide are presented. This paper contributes to the knowledge that while mobile phones support learning for livelihoods, they are only one element amongst different technologies and interactions. This means, mobile technologies do not replace existing technologies like desktop computers and print material but rather complements them by adding something extra. The mobile phones were not the sole igniter of learning. Other support factors like organizational scaffolding, social capital, and farmers' internal motivation were essential facilitators in the farmers' learning processes. To meaningfully use mobile learning, the local context and societal considerations must be thought through.

Mobile learning in developed regions cannot be the same as mobile learning in developing regions. Thus, appreciating locality through integrating non-formal requirements will place mobile learning as a justifiable and ethically upfront intervention in taking learning to where 'those in need are reached.'

### 5.5 Paper 5: Mobile learning in Non-formal contexts. Exploring the nexus of practice and use of mobile technologies among smallholder farming communities in Resource limited environments

Paper 4 and 5 answer Research Question 3 - exploring the possibilities and constraints of using mobile technologies for learning. The study findings from both papers designated mobile learning in non-formal contexts as an aspect that is rarely studied. Paper 5 gives further insights by exploring the nexus of practice and the use of mobile technologies in resource-limited settings from two case study sites - the Grameen Foundation CKW project and the Lifelong learning for farmers. This paper primarily analyzed how mobile technologies can support and extend learning opportunities to the marginalized and hard to reach populations. It analyses the context of smallholders who are often less empowered due to low literacy skills and lack of access to extension services. The paper offers theoretical perspectives about how learning in non-formal contexts is embedded in a practice-based context where learning becomes a problem-solving venture that addresses real-life immediate problems. Farmers were looked at as co-creators of knowledge, implying that not only knowledge on mobile phones informed their learning about farming. More insights about how each project was constrained by using mobile technologies is discussed.

Consequently, the paper examined how mobile technologies play a supplementary role and not a replacement for existing educational programs. Mobile technologies are not silos to support learning, but the observance of other support available makes mobile learning practical in non-formal contexts. The paper discussion also points to how most available mobiles for development projects in developing regions are donor-funded, which questions the sustainability of such projects as the majority end up 'limping' when donor funds stop. The paper concludes that although all farmers in the project attested to the increased learning afforded by mobile technologies, visible constraining factors like presence of multilingual societies that affected content digitalization and government failure to support M4D initiatives affected mobiles uptake and scalability. Nonetheless, the availability of strong social relations and networks among farming communities facilitated mobile learning. Thus, the role of social capital in strengthening smallholder farmers' resilient capabilities while using mobiles to support learning for livelihoods should be an aspect for further exploration.

## 5.6 Paper 6: 'It is not only about food, but food of nutritious benefit'. Mobile Learning Possibilities for Food Security among Smallholder farmers in Uganda

Food security is an example of livelihood support and, as such, a development issue. This final paper has conceptualized mobile learning contribution to a specific livelihood by tracing mobile technologies' real impact in supporting knowledge access and sharing about food security. A comprehensive literature review to understand food security as availability, access and utilization is presented in this study. More so, given the study context and the uniqueness of different communities, the cultural dimension to food security and food sovereignty influenced this paper analysis. To explore aspects of food security as afforded by mobile technologies, the USAID Community Connector (CC) project that employs a multisectoral approach to poverty, food insecurity, and nutrition at community and household levels was the case that aided this exploration. An ethno-qualitative study with fifteen farmers and seven key informants from the USAID Community Connector project was conducted. The specific focus was on the mobile phones owned by Grameen Foundation CKW project.

The food security analysis was further guided by the Community of Practice strands: community, identity, practice and meaning. In practice, members become practitioners in addressing a common cause (farmers' problems). Learning happened in nutritional gardens, at livelihood sites, village saving groups, and family life schools. In most households, farmers had knowledge about food security, and like a male participant exclaimed, '*...Having food is not only about food, but food of nutritious benefit'.* The paper discusses the unique constraints of using mobile technologies for livelihood support. An in-depth understanding of how projects need to be considerate about multiple roles of change agents (CKWs) to enhance quality in development practice was analyzed. While CKWs in the CC project were supported by the Community Connector officer, service providers, and community connectors, their roles required more facilitation given the meager voluntary allowance of 80.000 Uganda shillings. The mountainous terrain of the area, poverty among farmers, inherent patriarchal relations with men controlling household incomes, and the cultural dimensions that limit women's agency affected the uptake of information. The paper concludes that the role communities and households play in food security related interventions is enormous. However, their success largely depends on the underlying social and economic structures. Even when the mLearning community of practice supported information access and sharing about food security, visible hegemonic asymmetrical relations affected knowledge use. Therefore, development interventions need to appreciate different characterizations and uniqueness amongst households to achieve livelihood viability for all.

## 5.7 Comprehensive story of the thesis

Paper 1 resulted from an exploratory study that mapped out the central actors in Grameen CKW mobile learning network and how the relationships between actors supported learning about farming. Whereas this paper has no stated research question, given that the study took place in resource-constrained settings, understanding the key actors was central to conceptualize actants in the mobile learning network. Paper 2 - answers the first research question of exploring the perception of and use of mobile phones by smallholder farmers. This publication examined the social implications, both positive and negative in line with mobile phone usage for livelihood support in the three case sites. Unlike other papers, this exploration particularly focused on mobile phones as the commonest technologies used by farmer communities. Paper 3 examined the adoption and use factors that facilitated mobile technologies use for learning by smallholder farmers. Given that farmers were already using mobiles in different livelihood activities, the focus was to understand their mobile use experiences for learning purposes.

To further clarify on mobile capabilities for learning, Paper 4 and paper 5 analyzed the possibilities and constraints of using mobile technologies. While the two papers appear similar, the breadth of presentation in each is unique. Besides, the limited wordage in most conference publications accounts for some repetitions in these papers. Nonetheless, each paper offers unique insights into how farmers used mobile technologies for learning. To assess mobile technologies' capabilities in supporting learning about food security, paper 6 availed this understanding. Paper 6 highlights a unique contribution on how mobile technologies can address a specific development issue - food security. Mobile technologies support for learning about food access, food availability, and food utilization is discussed. Unique constraints on how mobile technologies impede food security initiatives are also analyzed, considering the existent social and cultural dynamic among smallholder communities. This story would not be complete without offering a practical contribution concerning mobile technologies support for non-formal learning activities among smallholder farmer communities. Findings from the six papers offered a comprehensive analysis that conceptualized six critical factors 1) organizational support, 2) technological resources, 3) the needs of a diverse and dynamic learner, 4) problem solving and situated learning, 5) the community as agency, and 6) sustainability relevant for mLearning for livelihood support. These formed a basis for the practical contribution to this thesis. Together, the six presented papers and the mLearning conceptualization for livelihood support discussed in Chapter 7 (Section 7.4) details a thorough narrative for this thesis.

# 6. Discussion of Main Findings

This chapter is significant in lieu of the overall research objective. It discusses the main research findings, as reflected in the five research papers. The findings are discussed in light of the empirical data following the research questions, theoretical underpinnings, and methodological approaches discussed in Chapters 3 and 4. The chapter comprises four sections; section 6.1 answers RQ 1 and presents findings that contributed to an exploration of perceptions and use of mobile technologies for livelihoods. Section 6.2 answers RQ 2 and analyses people's experiences in the adoption and use of mobile technologies for learning. Section 6.3 answers RQ 3 and presents possibilities and constraints of using mobile technologies for learning. Section 6.4 offers insights on mLearning capabilities for food security among smallholder farmers and answers RQ 4. The findings for RQ 5 about mLearning conceptualization for smallholder farmers' livelihoods are discussed as practical contributions in Chapter 7 (Section 7.4).

## 6.1 Perceptions and Use of Mobile Technologies for Livelihoods

| |
|---|
| RQ 1: What are the perceptions among smallholder farmers on the use of mobile technologies for livelihood enhancement? |

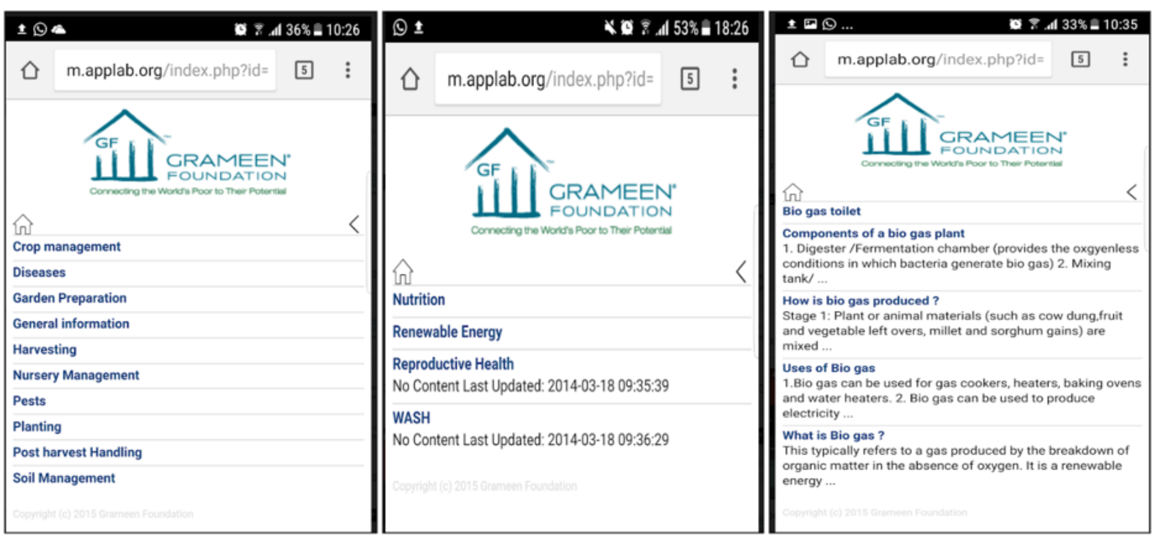
### 6.1.1 Livelihoods among smallholder farmers

To explore perceptions of and use of mobile technologies for livelihoods, analysis of the essential livelihood activities among smallholders was deemed necessary. As a term, livelihood encompasses "the assets, the activities, and the access to these that together determine the living gained by the individual or the household" (Ellis, 2000, p. 10). In everyday use, livelihoods imply the activities people engage in to obtain and sustain a living. Findings from this study show how most smallholder farmers engaged in several activities outside farming. While most smallholder farmers who were part of the different case organizations prioritized farming in coffee, plantain, and potatoes, some engaged in poultry, apiary, animal husbandry, charcoal burning, motorcycle business, retail shops, mobile money business, and tailoring. Other smallholders were primary school teachers and local government leaders (like sub-county chiefs, Local Chairpersons 1, and Local

Chairperson 3). The latter were thus not full-time smallholders but engaged in farming as an additional livelihood activity.

Livelihoods in rural communities imply diversification. This means, “rural families tend to adopt survival strategies composed of a diverse portfolio of activities that cut across orthodox economic sectors and transcend to rural urban divide” (Ellis, 2000, p. 231). Their livelihoods tend to take the form of “an asset-access” of activities where the majority tend to cope with different circumstances presented by the various vulnerabilities. Smallholder farmers' engagement in diverse activities is not only for obtaining incomes, but also an avenue for nurturing, strengthening, and sustaining social networks for kin and community (Ibid). Therefore, in understanding mobile technologies’ support for learning, the livelihoods context needs to be an interdisciplinary part to explain the responsiveness of new technologies to both social and economic aspects of smallholder livelihoods. This requires a thorough understanding of what livelihood activities farmers engage in directing or facilitating learning. Tracing what they do and knowing what they want facilitates sustainable use of knowledge.

**Figure 12: Mobile phones screenshots with different livelihood activities**




*Source: Field work photos*

In this study, as depicted in Figure 12, mobile phones had content on different livelihood activities ranging from growing different varieties of crops (like maize, banana, sorghum, millet, coffee, fruit tree planting) to sanitation, animal husbandry, gender issues, and microcredit knowledge. The M4D projects engaged farmers in diverse activities which corroborated with the content on mobile phones.

Rural people take part in varied activities. Farming (in its entirety) is not the only source of income, but just part of it (Fan et al., 2013). Smallholder farmers take up multiple low-skill occupations that are casual, part-time, insecure, and low paid. For example, in the Grameen CKW project, during rainy seasons, some farmers neglect registered coffee and plantain gardens to offer farm labor within villages and urban towns. These opt for growing seasonal crops like maize and beans, and some men migrate to forests in search of honey. From the organizational point of view, however, such farmers are tagged non-adopters yet; in understanding livelihoods, smallholders will adapt to different activities depending on necessity and seasonality.

Smallholder farmers' diversification of activities offers potential benefits like coping in case of seasonality challenges, risk reduction, and search for higher incomes to support farm activities. For example, in the 2016 heavy rainstorms in western Uganda, Katerera village, one of the study villages was severely affected by hailstorms, which destroyed homes, schools, and plantations. This affected farmers, mainly the elderly and female-headed households, who entirely relied on farm activities for livelihood support. Farmers in possession of plantations in different parishes, small shops in town, or with market stalls in village town centres, were able to 'start-up' again more quickly.

Consequently, the fact that female-headed households were affected shows rural livelihoods connexions with gender relations as women often lack assets that allow them to engage in several activities (Moser, 1998). In addition, "women are more relegated to domestic work sphere and to eking out a livelihood from subsistence food production" (Ellis, 2000, p. 237). In other words, if women do not grow a surplus for sale, they will not have additional sources of income like the men often have. While women are curtailed from engaging in several livelihood activities, their participation in ongoing initiatives supports their livelihoods. In the Grameen CKW project, the female CKWs and some female farmers joined informal village saving groups to enhance their incomes. Many testified how the saving schemes had helped them to pay for their children's school fees and buy some household essentials to support their families. Because the study did not go further to engage with women outside the organization's scope, it was hard to establish how their livelihoods revolved.

From a more analytical perspective, however, even when many smallholders engaged in different activities, this livelihood diversification could have negative implications on their general wellbeing. For instance, participating in many activities can result in low farm output and puts food security at stake. In USAID CC and Grameen CKW projects, all farmers who did not adopt[27] had challenges with food security since many were not available to participate in different trainings and sensitizations. Such farmers engaged in other livelihood activities which limited their access to new knowledge since learning was often 'less prioritized.' Hence, a conclusion can be drawn that engaging in diverse livelihood activities can possibly impoverish agriculture by withdrawing essential resources relevant during the production process (Ellis, 2000).

### 6.1.2 Perceptions and use of mobile technologies among smallholder farmers

Rural communities of many developing regions have prioritized mobile phones over other mobile technologies like laptops. Most smallholders consented that mobile phones supported their livelihoods in several ways. Documenting smallholder farmers' perceptions of mobile phone uses is not based on more incendiary relevance than the others. Instead, this presentation is mindful of the personal and collective considerations of the positive and negative perceptions as they appeared from the participants. The study findings show how small end (traditional) mobile phones were the commonest among smallholders, with limited availability of smartphones in all the three M4D projects. Questioning about the uses of mobile phones (In the Grameen CKW and USAID CC projects), the first question was; which phone? The project phone, or my personal phone? With this expression, it was clear that both phones had separate roles. The primary mobile phone use was to communicate and stay connected to one another. The emotional attachment to mobile phones allowed for some degree of privacy and ease to speak to any relative or friend in private. This mobile affordance accorded a unique space for women

[27] Adoption is the ability to use information shared. This use is based on the ability to show proof of learning at household, garden, or even change in a farmers' behaviours.

smallholders to talk to their families. Noted by Tacchi, Kitner, and Crawford (2012), such calling consolidates a sense of attachment to family members and relatives outside the households. Interestingly, even when the phones helped in contacting one another, it was observed that many farmers did not use their airtime to contact neighbors. This implies that additional mobile costs limited engagements unlike in times of emergencies.

Mobile phones were considered to have increased farm productivity by facilitating marketing channels. Farmers used phones to negotiate prices of different food items and farm inputs, which lessened travel costs, thereby increasing farmers' incomes. Financial transactions through mobile money was an essential benefit the mobile phones extended to smallholder communities. Most farmers saw a mobile phone as a bank. For example, some farmers and village savings groups stored savings, profits, and returns on their mobile money accounts[28]. In particular, the women saved on mobile phones to hide from male/husbands' exploitations. The marketing and financial phone capabilities were significant, as one smallholder exclaimed, *"if you take away my phone, you take away my life."* Another from Kabale town said, *"I feel disarmed without my mobile phone. My phone is my business, and my phone is my life"*. This depicts farmer's personalization of their mobile phones and the magnitude of relevance to their day to day activities.

Farmers with smartphones felt how mobile phones uplifted their status thereby elevating them socially. For instance, in the Grameen CKW project, CKWs with smartphones felt how mobile phones lifted their social standards. In a FGD, Kato, a CKW narrated that *"…being given a smartphone in 2009 was no simple business to my life. I felt respected and am telling you; this phone has changed the way people look at me. I am considered a respectable person with knowledge on my phone, an educator, and a role model farmer. In this village, other organizations now consult me about mobilizing people and the community looks at me as a key resource. Thanks to Grameen for this opportunity".* All CKWs felt the mobile phones and other supporting equipment impacted on not only the community but also their general household wellbeing.

[28] A financial mobile phone powered account where you can save, deposit or withdraw money.

Further, mobile phones increased employment opportunities given the presence of many mobile phone related business stalls in different rural trading centers. For instance, mobile phone technicians, solar panel equipment, airtime load, and mobile money booths were linked to mobile phone operations. Youths offered mobile services at a cheaper cost since some farmers were non-literate. More so, the availability of 2G and 3G network coverage in many rural areas extended and quickened access to weather and market information updates online.

One intriguing explanation that justifies the increased prevalence of mobile phones in rural areas is their multifunctionality. Unlike other mobile technologies like tablets, laptops, and computers whose concentration is urban-based, mobile phones are easily accessible by the rural populace. This accessibility, coupled with multiple capabilities, makes mobile phones suitable for smallholder farmers' use. For example, in most rural communities, mobile phones act as a torch for lighting at night, a radio to access different signals, and some youth with smartphones can access television signals. Phones are safety net tools and considerable assets if one needed urgent money to take care of any emergency. Further, mobile phones aided electronic banking transactions by connecting to different commercial banks. Instead of carrying the radio, one considers buying one media to access a pool of services. The portability of these mobile technologies has also reinforced multiple functionalities (Schuck, Kearney, & Burden, 2017). This portability and ease to use anywhere contributes to 'my phone my life' adage.

It should be noted that in this study, smallholders were asked as to whether they felt the mobiles were costly. It was interesting to find out why smallholders prioritize the possession of a mobile phone at the cost of other essential services. All participants expressed the fact that mobile phones required money for proper sustenance for both airtime and charging. Evidently, in all the study villages, electricity was only in trading centers, next to local government administration buildings. To sustain a mobile phone, therefore, the farmer had to have a solar panel or money to charge. Elderly farmers observed how the youth had prioritized mobile phone possession yet, some are unemployed and sometimes lack airtime. Others echoed how mobile phones were a social fit. *'You gain a social class status when you own a mobile phone,'* said a youth farmer. Hence, phones were not only looked at in economic terms, but also a social class issue.

Similarly, once technologies interface and mix with communities, they may distort a particular cultural ecosystem. Some CKWs and group leaders felt they were disliked by some people, including family members for possessing mobile phones and other related equipment like solar panel charger and solar lights. This created a social divide in some sort, although mobile phones are looked at as technologies to reduce the digital divide. This perception relates to how technology is never neutral since people have different opinions regarding their use.

To summarize the negative implications of mobile phone usage, mobile phones have facilitated and increased burglaries and theft in different areas, supported murder activities, vandalism, thereby threatening peoples' safety within communities. A significant number of participants echoed how mobile phones had affected marital relationships making attribution to increased marriage breakdowns in their societies. Farmers also noted how mobile phones were responsible for many health challenges like new cancers since people are unaware of proper use. As narrated by one farmer, "*…many men and women keep mobile phones next to their genitalia and breast for fear of being stolen*". Currently, Uganda has mushrooming telecommunications musts in the middle of many town centres, some allegedly with health effects on human life.

Whereas many farmers attested to the increased usage of mobile phones, some farmers and minority religious groups did not welcome mobile phone integration in their daily activities. There were visible patriarchy inferences given that mobile phones gave more power to women. Some male smallholders did not allow their wives to own mobile phones. On the religious angle, the 'Abazukufu' religious group felt mobile technologies would instigate satanic integration in society. Therefore, amid increased mobile phone integration, not all communities embraced mobile usability. Further details on how mobiles are considered as disruptive are expounded as negative social implications in Paper 1.

## 6.2 Adoption and Use of Mobile Technologies for Learning

| |
|---|
| RQ 2: What are the smallholder farmers experiences regarding the adoption and use of mobile technologies for learning purposes? |

To analyze the adoption and use of mobile technologies for learning, this study sought to first explore the main actors in the mobile learning network. With the rurality context of the study area, characteristic of resource-constraints, an exploration of the main actors and how they influenced mobile technology use was significant for this study. Grameen Foundation CKW project was the case most prioritized for this analysis given the methodological limitations in USAID CC and L3F projects as expounded in Section 4. 3.5. The presentation of findings is subdivided into 6.2.1 - Mobile learning actor-network and 6.2.2 - Adoption and use of mobile technologies for learning.

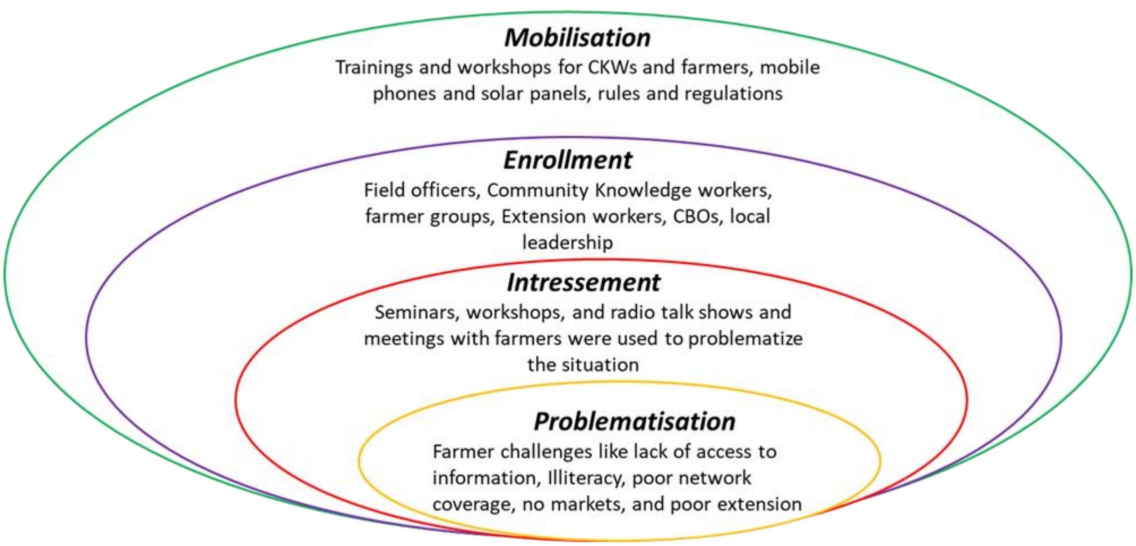
### 6.2.1 Mobile learning actor-network

To locate the available actors and networks in the mobiles for development projects, the study employed the Actor-Network Theory (ANT) to explore how human networks support mobile learning for information sharing and use. The uniqueness of ANT to be adaptable to different contexts (Mol, 2010) makes it particularly fit for this study. ANT provides a *"framework of ideas for describing the process of technology adoption and developing stories that explain technology take-up.* Introducing ICTs to enhance livelihoods is not just a matter of availing the technology; there must be capacity builders, technicians, network providers, and content developers to support such processes. To ANT, analyzing human networks provides a frame of re-echoing the role of humans and their cultures in the technology adoption process since the social and technical considerations are paramount to ANT.

From the study findings, both human and non-human actors in the initiative are; Grameen Foundation as the macro actor (Translator), field officers, Community Knowledge Workers (CKWs), smallholder farmers, mobile phones, mobile phone company (MTN), Google, Grameen App lab, the agricultural content, the solar panels, the technicians, and other collaborating agencies like NAADS[29]. Since ANT avails mega data and numerous analyses, the study focused on the smallholder farmers and Community Knowledge Workers, who directly interacted with mobile technologies.

ANT has been used theoretically and methodologically. Theoretically, it suggests traceable elements in empirical work that support real world conceptualization (Walsham, 1997). The four moments of translations - problematization, intressement, enrollment, and mobilization, as depicted in Figure 13 were considerably prioritized. The translation level largely depends on the Obligatory Passage Principle (OPP), an initial stage that forces people to converge to solve a problem (Rhodes, 2009). The macro actor, Grameen Foundation was central in defining interventions that would work to support community livelihoods in rural Uganda. OPP allows local networks to set up negotiation spaces central to operations of the mobile learning network.

**Figure 13: Mobile learning network formation process**




To begin with the *problematization phase*, the macro-actor defines the interests of other actors. Grameen Foundation uses ICTs poor communities have access to and for Uganda's case, it saw the proliferation of mobile phones as tools to extend information services to

[29] National Agricultural Advisory Services (NAADS), is a chief agricultural advisory body in Uganda, charged with availing agriculture advisory services to farmers http://www.naads.or.ug/

poor communities. This phase started in 2008 when Grameen Foundation, with support from other local organizations like NAADs, Mbarara University, and MTN Uganda, conducted community surveys to suggest village translations (problems affecting communities). The challenges identified included inadequate expert agricultural advice, limited access to market information, poor health services, lack of up-to-date and accurate information, as most rural populations were dependent on farming (Grameen Foundation, 2015). An elderly CKW who was present at a time of initial needs assessment narrated that "*at sub county offices in a big community gathering, Grameen team and other local government officials from the district asked people about community problem. With much excitement, many problems were identified ranging from no capital, poor education, extension officials not reaching rural areas, need for loans, poor markets, to poor roads.*" Problematisation posed the lack of up to date agricultural knowledge as a problem and mobile technologies were considered cheap solutions to support agriculture extension. At this level, key actors at the community level that's smallholder farmers and Community Knowledge Workers (CKWs) were critical agents identified.

This identification of local actors marked the *intressment phase*. Grameen officials and local government leadership used meetings, workshops, and radio broadcasts to problematize the situation in different villages. For instance, to identify CKWs who would meet organizational criteria, messages about the search in church and mosque gatherings, community radios, and different farmer group meetings were shared. This community sensitization was meant to help people understand the problem and form alliances of interest (Rhodes 2009). To select the CKWs, eligibility criteria like Senior four[30] (S.4) certificate, ability to speak, read, and write in English, reputable and respectable community member, and a village resident was used. The search was to identify two (2) CKWs from each parish preferably, one female. However, from the findings, the set criterion was compromised in some parishes since some villages lacked qualified participants. Therefore, to identify CKWs, anyone who attended high school level with the ability to read and write in English, and with experience in community work was selected. With such criteria, some parishes lacked educated women, which meant that such a parish had two male CKWs.

[30] A Senor four (S.4) certificate is an Ordinary Level (O-level) certificate obtained by one who has attended high school.

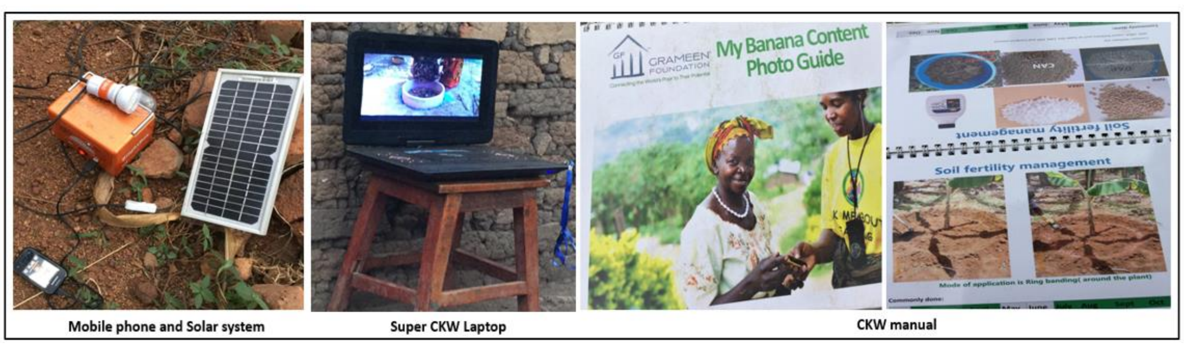
A CKW in Katerere rightly narrated this process *"…as I may recall, this interview process was not easy. Many people gathered at the sub county offices for over three days, and one by one accessed a room of over seven panelists. The questions asked were community reputation (mainly wrongdoings) and the ability to read English sentences. I was given some textbook which I had to read. I was asked about my knowledge of using mobile phones and the economic activities I engage in. I tell you; people cried for not going through. Tense as I was, gladly, I managed to qualify since my parish had over 10 participants who qualified even when I was a diploma holder.*" Interestingly, most CKWs were above S.4 level, as 30 out of the 50 CKWs in the study had certificates and diploma qualifications way above the requirement. Therefore, regarding the ability to translate information from mobile phones, most CKWs were literate, with good English command. This explains the use of English in most field interactions with CKWs. Some females and older CKWs were, however, not comfortable with English. Perhaps these were among those from parishes that did not meet the desired standards. Nonetheless, they managed to understand the forms, manuals, and content on mobile phones, all written in English.

In the *enrolment phase*, Grameen Foundation as a macro actor established guidelines, rules, and regulations of different actors to support the mobile learning network. Whereas the CKWs were the centre of attention, they could not work alone. According to ANT, actors do not act alone but engage in networks with others. Field officers, CKWs, farmer groups, and local leadership were actors enrolled to complete the mobile learning network. Each parish had two CKWs, where each had to pay for the android phone as a loan, meet monthly targets of reaching out to 50 farmers through one-to-one and in group meetings. As depicted in Figure 13, the translation phase overlaps. The activities in the enrolment stage were interlinked with activities in the mobilization stage.

The *mobilization phase* marked the identification of CKWs and farmers groups to work in the knowledge sharing network. CKWs were trained in the use of android phones with digital agriculture information, facilitation skills, communication skills, modern farming practices, leadership skills, and conflict management. Several residential and non-residential training workshops were conducted before embarking on the knowledge sharing process. Quite interesting, in the workshops, female CKWs with children and husbands were facilitated. Like one female youth CKW recalled, "*We received very many* *trainings both at the sub-county and at Grameen offices in Kampala. They trained on how to use mobile phones, good farming practices, how to work with the Grameen phones to fill monthly targets and enroll farmers. My husband and daughter (three months baby) accompanied me which brought excitement to the family*". Coming from a rural setting, it was fascinating for the CKWs to travel and explore Uganda's capital city Kampala. The inclusion of males in the CKW activities was to reduce possible male resistance. Married CKWs were asked first to enroll their partners as group farmers to allow for favorable household integration.

Given that CKWs had to work with other farmers in the network, at the mobilization phase, each CKW was required to identify 50 farmers in a given parish. These had to come from different villages but within a reachable distance. With mobilizations by field officers, CKWs, and local council leadership, the 50 farmers had to be registered in the mobile phone system, each with a pressing problem. Each farmer possessed an enrolment card that registered name, name of spouse, number of children, size of land, economic activities, and farming challenges (termed gaps in project naming). These *'other farmers'* were trained to contact the CKWs in case of any need for agricultural advice. As depicted in Figure 14, CKWs were given android smartphones fully equipped with agricultural content on different enterprises, a CKW manual, a CKW farmers gap list, and a solar system with bulb, charger, and solar panel.

**Figure 14: Examples of some CKW Tools**




Laptops were only given to super CKWs who shared with CKWs in different villages. "*In 2009, when the project started, a smartphone was no joke. Imagine a solar panel during that time and light in our homes! This Grameen system improved the wellbeing of our* *households as many of us started charging mobile phones at a fee, registered mobile phone sim cards for different telecommunication companies, and collected field data on mobile phones for many international research students. Things were very okay am telling you….”* Said a CKW during a FGD in Katerera parish. The mobilization stage saw many new farmers join the network as the majority were too enthusiastic, with high expectations. However, with time, some started withdrawing as explained later in the constraints section.

Interestingly, although the Grameen Foundation has a call centre, only two farmers called to get information. To a great extent, farmers relied on the CKWs in their locality, but if the CKWs failed to address a challenge at hand, they could call the resource person from the organization to offer advice. The use of relevant others in any community supports the diffusions of innovation and uptake of information since people usually trust sources within their communities (Knoche, Rao, & Huang, 2010). The presence of the CKWs in the Grameen Foundation and USAID projects, and the use of group champions in the L3F project, supported information uptake. Smallholder farmers felt comfortable approaching CKWs and group champions as most were available and within their locales. The next section hinges on the concept of knowledge workers and its implication to mobiles for development practice.

#### 6.2.2.1 The concept of knowledge workers and its implication to development practice.

Peter Ducker first coined the concept of knowledge work with an emphasis on how knowledge is among the main production activities that organizations need to fit in the changing and challenging trends. Knowledge workers are essential ‘assets’ in most business activities since many organizations depend on knowledge in most of their day to day activities (Sener, 2018). For new strategies to be successful, they need to advance the productivity and effective use of the knowledge workers (Hunter & Scherer, 2009). Thus, improving productivity is among the survival strategies that require continuous learning for many ICT related projects, especially those in rural communities. Whereas the concept of knowledge worker was first coined in management and business studies, its genre and emphasis can also be used in development terms. For example, the Grameen Foundation and USAID CC projects used the term knowledge workers in a more community-based setting, hence the term *Community Knowledge Workers* (CKWs). In community development and capacity building terms, CKWs are characterized as change agents. In the two M4D projects, since the CKW agency relied on mobile phone content, the knowledge worker terminology was adopted. Drucker (1999) suggests six factors that explain the knowledge workers' productivity.

- Responsibility and productivity
- Self-management and autonomy
- Continuous innovation
- Continuous teaching and learning
- Productivity measured on quality and not quantity of output
- Treated as "asset" rather than a "cost" in an organization

These characterizations reflect the activities of CKWs in the Grameen CKW and USAID CC projects. Albeit working in villages with more informal structures, the CKWs showed responsibility, autonomy, innovativeness with a dire need for continuous learning. Their motivation to work was influenced by their productivity, measured by the ability of farmers to get access and use knowledge for improved farming practices. Whereas information was on mobile phones, their ability to translate this knowledge was a vital asset to the community of smallholder farmers.

Improved autonomy and responsibility among the knowledge workers is central to farmers' mobile learning activities. As part of their inculcation practices, knowledge workers are empowered to take more responsibility for their day to day routines. CKWs are mobile practitioners who move from one place to another to share knowledge about farming using mobile phones. At the core of any knowledge worker is a notion of continuous learning and training others, coupled with high rigor of self-management. At the heart of their engagement is to maximize their human capital whose relationship will depend on economic interests as identities of their firms (Sener, 2018). The concept of 'learning with mobiles' in the PhD title comprehends this perspective of how the CKWs were not only sharing information and knowledge afforded by mobile phones but were mobile learners themselves. On-farm and off-farm training were adopted to supplement practical experience, considering that farmers' learning for livelihoods requires practical learning, highly embedded in a real-life context.

While professionalism is an essential virtue of enhancing practice and quality, the CKWs were not professional extension workers. But as Ducker notes, “in most knowledge work, quality is not a minimum and a restraint. Quality is the essence of the output. In judging the performance of a teacher, we do not ask how many students there can be in his or her class. We ask how many students learn anything” (Drucker, 1999, p. 84). Thus, farmers' ability to use the knowledge was a measure of CKWs’ productivity. To clarify this, most CKWs were positive towards work and showed commitment in their day to day routines. The successes of farmers' learning increased their motivation and determination to work. “*Even when not all my farmers have adopted, I have many farmers who can now take over twenty bunches of plantain to the market in a week. Some are now taking their children to good schools and others have constructed new iron-roofed houses,”* says a CKW.

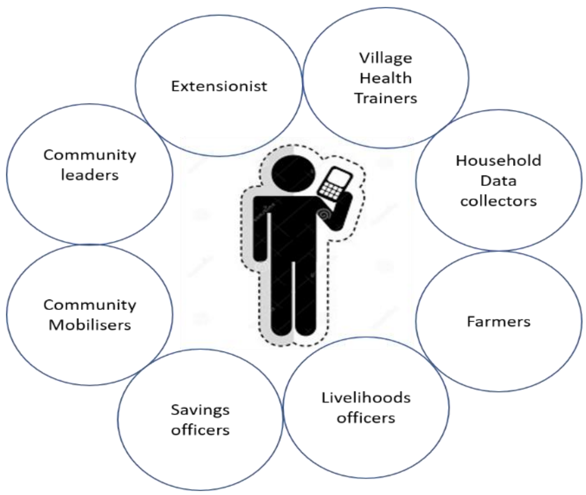
While autonomy and personal responsibility is a central principle in knowledge work, the CKWs were rather semi-autonomous. They were monitored by organization supervisors who on several occasions regulated their activities. In the resource-constrained settings where the knowledge workers operated, organizational support was received as a positive benefit. Whereas many disliked the little payment given to them, their passion rested in being community volunteers to support a common cause. Nevertheless, despite the meager pay, some CKWs felt their impact was felt in the community. The female CKWs noted how mobile phone content complemented their household roles. Nandi[31], a female CKW narrated that, “*even when I work hard to help others, I feel satisfied with my CKW position. While it looks too much work, given my other motherly responsibilities, I feel obliged to help. Because the mobile phone has information that covers part of my roles as a woman, I don’t feel overburdened. What is in the garden, what is in the kitchen, and the hygiene I need to have is in this mobile phone”.*

Despite their prioritization to support farmers, most CKWs engaged in multiple roles within their communities. As observed in Figure 15, several doubled as CKWs, Village Health Trainers (VHTs), community mobilizers, data collectors, saving officers, leaders, and farmers at the same time. Unlike the notion of Druckers’ knowledge work whose survival and earning depend on their output, in the CKW projects, this was not the case.

[31] Not real name

Explicitly, engaging in multiple roles questions the quality of their productivity, and as Ducker accentuates, measuring quality implies looking at the output. Putting quality aside, some CKWs felt their selection to serve the community did not come with more additional responsibilities since knowledge work roles were part of their daily activities. Choti[32], a female CKW, emphasized that "*... even if originally most of us were VHTs in our community, I see no heavy workloads on my part since the same villages we meet are the same villages where the farmer groups are. The CKW role gave me a chance to know more about the community I was serving and besides, VHT activities are not daily routines".*

**Figure 15: Multiple roles of Community Knowledge Workers**




Conversely, others like Domi[33] felt the CKW roles came with challenging tasks and adept self-management. Domi was a primary teacher at the time of CKW selection. His first years of knowledge work were exceptional, but with time, Domi established a school and became the headteacher leaving him with less time to take part in the CKW activities. This meant that farmer groups did not receive enough training, including his inability to upload the monitoring forms to the Grameen system portal. Domis' ability to move up was something beneficial to the community since more children could access primary education. His engagement in school activities implied less engagement with the farmers. Thus, in this, I concur with the argument that efficient knowledge workers have to vest

[32] Not real name
[33] Not real name

enough time to the community for knowledge to be efficiently absorbed by those being supported.

The immense expectations accorded to knowledge workers are usually high (Sener, 2018). CKWs being farmers themselves, expectations from the organizations and the community of farmers were high. For instance, as farmers, they were expected to be the first adopters and users of the knowledge shared on mobile phones. This put them in a seemingly challenging position as some felt pressured to lead by example. Observed by Sener, the high regard for autonomy and self-management that comes along with knowledge worker creates more burdens on their shoulders (Ibid). For example, two female CKWs claimed to have adopted partially given other family responsibilities like nursing sick family members in hospitals, and even in worse scenarios, they themselves falling sick. Given that a CKW was entrusted to share knowledge amongst 50 farmers in such circumstances, the 50 farmers missed out on adequate support. This shows a gap in the CKW approach. Therefore, to counter such uncertainties (most of which happen in other workplaces), the Grameen project made replacements for communities to be supported.

Generally, to some extent, most CKWs testified about how the mobile phones supported the knowledge sharing activities as many looked at mobile phones as libraries and knowledge banks within their community. Like one noted, *“my phone is my treasure, my phone is my bank, and my phone is my expert.”* This depicts the blurred nature of what mobile phones afforded to both lives and livelihoods (Donner, 2009). Most importantly, this knowledge on the mobile phones’ translations depended on the innovativeness of the knowledge worker. The more the CKW was tactful and innovative in encouraging farmers' participation, the more learning was envisaged. The knowledge workers' agency, willingness, and determination to work with a group of farmers contributed to collaborative learning among peers. As emphasized by Hunter and Scherer (2009), the autonomy, self-management and self-responsibility accorded to knowledge workers gave CKWs a chance to manage and explore potentialities that contributed to group bonding activities.

Finally, in the farmers’ context, CKW activities were supported by different actors. The presence of significant others in helping communities improve their agricultural practices deserves attention. The CKW activities were supplemented by other professional agriculturalists who occasionally visited the farmers' groups. In the USAID CC project for example, the availability of service providers to avail the technical information supported expert knowledge sharing. In the Grameen CKW project, project officers and the National call centres offered technical advice to different farmers. In the L3F project, the availability of project facilitators to facilitate on-farm training and the use of the call center supported learning. Generally, CKWs were trusted local intermediaries with mobility capabilities to work with farmers anywhere and anytime. These were locally termed '*Abahingisa*,' literary meaning extensionists as their shirt logo read 'Ask me about farming.'

### 6.2.2 Adoption and use of mobile technologies for learning

Adoption entails acceptability and use of a technology and or an innovation. In exploring the adoption and use of mobile technologies for learning among smallholder farmers, this study aimed at understanding what key factors facilitated the use of mobile technologies in rural areas. RQ 2 answered by paper 3, offers details of what influenced the adoption and use of mobile technologies. Profoundly, among the farmer communities, adoption and use is two-fold. First, it entailed the ability to use mobile technologies to share knowledge about farming, and second, the shared information and knowledge about farming became an aspect of adoption. Whereas the findings of this paper point to the adoption of mobile technologies, it was later noted that the ability of the farmers to use knowledge was also a measure of adoption. Mobile phones as technological tools disseminated new technologies in farming like new methods of planting, new information about animal husbandry, better ways to ensure food security, with a focus on financial literacy. However, the analysis of farming technologies was not adequately addressed in this study given the lack of professionalism in agriculture. Besides, the study intended to explore and understand mobile phone usage and how this translated into learning for better livelihoods.

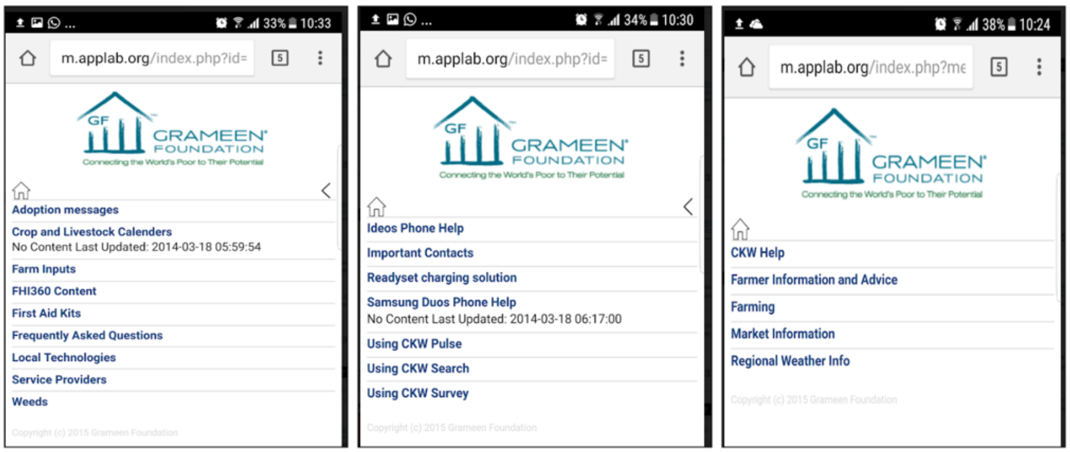
That notwithstanding, the CKWs in the Grameen project who have been at the centre of this analysis used mobile technologies to support knowledge sharing. Adoption and use factors like organizational support, performance expectancy, social influence, peer support, immediate learning impacts, and increased output as prescribed by the Unified

Theory of Acceptance and Use of Technology (UTAUT) facilitated mobile learning. Both human and non-human actors supported learning on mobiles (as detailed in Section 6.2.1). Most importantly, the agency of the CKWs, whose role was to work as organizational ambassadors to share knowledge with the farmers largely influenced technology adoption. In a FGD with the CKWs, Kato, a CKW in Katerera narrated that, "*…the trust entrusted in us by both Grameen and our people gave us the motivation to learn how to work with the phones. While the organization gave support, our internal drive as CKWs to not only work for ourselves but also to work on behalf of others forced everyone to use mobile phones for learning. In case one failed to work with farmers, no voluntary payment would be given, which forced us to learn how to use them*".

Equally important, even when CKWs used mobile phones as a way to get payment, and that they were local community trained resource persons, the limited agriculture advice in rural locales was a factor that increased mobile use for learning. CKWs as rural farmers themselves needed this information to improve their livelihoods. Besides, they were community role models who had to 'walk the talk' as most farmers often learnt from their gardens. In the Grameen CKW project, adoption terminology was used to imply the ability of farmers to use new knowledge. Through adequate interactions with the rural farmers, it was easy to observe which farmers had adopted or not adopted. "*Through several visits and follow-ups on how farmers used mobiles for learning, my academic supervisor and I could tell an adopted and a non-adopted plantation within a specific village, which facilitated further field inquiries*" (field journal). This understanding was possible since in the last phase of its operations, Grameen prioritized only two enterprises - coffee and plantain management. The ability to read CKW manuals and attend several CKW knowledge sharing meetings made me knowledgeable but limited in practice.

While new technologies are usually adopted slowly, this was somewhat different with the smallholder farmers as some CKWs previously owned mobile phones. Even when the project started in 2008, handling a mobile phone was not a new experience for most CKWs. The only difference was having a smartphone, locating agricultural information (CKW search), learning how to navigate across different options, and the ability to upload field forms. The CKW phone had a CKW help function that CKWs consulted during their daily field operations. Figure 16 shows different embedded support systems for CKWs like service providers, frequently asked questions, ideos help, important contacts, Samsung phone help, and CKW help. Additionally, the strong organization support (both technical and social) offered by Grameen Foundation increased mobile use and adoption for learning. Besides, the call centre also supported CKW mobile-related activities.

**Figure 16: CKW support functions on mobile phones**




*Source: Field work photos*

However, this does not mean to say that it went well with mobiles for learning. Older and some female CKWs had challenges with technical issues which sometimes hampered their knowledge sharing practices. "*My phone used to disturb me. Even the super CKW in my area failed to work on it and it was later sent to Grameen head office in Kampala. I spent over two weeks without getting it back. But good enough, I had another ideos old phone*[34] *that also had some agriculture information. But during that time, I could not upload weekly activities to the Grameen portal,*" said Jovita, a female CKW in Katerera parish. Although the portability of mobile phones explains increased adoption, it comes with challenges of use. Given the fragility of mobile phones, some CKWs had broken mobile phone screens that affected content navigation. The intermittent network connections and network shadows in some hilly locations also affected mobile use. The negative factors to

[34] The Ideos yellow phone was the first phone issued to CKWs in 2009 fully installed with farming and poultry information. This however had weak network capabilities and could not locate GPS in rural places. In 2012 CKWs were given new Android Samsung phones with stronger functionalities, which meant that each CKW has two smartphones with agricultural content.

adoption present as limitations to mobile learning. The next section alludes to this discussion.

## 6.3 Mobile Learning Possibilities and Constraints

| RQ 3: What are the *possibilities* and *constraints* of applying mobile technologies for *learning in livelihood projects*? |
|---|

To arrive at an understanding of how mobile technologies facilitate learning, this study explored the possibilities and constraints of using mobiles for learning. The possibilities entail factors that facilitated mobile use, while the constraints included challenges and limitations that hampered effective mobile integration for learning. Field interactions with the CKWs and farmer groups in the three M4D projects aided data collections and analysis. This section is subdivided into two sections, 6.3.1 possibilities for applying mobile technologies for learning, and 6.3.2 on constraints for using mobile technologies for learning. The presentation of study findings corresponds to the different case studies unique approaches to learning. The Grameen CKW and the USAID CC project use smartphones and the CKW approach, while the L3F project uses farmers' phones to share educational messages.

### 6.3.1 Mobile learning possibilities

Pedagogical integration of ICTs in many developing regions is greatly hampered by installations costs, ICT infrastructure maintenance, and limited sustainability plans to support technology-related initiatives. The availability, mobility, and portability affordances inherent in most mobile technologies can supersede these challenges. Mobile learning is one way to sidetrack costly physical infrastructure to enable access to education by the majority (Oluwatobi & Olurinola, 2015). The "mobile learning community has demonstrated that it can take learning to individuals, communities and countries that were previously too remote for other educational initiatives…[mobiles] can enhance and enrich learning beyond earlier conceptions with learning experiences that are more personalized, authentic, situated" (Traxler 2013, p. 1). Mobile learning, as a term much used in formal education, has had different interpretations. The concept is defined in accordance with the context, technology, and learner mobility. In this study, mobile learning is conceptualized as the use of mobile technologies like mobile phones (both smart and small end) and laptops to support information access and knowledge exchange among smallholder farmers. Learning for smallholder farmers is largely non-formal since farmers need knowledge for immediate use.

Mobile learning offers a variety of choices available for the different needs and situations of different groups of learners. The smallholder farmers in African communities are among those who can benefit from non-formal learning activities as afforded by mobile technologies since majority lack access to actionable information. In ICTD research, the digital divide can also be portrayed as a knowledge divide (Best 2009). Knowledge sharing is essential in agricultural education, and mobile technologies may engage and empower farmers to learn about modern agricultural practices. Smallholder farmers see pride in their farming activities and demand active learning strategies (Sneller & Lima, 2015) that mobile learning can facilitate. Mobile technologies avail a platform where smallholder farmers access and share information and knowledge about farming and other livelihood activities. In this study, because some farmers in rural communities are non-literate, the notion of learning as conversational was significant.

Learning as a conversation entails a process of coming to know through communicative processes that engage the recipient in sharing experiences (Sharples, 2005). Learners cooperate with peers and facilitators to construct meaning within defined contexts. For instance, when people participate in a conversation, they often come to a shared understanding. This shared understanding informs learning since all those involved in the conversation will derive meaning. Laurillard (2002) considers learning on mobile technologies as conversational and constructivist, highly situated, collaborative, and informal. Smallholder farming communities have limited technological capabilities to influence high level learning with technology. Majority live in resource-constrained settings, where it is not only the physical resources (like poor network coverage) that are lacking but also where language capability resources are inadequate. For example, some smallholders had limited literacy capabilities to influence adequate interactions on mobile phones. Such context-specific challenges made conversation learning with mobile technologies possible since the process involved 'just calling'. The subsequent subsections elucidate mobile learning attributes, unique to the different case study sites.

### 6.3.1a Learning with smartphones in the Grameen CKW and USAID CC projects

Technology supported learning requires an appreciation of the unique characteristics of the learners. Regarding mobile learning for farmers, the context, software adopted, and the availability of hardware influenced learning. It is important to note that technologies do not share the learners' context, nor do they provide solutions to all learning situations (Sharples, 2005). In the context of this study, mobile technologies acted as digital libraries that stored actionable knowledge on agriculture and other activities. Mobile phones and laptops acted as media that supported farmer's access to information and knowledge. While previous studies indicate how mobile phones increased farmers' access to weather and market information (Brugger, 2011; Bolton Palumbo, 2014; Crossan et al., 2018; Evans, 2018), from the study findings, farmers' learning was beyond information access.

Moreover, access to information does not translate into meaningful learning (Bjørke, Lazareve, Mayende, Nampijja, & Isabwe, 2015). Whereas content on mobile technologies included information on both farming and other livelihood activities (such as sanitation, gender violence, energy-saving technologies and food security), farmers' on-site sharing and discussions about these topics contributed to learning. Organizational approaches like one-to-one meetings, group meetings, and the use of the call center also supported learning. While WhatsApp interactions were not considered a knowledge sharing platform, in this study, it was noted that CKWs used WhatsApp to learn. All strategies used in the knowledge sharing processes and assessment of farmers adoption capabilities pointed to non-formal learning practices as explained below.

**1. One-on-one[35] meetings.** In both projects, CKWs had smartphones with digitalized information on agriculture and other livelihood activities. These had to meet farmers monthly. In the Grameen CKW project, each CKW worked with 50 farmers whom he/she had to visit on a one-on-one interaction on the farmers' plantation. While the Grameen project interacted with farmers, in the USAID CC project, the CKW worked with 60 households. This meeting depended on the farmers' and households' knowledge gaps identified during the needs assessment process. Here, agriculture advice was given, gap progress shared, and adoption challenges discussed. As depicted in Figure 17, the mobile

[35] One on one is term used in the CKW project as compared to one to one.

phones acted as digital libraries that the CKWs consulted about a given topic. The one-on-one strategy was to ensure that farmers and households not active in group discussions can get a chance to share knowledge about farming challenges. In addition, these meetings aimed at identifying adoption progress and gaps which the CKW submitted to the Grameen mobile portal monthly.

**Figure 17: One-on-one meeting in Grameen CKW project**

CKW reading mobile content | CKW demonstrating coffee de-suckering

*Source: Field work photos*

The CKWs in the USAID CC project visited both farmers' households and their plantations since the integrated nature of the project demanded following up on the Community Connector (CC)10[36] quality standards. While the CC project's CKWs used monitoring tools to measure adoption, much learning and interactions took place as group activities on different learning sites. Nonetheless, in both projects, the CKWs interacted with farmers in authentic environments (farmers gardens) where learning happened. Group learning activities supplemented one on one meetings.

**2. Group meetings.** In group meetings, the CKWs interacted with different farmer groups who took part in project activities. In the Grameen CKW project where each CKW worked with 50 farmers, every month, he/she organized two group meetings at the host farmer's garden. As presented in Figure 18, the CKWs used mobile phones to get topics that

[36] CC 10 are quality standards each household had to exhibit as a measure for adoption. These included; 1. Saving with a Purpose (SWAP) 2. Water Sanitation and Hygiene (WASH), Homestead compound clean and neat, 4. Vegetable garden, 5. Fruit trees, 6. Poultry in a homestead, 7. Income-generating activity, 8. Productive assets like hoes, 9. Food stocks (garden and granary) and 10. Seeing a family working together (USAID Community Connector, 2015)

triggered further discussions. On some occasions, the CKW groups interacted on how to support the different farmer groups. Such group learning activities allowed for deeper interactions that facilitated constructive and transformative learning. As Paulo Freire noted, in transformational learning, ‘whoever teaches, learns in the act of teaching, and whoever learns, teaches in the act of learning.’ Despite being trained resource persons and in possession of smartphones, the CKWs claimed to have learned from farmers’ varying opinions beyond knowledge on mobile phones. Like a CKW noted, “*some knowledgeable farmers with good experience can challenge content on mobile phones. In case the CKW lacks good facilitation skills, he/she might be overtaken. But farmers have their ways of doing things and we always use mobile phones to challenge their bad practices. Also, when they see that things are working on other gardens, they accept to use the knowledge*”.

**Figure 18: Group learning activities in Grameen CKW project**

**CKW using mobile phone in group meeting** **Authentic group learning**

*Source: Field work photos*

During group meetings, the more knowledgeable farmers supplemented information beyond what was available on mobile phones. In such discussions that often lasted for two hours, the CKWs introduced the topic using the mobile phones, shared about strategies used and the practical learning extended to farmers' gardens (refer to authentic learning in Figure 18). In this way, the mobile phones availed a knowledge sharing space that brought the farmers together in a community of practice which supported authentic and problem-solving learning.

Unlike the Grameen project where the CKWs were the main resource persons, in the USAID CC project, the service providers - as professional experts in different agricultural fields worked with groups of farmers at established learning sites like family life schools and livelihood projects. At such learning sites, a household offered land to support group learning activities. Figure 19 shows an example of an apiary project where neighboring households and service providers converged not only to get knowledge but also learn to generate income. The notion of peer to peer learning and expert knowledge sharing supported learning for improved livelihoods.

**Figure 19: Group Apiary learning site in USAID CC project**


*Source: Field work photos*

Additionally, while farmers authentic/practical learning required the use of necessary tools, CKWs were equipped with different tools to facilitate practical sessions. Through field observations, it was noted that the financially stable farmers owned special tools way beyond what the organizations could provide. This supported situated learning since the '*haves*' managed to share with the '*have-nots.'* Tools availability eased adoption of ideas, quickened transferability and facilitated subsequent replications.

**3. Calling to ask about farming**. The national call centre was an option available for all CKWs and project farmers to consult about farming. Unlike the L3F project where farmers incurred some cost to call for advice, in the CKW projects, a code 8338 was used to call in case of urgency. The centre had agricultural experts competent in different languages who offered agricultural advice. To find out how many farmers used the call centre, in the Grameen CKW project, out of the 30 CKWs, only three managed to contact the call centre. Among the farmers, only two called. "*My goat had eaten something dangerous, and it was choking and dying in pain. I contacted to get support at the call centre, and I was helped. Thank God, my goat survived,*" says a farmer who used the call centre. On asking about why some did not contact the call centre, several narratives came into focus. For instance, "*I have tried calling the call centre but sometimes I fail to connect. The system takes long to connect to an expert. They first ask you which language to use, what problem, and then when you reach the attendant, it asks you to wait, which process puts off many*". Another farmer in Mitooma exclaimed, "*whenever I tried calling, and I heard ladies speaking in very fast Luganda accent. The procedure and numbers to follow stopped me from consulting*". These narratives point to the lack of adequate knowledge on the use of the call centre, and the fact that those who tried consulting were sometimes not successful. For instance, I tried contacting the call centre but all my attempts were unsuccessful.

Another additional calling feature specific to the USAID CC project was the Caller User Group (CUG) App installed on CKW phones. This enabled free calling among the CKWs, project leaders, and service providers to stay in contact with one another. The CUG interactions and CKWs phone contacts supported the sharing of farming information which facilitated conversational learning. In conversational learning, learning is a process of coming to know where learners work in cooperation with peers and facilitators to construct meaning (Sharples, 2005).

**4. WhatsApp and learning.** The WhatsApp feature on smartphones supported the CKWs to stay in contact with one another and interact about different farming topics. District level and parish level CKW WhatsApp groups supported learning on mobile phones. "*Even when some youth over post the political jokes like the president in the cartoon fighting the opposition leader, some CKWs take pictures and ask about the names of different weeds and different pests. Here, some even use local languages which supports sharing,*" says Muzei, an elderly CKW in Mitooma parish. WhatsApp also supported communication from the Grameen head office about various operational reminders and updates about future meetings. Some CKWs captured updates in the form of pictures about their adopted farmers and other field happenings. WhatsApp affordance aided video and picture attributes that some CKWs used to share and learn about different farming practices.

Project officers and district champions offered professional guidance on CKW WhatsApp groups. During the face to face meetings, some CKWs referred to WhatsApp interactions;

an indication that some learning was happening. On questioning about the limited CKW involvement on group WhatsApp, Luke, a CKW in Katerera noted that "*Some CKWs do not visit WhatsApp because they fear to consume their monthly MBs since Grameen sends MBs which we use to submit the monthly adoption forms*." The monthly 100 megabytes (MBs) given to the CKWs limited WhatsApp usage since not many were willing to use their own money to buy more data. Thus, the CKWs who used WhatsApp to socialize with others purchased cheap social media bundles.

To understand farmers' learning in the above organization strategies, as explained earlier, adoption and non-adoption terminology was used. An adopted farmer was one who showed progress in terms of addressing the initially identified gaps in knowledge. The farmers' ability to show a well managed plantain or coffee plantation signified adoption. In each season, a CKW followed up a farmer not only to share information but to assess the level of knowledge usage. Several other strategies were implemented to measure farmers' adoption capabilities. In this study, as guided by social constructivism, this is categorized as assessment for learning as discussed below.

**Strategies to assess smallholder farmers' learning**

The Grameen Foundation CKW project devised mechanisms to monitor progress in different rural communities. The central focus of the analysis was the CKWs and farmer groups. Therefore, to analyze whether learning happened, the monthly reports[37] about CKW activities formed the basis to not only assess organizational performance; but analyze farmer's learning. The forms were submitted through a mobile system installed on the CKW phone, rendering it hard to locate such information. Nonetheless, I observed the gap forms administered to the CKWs stipulating what topics each farmer needed to learn. Apart from the monthly reports, other monitoring mechanisms also supported farmer adoptions (learning) at different levels.

i. **Individual farmer assessment**. During one-on-one meetings, it was clear that the farmer assessed his/her capabilities depending on the previous knowledge gaps. Through face to face meetings, the CKW identified farmers' progress in gap handling,

[37] Monthly reports are forms given to each CKW every month to report about each farmers' progress on site. Each farmer has a unique identifier and a gap (farming challenge) to address. Prior to a new month, CKWs are given these forms in print which they later use to upload in the Grameen portal. See appendix 10

which information was later recorded in the field monitoring forms. In the USAID CC project, the CKWs used mobile phones to monitor the presence of CC 10 standards in a given household.

ii. **Peer to peer group support**. Since the group rules demand that each farmer hosts a group meeting, it was possible to give and share feedback about the status of a farmers' plantation. Learning was authentic and problem-solving with interactions beyond the content on mobile phones. Farmers offered practical advice based on each member's farming experiences, which then supported peer to peer learning. In the USAID CC project, monitoring progress happened at learning sites like family life schools and livelihood projects with the help of service providers. In the family life schools, for example, the project monitored the ability of the household to have a vegetable garden, fruit trees, good hygiene, and sanitation with proper food preparation and storage facilities. Households were required to have energy-saving cooking stoves to reduce costs on fuel consumption. The presence and or absence of these standards meant the household had either adopted or not.

iii. **Service provider visits.** Unlike the Grameen CKW project, the USAID CC project works with service providers to support CKWs activities. The integrated activities in the project demanded different livelihoods experts to supplement CKW knowledge sharing processes. "*Our primary roles as service providers is to monitor different livelihood projects like apiary, vegetable growing, and poultry farming. CKWs can only offer advice on mobile phones but we came in to offer more professional and practical advice*," said a poultry specialist service provider.

iv. **Organizational monitoring visits**. Upon meeting the farmers, the CKWs submitted monthly reports formed a basis for monitoring. The Grameen project staff randomly selects which farmers to monitor by correlating with the CKW uploads of adopted or non-adopted farmers. The community connector officer (CCO), district champion, project officers, and national coordinators from the organizations followed up farmer activities in different villages. It was clear that at this level, the organization was also pushing for results to document good practices for more funding. Records of farmers whose plantations showed impact were captured and later published in organizational reports and newsletters. Most farmers were extrinsically motivated to not only appear as best farmers in organization records but also to have hosted Grameen officials. "*Mere hosting organizational staff on one's plantations was empowering and motivating. In the three organizational visits I participated in, I noticed farmers' negotiations as most wanted their plantations to be visited by the Grameen team. Utterances of I have adopted, my plantation has improved showed how many farmers needed to be monitored*" (Researcher field journal). This meant that such farmers were ready to show impact, which implied that learning took place. Quite notably, during the organizational monitoring visits, most staff provided on-site feedback to the farmers about the status of their plantations. Such expert sharing facilitated new learning and gave confidence to farmers about their practices.

v. **Evaluators from the organization**. Occasionally, a special management team and external auditors sampled some farmers and followed up different CKW farmer groups. This was meant for verification purposes and to identify actual project impact. The team included international participants, mainly project funders, who randomly identified farmers using the project farmer database, contacts, and GPS location. Like one old female farmer exclaimed, "*I got a chance to be monitored by 'Abazungu' (International participants) from Grameen. They visited my banana plantation, captured my photos while in the plantation, which later appeared in Grameen end of yearbook. This excited me and increased my motivation even to work harder. It connected me to many friends since I have been receiving many researchers to learn about my story*". Another visited male farmer added, '*…who am I to even host 'bazungu' on my land! Seeing the organization car park in my compound is rewarding and fulfilling. It gave me more confidence to even work better and improve my coffee plantation*". The magnitude of motivation exhibited when farmers received visitors facilitated continued practice.

Interestingly, in one of the project areas where Grameen had phased out its activities, most farmers felt extrinsic motivation had affected the adoption of new knowledge. An older female farmer narrated that "*At least 'Bazungu' would come and visit our activities as this was rewarding and motivating. Their encouragement words would give us hope even to work harder. They were our friends but since they no longer visit* *us, our motivation got low*". Visits by the international participants members made the farmers feel part of the big international community as visitors shared stories about their home countries. At this level, organizational monitoring aimed at identifying good practices, impact, gaps, and understanding challenges that affected farmer adoptions to new farming practices. The videos and field photos captured during these visits supported documentation of good farming practices.

Summarily, in all the interactive sessions, feedback given to farmers on their plantations was a measure to assess improved learning. The experts from Grameen, the CKWs, and fellow farmers visited each farmer on-site and gave comments as they moved around the plantation. This depicted peer assessment and support to one another that promoted further learning. This feedback, often authentic, was recorded by the Grameen team and later informed the individual learner portfolio. Because most farmers are not literate, self-assessment was done through one-on-one interviews by the project officers. In the farmer portfolio, achievements, learning gaps and challenges were identified on every monitoring visit, which informed future learning needs. The mobile phones' in-built system aided the process of recording and interviewing farmers during monitoring. Although the organization carried out this monitoring once a month, there was feedback given to farmers by their fellow farmers that facilitated farmer to farmer assessment. In line with the idea behind socio-constructivism, the presence of the mentor, service provider, role model farmer, and the CKWs to offer expert advice catalyzed the discussions and allowed for deeper reflections.

#### 6.3.1b Learning with small end phones in the Lifelong Learning for Farmers (L3F) project

Introducing learning materials on mobile phones that people already possess offers mobile learning affordances to situate learning in people's contexts (Young, 2009). At the very end of this mobile phone integration, "the central question is how to submit and convey information through low-end mobile phones in ways that illiterate or semiliterate farmers will find trustworthy and help them adapt their farming practices" (Knoche et al., 2010, p. 1). Access to mobile phones does not imply access to and use by all. Understanding what people do with small end phones, and how they can support learning for livelihoods is a critical question to deliberate on issues of access and equity by all. The Lifelong learning for farmers (L3F) project used the locally available (small end phones) to share information with the farmers. Both text and audio messages (SMS) were shared on the farmers' phones in different local dialects. The text message and direct farmer calling were supplemented by other training strategies for the different farmer groups as depicted in Figure 20.

**Figure 20: Small end phone and other farmer learning strategies**

Small end Phone

Other learning strategies

According to the L3F approach, the integration of human capital (viewed purely from learning, knowledge acquisition, and skills reflective practices), social capital, and financial capital avails self-sustaining, self-replicative, and self-generative approach to learning (Atieno, 2013). In the L3F, learning was categorized as vertical and horizontal. In vertical learning, mobile messages from the L3F data centre reached the farmers' mobile phones. The one-way sharing was considered vertical that is, from L3F to farmer phones. Since not all farmers were registered in the L3F mobile system, those with L3F messages shared with other farmers in what the organization referred to as horizontal learning. Another organizational approach to vertical learning was the use of the Caller User Group that enabled different users to make cheap calls to those in the network. The group consisted of farmers, researchers, extensionists who interacted with one another at a low cost. This meant that farmers who could afford airtime contacted experts for advice.

Using different local dialects, L3F farmers called to ask about farming. While Knoche et al. (2010, p. 2) recognize “literacy being one of the biggest impediments to access existing data,” farmers in L3F interacted with mobile phones in their different local languages. The messages shared targeted different ethnic groups across the region. From the study findings, farmers attested to learning from both the organization and other group members. Significant was the element of financial empowerment in the project. Farmers narrated the importance of accessing financial literacy messages, like how to manage a loan, how to sustain a loan, and when to get a loan. On this note, the need to ensure guided use of the technology to avail solutions beyond general use (World Bank, 2016) is essential for technological initiatives to address available needs. The relevance of contextualized curriculum embedded within the technological solutions is important for sustainable adoption and use.

Interestingly, the farmers noted how the text messages increased their literacy skills. "*Before joining the project, I was not sure whether I would read the message well. I used not to use text messages but with time, because of L3F, I can ably communicate via text,*" said a farmer in Kabale town. ICTs have supported literacy practices among poor rural women in most developing countries (Bhatnagar, 2000). Mobile phones availed a platform where rural farmers exercised both reading and writing skills in their local languages, which is an aspect of learning to read and write. The use of locally available phones owned by rural people is also a sustainable component in ensuring how mobile phones can facilitate inclusive learning for all. This is especially relevant when thinking of advancing the use of available technologies to work for disadvantaged communities. This justifies the need "to identify what people have rather than what they do not have (Moser, 1998, p. 1). Such a realization strengthens farmer's available resources, rather than substituting, blocking, or undermine them (Moser, 1998; Ellis, 2000). L3F utilizes the available farmers' phones amid restrictive text requirements with limited functionalities.

#### 6.3.1c Other factors that facilitate mobile learning among smallholder farmers

Given the varying ways mobile phones support learning, the presence of experienced peers, the value of social capital, and the availability of other knowledge sharing platforms supplemented mLearning for livelihood support.

**The value of social capital**

In development practice, social capital is a core foundation in exploring and understanding how individuals achieve coordinated efforts (Ostrom, 2000). Social capital includes "…

the features of social organization, such as trust, social norms and networks that can improve the efficiency of society by facilitating coordinated action" (Putnam, Leonardi, & Nanetti, 1994, p. 167). Social capital can also imply "norms and networks that enable people to act collectively" (Woolcock & Narayan, 2000, p. 226). In the study context, social capital encompasses available trusts, norms, and networks that helped farmers to work together and achieve a common aim. Social capital availed agency with information and knowledge resources that helped farmers overcome constraining challenges like the lack of updates about modern farming practices, lack of market and weather information, and limited capital. Øyhus (2017) defines agency as a force behind social action performed by actors within the social network. The agency of CKWs and other farmers within the social network supported mobile learning practices. For non - literate farmers, the availability of significant educated family members like school children and youth within the social network supported mobile phone usage. The social ties in some households with friends and relatives both in Kampala and diaspora supported mobile phones acquisition since some smallholder farmers claimed to have received mobile phones from relatives and friends.

The idea behind learning for livelihoods mainly builds on social networks available within local communities. The available social networks, both internal and external supported learning on mobile phones. Internally, the CKWs were not the only resource persons; the availability of knowledgeable and experienced farmers supported learning. Externally, the service providers, researchers, and organizational staff supported CKWs to learn about farming. As Putman notes, organizational structures that build on horizontal linkages will increase trust and cooperative relations necessary to strengthen social capital, better than organizations that use vertical hierarchical linkages (Putnam et al., 1994). Whereas all the M4D projects availed top-level support, the availability of CKWs and group champions in communities enhanced networks that supported collaborative learning. From field observations, many farmers consented how an extension gap was reduced in their communities'. Similarly, mobile technology affordances supported the socialization of farmers and thus widened social networking among those involved in the M4D networks.

Adversely, Øyhus (2017) makes a claim that social capital can overrule local norms and values, with efforts that negatively impact the local community. For instance, in the

Grameen CKW project, the available bonds within CKW groups restricted other members from joining the groups. Like one non-project farmer pointed out, "*the village level CKW group has farmers in strong positions like chiefs, local chairpersons, teachers, parish chairpersons, people on big land acreage, and many are educated. As a poor person, sometimes you fear to mix with such people*". In this context, the CKW group composition restricted less privileged farmers from joining. Whereas some farmers with moderate financial position gained from group activities, their agency to influence group activities was low. Moreso, while the CKWs were given smartphones to support communities, this was perceived negatively by some community members. The CKWs and group champions shared the negative perceptions from partners, relatives, and some community members. For example, in the L3F project, a lady who belonged to the 'Batwa' group was excommunicated for owning a mobile phone. The Bazukufu religious group in Katerera sub-county could not socialize with people in possession of mobile phones and other computerized gadgets. This affected social relations and technological integration in everyday life activities.

**Prior knowledge and availability of experienced peers**

"New learning is shaped by prior knowledge and cultural perspectives" (Shepard, 2000, p. 8). For technologies to meaningfully contribute to the farmers' practice, integrating prior experiences and cultural perspective is significant for learning. Whereas mobile learning can support community centredness, the availability of agricultural experts and model farmers in different communities complimented farmers' mLearning. Unlike the Grameen CKW projects with no immediate experts in the villages, in the USAID CC project, the CKWs benefited from the presence of more knowledgeable service providers in their learning circles. In the Grameen CKW groups, the role models and other experienced farmers equally complemented learning on mobile phones. The professional touch and vast farmer experience increased knowledge acquisition, trust, and group bonding.

Consequently, to avoid being a myopic promoter of how mobile phones have supported learning for livelihoods, this study attempted to explore available information systems before M4D projects. Definitely, smallholder farmers had available local spaces within which they interacted and worked with one another through socialization. Among the farmer groups, some farmers had interacted and worked with government extension workers. This exposure contributed to more learning given the availability of a previously rich pool of farming knowledge. Thus, it is crucial to appreciate what was available before and that the M4D projects were not the sole contributors to farmers' learning. The mobile phones extended and updated farmers' available knowledge through capitalizing on farmers' previous experiences; and most importantly, extending new knowledge to supplement on the previous agricultural practices. The M4D projects were not the first actors as priority was to make use of mobile technology tools to extend modern farming practices.

**The relevance of other knowledge sharing platforms**

Mobile phones cannot offer all kinds of communication to facilitate learning (Yim & Gomez, 2018). Mobile technologies work in synergetic relations supported by other networking technologies. In all the M4D projects in this study, available avenues like print media, radio talk shows, community sensitization, and meetings supplemented farmers' learning. Envisaged organizational strategies like service providers, family life schools, nutritional sites, call centre support, and different expert visits supported learning on mobiles. Whereas at the time of data collection, agriculture extension activities were limited to seeds distribution, the partner agencies available in different rural communities supported farmers' livelihoods. Mobile phones cannot replace conventional extension, but they are important to reach the unreached for support. Mobile phones created a network niche that supported communities to work together. Ultimately, mobile phones acted as cognitive tools that facilitated farmers' doings. This mobile learning possibility was enhanced amidst the availability of telecommunication, internet services, and organization support mechanisms in all the M4D projects.

**Access to telecommunication networks and internet facilities**

The availability of telecommunication services and internet in the rural areas was critical in facilitating mobile learning among smallholder communities. The M4D projects had strong bonds with different telecommunication providers which eased information access on mobile phones. MTN Uganda partners with Grameen CKW and USAID CC projects to facilitate CKW activities. L3F project had close links with Airtel Uganda regarding text and audio messages shared on farmers' phones. Amidst the presence of network shadows in some hilly places, the telecommunication climate that accounts for 98% network coverage in Uganda is a founding factor that supported learning on mobiles. Uganda's 44% internet penetration rate has been attributed to the increased penetration of cheap smartphones (Sebunya, 2018). In rural areas where electricity to support fiber connections is a challenge, mobile phones have enabled the transfer of internet services to many rural communities. The previous telecentre models that extended internet in far to reach communities failed to sustain most of their activities given the cost implications involved in equipment sustainability (Nampijja, 2010; Rhodes, 2009). To date, this 'my device my phone' capabilities have improved and extended internet access in local homes, thereby bringing internet closer to the users. The youth farmers and the CKWs use mobile internet connections to access market and weather updates which ultimately supports their livelihoods.

**Women agency and gender in project activities**

The relationship between women agency and gender in M4D projects was significant in facilitating mobile technologies use for learning. Women smallholders felt a sense of belonging and social connection through their different farmer groups. Many testified how the projects facilitated relationships with others, extended learning about new farming practices, and supported knowledge sharing and feedback activities in their gardens. *"…We have been empowered by this project. Not only through training about farming, but we have started savings activities in our village groups which has improved wellbeing in our homes. We no longer face challenges alone as women; we have people to run to always…"* said a women leader in Irimya parish, Kicuzi sub-county. To proximate agency and mobile technologies, women CKWs with mobile phones felt empowered, and their self-esteem was uplifted. For instance, most CKWs contested as women leaders in their respective locales, where some victoriously emerged as leaders. These achievements are partly attributed to the CKW roles that gave them agency to work with communities in different capacities.

One interesting observation was that in the Grameen CKW project, during the needs assessment phase, whereas men were the registered project beneficiaries, women were the most active participants in most Grameen activities. This realization relates to socio-cultural roles since during registration, the family head was registered and in Uganda, except for widowed households, women do not head families or own land. In this project context however, women were the actual users of this information since most kept at homes and attended the different farmer sessions. This increased their agency to learn new farming practices, and accordingly, to the National coordinator, women were ranked as the best performers compared to their male counterparts in most project activities. Amid reproductive and other social obligations, women agency in most activities was rated high than their male counterparts.

In appreciating the role of women in all three case study sites, women’s livelihoods improved since all projects were critical to women's needs. Whereas the Grameen CKW and the L3F did not have clear women inclusion strategies, it was evident that at all levels, women were included and given priority in most project operations. This resonates with the fact that women are key stakeholders in supporting and maintaining sustainable and resilient households in rural communities (Jahan, 2017). The projects’ benefits to women's livelihoods in rural locales can be traced from the fact that men (husbands) availed ‘spaces’ in terms of time and land for women to participate in project activities. More so, such women empowerment activities are in cognizant of livelihood activities that were directly linked to women’s roles in society. The USAID CC project aimed at fighting malnutrition and poverty in homes through an integrated approach that included not only women but also men in different livelihood project activities. This opened a space for supporting men's livelihoods in project activities like apiary, horticulture, vegetable, and poultry. Therefore, male inclusion in women-led project activities leads to project acceptance and contributes to the long-term empowerment of women in rural communities.

### 6.3.2 Mobile learning constraints

Whereas mobile learning avails knowledge sharing platforms among the less privileged, in this study, there were notable constraining factors. These ranged from technology constraints, the inability of farmers to use the knowledge on mobile phones, to mobiles as disruptive to society. Part of this analysis is adequately explored in papers 1 and 6.

To begin with the technology related constraints, mobile phones had limited text affordances that only supported fewer characters. In the L3F project, the small end phones had character restrictions that increased the costs of mobile content sharing. From the L3F in vivo inferences, "*The phone character limitation was our biggest problem since only 162 characters including spacing is what the phone supported. In addition, each message cost 80 shillings, yet we send both text and audio to over 1000 farmers*". In the Grameen CKW and USAID CC project, the fragility and portability of smartphones made them susceptible to damage since CKWs moved with mobile phones anywhere, including in farmers' plantations. Some CKWs had broken phone screens that affected content navigation. Moreover, as fragile tools, smartphones needed proper maintenance which was sometimes hard considering the daily routines of CKWs.

Relatedly, being fancied by the majority, all participants attested to increased phone theft in their communities. If a farmer or CKW lost a phone, getting a replacement was a process. As noted by a key informant in L3F, "*phone theft is our biggest problem. Our farmers keep losing their phones, yet in the database, whether a phone is on or off, the telecommunication company will charge the project*". Other notable limitations were linked to mobile phone technical problems. The batteries, the touch screens, failure in charging systems were problems encountered while working with mobile phones. Although the super CKWs in the Grameen project offered basic troubleshooting, some technical issues needed mobile phone technicians. For instance, if a CKW's phone had a serious mechanical problem, the phone was sent to Grameen Foundation head office technicians. It takes two to three weeks for a farmer to receive his/her phone back, yet, all content the CKW used was in the smartphone. This stagnated CKW activities thereby limiting knowledge sharing processes.

The intermittent network and internet connections in some places did constrain mobiles use for learning. Some hilly locations had network shadows that hindered the CKWs from accessing mobile phone updates and uploading monthly field reports. In the L3F project, some farmers even had to move to nearby town centres to access the network. "*The poor networks in some places affect our operations. Once you run L3F messages when the farmers' phones are off network, farmers cannot receive that information even when the phone gets back to full coverage,*" said a key informant in L3F. While there is internet progress in Uganda at 44%, in some locations, connectivity is still a challenge. From a national household survey in Uganda, 89.2% of all households did not have internet access at home (NITA, 2018). It is rare to find homes with internet connectivity given the costs involved in installing internet at home.

The disparity in internet connectivity becomes more significant in rural communities where telecommunication network challenges are frequent, and where the majority have access to small end traditional phones with limited connectivity capabilities. Although some new developments like Facebook Lite[38] facilitate quick connections among phones with limited specifications, their ability to access other farming updates online is limited. Likewise, the newly introduced Over The Top (OTT) tax, where internet users on social media platforms incur a cost, has implications for learning using mobiles. Despite smallholders not being ardent users of social media platforms, the OTT tax will affect not only their operations but other M4D organizations that integrate social media platforms like Facebook and WhatsApp to support different farmer groups.

Besides the technical and network challenges, some cognitive barriers (Haseloff, 2005) also affected mobile learning. For example, some rural people lack literacy skills, with no English language command to navigate through mobile applications. The lack of a national language in Uganda partly explains the increased costs incurred by the L3F in trying to translate farming information in different vernacular languages. Whereas Grameen Foundation only shared the mobile content to farmers within the organization, not all farmers in the project would understand the mobile content in English. Moreover, the content on CKW phones was not accessible to the public. In such circumstances, information is not only considered as a resource; but can be looked at as a commodity (Hetland, 1991). The content on the Grameen CKW phones was viewed as a commodity in that it was only accessible to organizational stakeholders. Even when Grameen mobile content farming package was at a level where anyone with basic English can comprehend, it was not accessible. This is viewed as a red flag (Wenger, 2000) that excludes others from accessing mobile content, thereby increasing the digital and cognitive divide.

The most profound finding regarding mobile learning was that some farmers did not use the information on mobile technologies. Just like in any type of learning, the learners'

[38] Facebook Lite is an application designed for low speed connections and low specification phones. It is designed to work on slow or unstable internet connections in rural areas with a bad signal.

failure to use information implies the existence of certain constraints that impede knowledge applicability. As discussed earlier, in the Grameen CKW groups, adoption and non-adoption were the terms used. Rogers (2003) defines non-adoption as the rejection of an opportunity to adopt an innovation. This rejection can be classified as either: active (where the innovation was adopted earlier, but later, a non-adoption decision is made) or passive (where no thought is given to the adoption of innovation at all). Smallholder farmers exhibited both active and passive non-adoption tendencies. In the Grameen CKW project, out of the 50 farmers each CKW interacted with, on average, only 30 farmers had adopted (applied knowledge in their gardens). In the USAID CC project, even when the integrated livelihoods campaign targeted the entire community, not all households used this information.

Both projects had farmers who partially used information or who deliberately chose to be outside the learning community of practice. The study findings indicate that most smallholder farmers engaged in different livelihood activities which meant that in some seasons, they were attending to other activities. "*I have often attended most meetings. But because I have a part-time seasonal job every planting season, I leave my garden to my wife and children who cannot take charge. And when Grameen supervises, they look at me as a non-adopter, yet, I need more money for school fees for my children,*" narrates a non-adopted farmer in Katerera parish. In the CKW project, the ability to use knowledge was tagged to only those gardens presented, and yet their livelihoods were not entirely supported by only those gardens. Thus, to the organization evaluation standards, such farmers ended up as partial adopters or non-adopters.

Consequently, because of the failure to adopt, most CKWs felt demotivated as their voluntary payment varied on how many farmers had adopted. Good performing CKWs were awarded certificates for motiving them to continue with the good work. Such practices left other CKWS worrying. As noted by a female CKW, "*my farmers are not adopting. You tell them, they do not work. I sometimes feel I am not working enough. I devote enough of my energies but nothing, and in the end, I am judged for not working well by Grameen".* Assessing farmers' learning was tagged to the CKW's productivity, which was an unfair measurement standard. The CKWs were available to support the farmers but given existent factors beyond organization control, CKWs were not entirely responsible for farmers' non-adoptions.

Moreover, as fellow farmers themselves, some CKWs failed to make use of shared knowledge, yet they were the custodians of the mobile content. The non-adopted farmers regularly attended meetings and possessed knowledge about what needed to change in their gardens. But given the available constraints, most were considered as non-performers. This, however, contradicts the social constructivist approach to learner performance since what counts as learning is performance and not output. Learning ought to appreciate the process as failing to learn something is also learning. If farmers were unable to use the information shared, what is there to learn from this failure? On scrutinizing what failed some farmers and CKWs to adopt, this study identified several reasons that curtailed knowledge use.

As Ellis and Freeman (2004) confirms, just focusing on education in most developing regions is too simplistic as institutional policies and reforms need to facilitate available interventions. In this study context, focusing on mobile learning amidst unfavorable policies and infrastructure systems that stampede farmers' activities limit adequate exploration of intended project benefits. This implies that "technology-enabled interventions are no panacea in themselves, …they need to be backed by complementary investment in physical infrastructure" (World Bank, 2016, p. 92). Technology alone cannot solve problems if other essential services are not supported. Therefore, "rather than assuming that Information and Communication Technology will always be cost-effective and yield a better outcome, a more nuanced understanding of underlying institutional environment and constraints is warranted" (Ibid).

There were visible underlying factors that constrained mobile use beyond M4D projects control. Significant among these was the fact that the adoption of new knowledge required financial support. While the content on mobiles included some local technologies and indigenous knowledge, most farmers become constrained due to lack of money. The financially less abled farmers had challenges to access inputs such as tools, pesticides, farm manure, yet the practical application of new agricultural knowledge required the use of modern farming techniques. Through field observations, the well-adopted gardens belonged to farmers who had money to hire farm labor. Widowed and children headed households were severely constrained since they lacked the capital to purchase the necessary farm input. Thus, poverty and lack of credit facilities seriously affected knowledge use. While the L3F and the USAID project integrated financial capital and "Save with a purpose" components in their livelihood approach, the Grameen CKW project emphasis was entirely on farming knowledge.

Roy (2018)'s study on mobile usage in rural India points to the lack of credit facilities, poor financial literacy, limited or poor infrastructural facilities like storage facilities, and good transport systems as barriers to the adoption of mobile phones. Similarly, farmers in Uganda also noted the inadequate storage facilities, the lack of processing plants, and how poor road networks affected knowledge uptake. The contextual challenges constrained farmer's use of shared knowledge on mobile phones. In Katerera and Kicuzi sub-counties, the road network system affected the access to available markets. The Ugandan government has improved road networks on main roads as a national wide strategy to increase access to markets and ease the transportation of goods and services. The fact is, however, that most roads connecting villages to main highways are marram roads that are often impassable during rainy seasons. For instance, when it rains, the roads become muddy and slippery, negatively affecting transport services. As a mitigation measure, some farmers resorted to selling 'young gardens[39]' to reduce transportation risks and losses. One farmer noted that "*a bunch of plantain (matooke) in Kampala cost the same with that in Bushenyi because the bunch coming from far to reach villages incur higher costs*." In Irimya parish, most farmers opted to grow plantain for local brew that could be locally processed. Such local adaptive measures yield low productivity, stress the value chain system, and partly disempowers local farmers. Therefore, while content on mobile phones motivated farmers to increase farm productivity, the poor roads and limited storage facilities affected knowledge application.

Likewise, smallholders' limited access to risk mitigation or risk insurance instruments reduces their capacity to invest in productive assets. This drives them into subsistence farming and hand to mouth survival. Thus, innovative financing mechanisms are needed to increase farmers' financial ability to invest. "Weather index-based insurance has proved

[39] Young gardens are unharvested mature gardens. Many farmers in rural areas use this approach due to lack of capital, poor markets and inadequate transport systems.

useful in helping them cope with weather-related risks, but this requires access to good meteorological data" (UNCTAD, 2015, p. 7). This view about finance and insurance hinges on the smallholder farmers in Uganda. For instance, most smallholders being rural-based, financial services in the form of loans and insurance rarely reach them. Often, the financial support available are small loans, grants, and seed money offered by international NGOs. The weather index-based insurance opportunities often benefit large scale farmers who have enough assets as security. Such limited financing and lack of insurance programs curtail activities of most smallholder farmers in rural areas.

Another intriguing limitation to mobiles for learning were gender-related tensions. Whereas the interaction between agency, women, and gender was significant in exploring mobile technologies support for learning, there existed gendered tensions arising from different project activities. For instance, in the CKW project, two female CKWs testified how their husbands controlled and used project phones for personal calls. When it came to the monthly megabytes subscription, some husbands were seen to use all the money by themselves, which affected female CKWs. In worse scenarios, men forcefully asked women to withdraw the voluntary monthly allowances. Other insecurities rising from the mobiles' uplifting status of women were evident. "*I started getting threats and insults from my family members and mother-in-law. Although my husband was okay with my work, his family was unhappy since the Grameen project gave me a monthly allowance, smartphones, mobile charger, solar panel, and light bulbs. They often thought I was earning much, which was not the case,*" said a female CKW in Kateerera. In another dimension, because the CKW activities necessitated meeting farmers in groups and during one-on-one meetings, some spouses felt uncomfortable with their wives meeting men privately. Thus, this one-on-one meeting approach posed a practical limitation that affected learning.

Furthermore, whereas all projects embraced social constructivist learning, that is, making learning authentic, some structural issues needed attention. A female CKW testified how on several occasions, a male farmer was asking for sexual advances. She also decided not to share this information with the immediate supervisor since the male farmer was a local council chairperson and a relative. Similarly, there were some divorces among the CKWs that affected information dissemination. In the Grameen CKW project for example, two females CKWs had misunderstandings with their husbands and migrated to different places. The cause of divorce, however, cannot be linked to the CKW roles, although some CKWs felt that their husbands were not cooperative. To replace the CKWs, the Grameen Foundation and the community identified new CKWs to support communities in affected parishes. While the above tensions are seen against a background of female CKWs, I cannot conclude that the male CKWs were not affected. The study located some wives to male CKWs who seemed rather happy with their husbands' leadership roles.

The L3F project did not have such gendered tensions since all farmers received information on their mobile phones. I cannot, however, conclude that even with these messages, no gendered tensions were visible. Perhaps, sending information directly to farmer's phones would be sufficient to counter such tensions. However, this view of sending to personalized farmer phones had challenges in itself as sharing and pooling of ideas was limited, amidst other structural barriers like illiteracy and dissemination costs. In the USAID CC project, most gendered tensions arose in relation to food storage in homes. For example, some husbands sold food and young gardens with no consent from their wives and children, after which the sales were not shared. Yet, in most households, women and children were seen to offer more farm labor. Some men also denied women from having access to a mobile phone. In instances where a woman needed to make calls, she had to use a man’s phone. Because the USAID CC project approach integrated a gender and family relations discussion in the content on mobile phones, there were less of such happenings. Moreover, in this project context, the ability of a household to exhibit harmony (between husband and wife) was one of the yardsticks to gauge an adopted and transformed household.

Equally relevant, in the Grameen project where most of these gendered tensions occurred, the organization integrated men (husbands) in most trainings to counter such rigidities. But, despite all attempts, some men didn’t oblige. From the National coordinator, the organization sought permission from the husband when the identified CKW was a female. The wives to the male CKWs were neither contacted nor integrated into CKW trainings, which points to the visible escapades of a patriarchal society. In this way, gender issues are perceptual (Jahan, 2017). Sometimes, it is hard to understand women's issues because women do not see gender challenges as outsiders observe. Some of the apparent injustices perceived were not considered as challenges by some women.

For instance, some women did not bother about their spouse's access to the monthly pay and use of the project phones. Others also could not report nor question their husbands for selling stored food items. Like one female farmer noted, *'I cannot begin attacking my husband for the sold food. If I do, he will not come back home, yet I want him home to take care of the children'*. Some, however, were critical about these happenings and jealously guarded their savings. For example, some women stopped keeping money in their houses and resorted to saving on their friends or relatives' mobile phones. Majority also resorted to saving in village self-help groups. In this regard, the mobile phones secured women's finances for fear of being misused by husbands. Raising such injustices, however, does not imply that all men behaved that way. Some men were very positive about the enterprising capacity of their wives, and they worked with them on the farms. It has to be added that the content on mobile phones had information about gender awareness as gender inclusion and responsibilities were part of ongoing sensitizations geared towards enhanced harmony in households in the USAID CC project.

Health and disease affected farmers' participation in knowledge sharing meetings and sensitizations. Among the farmers who had not adopted, most were sickly or had to nurse sick relatives in the hospital for months. Some parishes had CKWs who failed to support their groups because of sickness. Undoubtedly, while replacements in the affected parishes were made, health challenges in most rural areas affect smallholder farmers' full participation in ongoing development projects, which in turn stresses the household income levels. The USAID CC project integrated health-related messages to curb diseases in the mobile content, but diseases like malaria and HIV/AIDs affected many households. For example, the available children headed households in Kicuzi sub-county resulted from the HIV/AIDS scourge. These children who toiled to make ends meet could not take part in most community sensitizations. This hindered their participation in learning about new adaptive strategies.

Lastly, from my reflective experience, this 'my personal, my self device' feeling has bred attachment to mobile phones. Some people have become too passionate about their mobile phones which unquestionably affect socialization with families and friends. Based on my personal experience, my daughter has asked what I always do on my mobile phone. While it was part of the study interactions that kept me on WhatsApp, on many occasions, I have also fallen victim to unregulated mobile use. In the church, at markets, offices, and schools, everyone connected on the internet gives much attention to mobile technologies. Currently, there several NDT videos educating people about the dangers of unregulated mobile usage. "*Let us not sacrifice our families and relationships over the pursuit of material things. Smartphones are here to make our lives easier, but not to make us addicted and unsociable…Put a smartphone down and talk to your children, spouse, or friends. Let's give a good example to our children. Whatever you do, they do*" (NDT videos). This situation is even becoming more complicated if we continuously advocate for mobile phones as tools for learning. That means, on top of social life, we continually load mobile phones with more tasks to make people unsocial. Therefore, on the one hand, while we claim to use mobile phones to support development initiatives, there is a need to forge a middle ground to embrace controlled mobile use. The ability to guide our conscience to regulate mobile usage will reduce unnecessary social evils resulting from mobile misuse.

## 6.4 Mobile Learning Capabilities for Food Security

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|---|---|
| RQ 4: | What mLearning capabilities can support food security systems among smallholder farmers in rural communities? |

This study broadly explored the development impact of how mobile technologies can be used in learning about food security. Food security is an aspect of livelihood security for most rural communities. This is also very much in accordance with SDG Goal 2: *'End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.'* To achieve this goal, building awareness and understanding about food security is one way to help communities cope (Van Ittersum & Giller, 2014). Since the farmers in this study were engaged in a diverse portfolio of activities, an understanding of the role of mobile technologies in supporting knowledge exchange and sharing for food security was significant. The USAID CC project was prioritized for this exploration since, in Ibanda district where the project operated, most households were considered food insecure, characteristic of high levels of malnourishment, child, and maternal mortality (USAID, 2014). To mitigate this situation, this project, in a consortium with other agencies, applied an integrated approach where the use of mobile technologies was one of the strategies to enhance community livelihoods through strengthening food security systems. Pregnant women, lactating mothers, and children below seven (7) years were the primary project focus. Men and husbands from different households were also included in some project activities to avert male resistances.

Technology and knowledge transfer are essential features in achieving food security. Smallholder farmers in developing regions need an understanding of food security and what it means to be food secure (Havnevik, 2015; Norad, 2013). Farmers need knowledge and skills to ensure a diet of sufficient quality and quantity. Numerous agricultural technologies have been adopted for more than 50 years of development, but Africa is still food insecure. This questions the nature of agricultural knowledge and the extension systems availed to support food security systems under ongoing technological interventions. For example, does the knowledge transmitted to the farmers enhance learning for more sustainable and secure food systems? What often hinders growth in agricultural productivity is the smallholders' lack of awareness of what, when, how, and where to locate the information they need to improve farming.

This threatens food security and permeates poverty among farmers. Verdin, Funk, Senay, and Choularton (2005, p. 2156) conceptualization of food security as “availability, access, and utilization” was used to analyze food security in this study. Among the smallholder communities, the relationships and cohesion between family members within a given household contributed significantly to how a household performed its food security activities. For instance, violence and erosion of household relationships deter household cohesion and willingness to support one another. This applies to both internal (within a household) and external (between households) family cohesion. This justifies the availability of gender and violence information on CKW phones. Also, in the CC 10 standards, good working relationships in the household signified an adopted family in supporting and building good family ties to promote food security.

In this thesis, all case study sites objectified food security, but the USAID CC project integrated unique categorizations to include nutrition and livelihood components. To enhance nutritious diets, farmers did not get only information about when and what to plant but also how and what to prepare. The family life schools in different parishes supported learning about nutritious diets, and mobile phone content ranged from nutritious food items to constructing energy saving stoves in homes. The livelihood component encouraged farmers to initiate income-generating activities while looking at farming as a business in their everyday activities. Mobile phones carried localized content that supported learning about context-specific issues. Discussion topics like plants and animals, farm inputs, local knowledge, market and regional weather information, water and sanitation, child spacing, alcoholism, family planning, gender-based violence, and male and female participation in household activities informed part of this learning. The integration of local content on mobile phones is one way to ensure ‘digital inclusion and bridge the content divide gap’ (Heeks, 2015, p. 18). Through field observations, farmers had adopted to this information and on asking about what food security meant, most claimed ‘*…having food is not only about food, but food of nutritious benefit’*. With the holistic approach in this project, there was some level of adoption as each project intervention had an income-generating component that helped households earn some income.

A significant insight from the USAID CC project was its ability to integrate financial capital in different project activities. As earlier noted, in the broader learning for livelihoods discussion, limited finance capabilities and access to loans deter the use of obtained knowledge, thereby affecting food security. While grants and seed money can be looked at as an aspect that promotes dependence, the start-up capital in different group activities increased knowledge sharing avenues that improved group bonding. Farmers were able to buy equipment to start up the income-generating activities, most of which were in line with farming. The apiary projects, fruit farming, poultry, and vegetable gardens were not only intentioned to increase the financial standing of homes but also to avail enough food for the households. The availability of small loans to start nutritional and livelihood projects supported food access and food availability among farmer groups. Farmers were able to not only learn about food utilization practices but managed to sell their produce too. This sustained the income levels of such households and contributed to food security.

For Uganda, 2017 was a catastrophic year as the country was declared food insecure, with 69% of the total population being food insecure (IPC, 2017). During this phase, the mobile phones played a critical role not only in spreading quick information but also crowdsourcing for funds to support people in affected communities. In the Northern part of the country, social media helped to disseminate information about how animals died due to drought with all water sources dry, and how people fed on insects to survive. This prompted people in different parts of the country to pool resources in the form of food items and money (through mobile money account) to support the affected communities. *'No ever before was a mobile phone seen to respond to such a national disaster. Ugandans within and those in diaspora sent funding through mobile money, money gram, and world remit to rescue the affected communities. Surprisingly, the mobile money phone accounts enabled these transactions,"* says a key informant in the study. Further, because of the attacks from armyworms, all three M4D projects updated their content by giving farmers specialized advice about controlling armyworms. In such circumstances, mobile phones were quick to reach out to many. Another dimension where the mobile phones helped to spread information about armyworms was through radios, as most rural people access radio stations through their mobile phones. Farmers received up to date information through daily news podcast about armyworms surge and how to control their spread.

The USAID CC projects' integrated approach helped households to appreciate, learn, and use information relating to food security dimensions (Availability, Access, and Utilization). Different households joined the knowledge sharing community of practice that supported collective and practice-based learning about everyday life experiences. However, this study concludes that limiting food security to only availability, access, and utilization was inadequate and limited the project in attaining full benefits despite its integrated approach. The available limitations (discussed in paper 6) that hampered food security knowledge uptake require an understanding of some cultural and power dynamics relating to food. Therefore, the need to integrate the cultural aspects of food and food sovereignty as essential knowledge shared on mobile phones will support smallholder communities in realizing food security.

This chapter has described outstanding findings from three case study sites. To arrive at a complete story, the research publications offer further details to the ideas explored. Research question 5 on what mLearning conceptualization can support smallholder farmers' livelihoods is discussed as a practical contribution in Chapter 7.

# 7. Contributions

An empirical contribution entails a novel account of any empirical phenomenon that reveals something undocumented (Ågerfalk, 2014). This thesis's main objective is to contribute to an understanding of the role of mobile technologies in enhancing learning for livelihood support. In this study, factors that explain perceptions and adoption of mobile technologies and the possibilities and constraints of mobile learning in non-formal contexts are identified. Using the four theoretical lenses (Actor-Network Theory, Unified Theory of Acceptance and Use of Technology, Communities of Practice, and Social Constructivism), the discussion in this chapter builds on previous research findings and advances new insights in understanding the role of mobile technologies in enhancing smallholder farmers' learning. The chapter articulates the thesis contribution to knowledge, theoretical lenses, methodology, and practice. RQ 5 - what mLearning conceptualization can support smallholder livelihoods guided analysis of the study's practical contribution.

Contribution to the knowledge section expounds on mobile phones' role for livelihoods, offers insights about mobile learning in non-formal contexts, and extends a livelihood discussion regarding what to consider about mobile learning for livelihood support. Contribution to theoretical lenses discusses how the study findings contribute to the applied theories. In contribution to methodology, qualitative approaches in a multiple case study design offer unique findings to support theoretical validation of context specific findings. Regarding contribution to practice, a conceptualization of mobile learning (mLearning) for livelihood support is discussed. The study suggests six categorical factors to support non-formal mLearning practice. The contributions in this thesis should not be treated as universal or deterministic. The aspects discussed incorporate contextually bound recommendations as suggestions for improved practice.

## 7.1 Thesis Contribution to Knowledge

### 7.1.1 Mobile phones for livelihood support

Mobile phones are one of the primary technologies that have penetrated several basic facets of life in many developing countries, making a tremendous impact on people's livelihoods (Baumüller, 2013; Gyan, 2018; Musungwini, 2018; Wasserman, 2011). Societies in many developing regions have customized and maximized mobile phone usage amidst development challenges like illiteracy, high mortality, climate change, food security, and high disease burden. Thus, the need to focus on how such communities use mobile phones for livelihood support raises ethical and moral considerations (Walsham, 2012). In this thesis, the ethical dimension agitates mobile phones as inclusion platforms to extend new knowledge to society's marginalized like smallholder farmers. On the other hand, the moral dimension focuses on how mobile phone integration can appreciate locality by taking learning to where 'those in need are reached'. This is rightly so because from the literature review, mobile technology integration was limited to formalized systems where it was mainly the economically well off who derived maximum benefits from mobile use. Smallholder farmer communities are mainly informal, rural, not educated, poor, yet are the majority in developing regions like Uganda. Better integration of mobile phones to support their livelihood fills a technological and cognitive divide.

Considering the highest incidence of poverty, disease burden, poor infrastructure, and other challenges visible among rural communities, smallholders still prioritised mobile phones over other technologies (Nampijja, 2019). The compelling factors for mobile phone usage include the availability of reliable telecommunication networks, the presence of many cheap and affordable mobile phones, mobile phones multi functionalities, mobile phones as gateway for financial inclusions, the need to stay connected with family and friends, and the need to access new knowledge that supports different livelihood activities. These factors are drivers that have led to the increasing mobiles for development initiatives visible among rural communities. Additionally, this study maintains that while previous research has highlighted similar reasons like the need to stay connected with family and friends and access to weather and market information (Mugwisi, Mostert, & Ocholla, 2014; Oladele, 2013); mobiles considerations as a social fit to belong to a particular social class was outstanding.

Literature in line with mobiles for development has not explicitly explored the negative implications for mobile phone use for livelihoods (Nampijja, 2019). Despite the numerous benefits communities derive from mobile phones, this thesis highlights negative narratives regarding mobile phone usage. In the social technical understanding therefore, technology is never neutral. “People will either love it or loathe it” (Sharples, 2006, p. 10). The negative implications like increased burglaries, theft, marital challenges, and health implications denote negative social implications on how mobile phones were a distraction (Nampijja 2019). Such negative perceptions about mobile phones use not only depict ideas about people resistances to mobile phones but also enable us to appreciate the hindrance force that curtails mobile phone use for livelihood support. Resistances are partly embedded in how technologies are culturally appropriated. Power, gender dynamics, and religion have a significant influence on how people use mobile phones. In this study, the *Batwa* and *Bafuruki* communities who did not welcome the mobile phone initiatives signified how some resistances are culturally and contextually defined. Moreso, men who were uncomfortable with their wives owning mobile phones are examples of male control over available household resources. Therefore, M4D initiatives have to be critical to such societal constructions about mobile use for healthier technological integration.

Nonetheless, whereas some cultural attributes can restrain effective technological integration, the same technology can transfer creative elements that contribute to the development of societal values and attributes (Kvadsheim, 1991). An appreciation of mobile phone roles in the development of societal values is one way to support the achievement of sustainable societies. In the USAID CC project, mobile phones addressed patriarchy challenges relating to men and women relationships in households. In this context, mobile phones acted as tools to challenge the existing cultural practices that deterred the realization of food security in rural communities.

Mobile technological research and practice have concentrated mainly on the role of mobiles in economic development and production. Whereas the latter is central to changing livelihoods for many rural households, exploring other possibilities where mobile phones can equally benefit such communities is essential. In this respect, Donner (2009) calls for the need to explore how mobile phones can build agency, nurture and cultivate self-expression, and increase social connections among users. Ling and Horst (2011)'s ethnographic study on mobile phones' everyday use hinges on the need to explore other mobile phone support systems beyond economic benefits. This study fills this gap by understanding how mobile phones can facilitate learning for livelihood support. The centrality of mobile phones in information access and knowledge sharing supported mobile learning in non-formal contexts (Nampijja, 2017). Moreover, the need for inclusive education to enhance access and equity in learning, as suggested in SGD Goal 4, places mobile learning as an avenue to increase access to actionable knowledge needed for communities to thrive.

### 7.1.2 Mobile learning in Non-formal contexts

Dedicated studies in mobiles pedagogical integration focus on formalized education systems while neglecting the substantial majority in society (Zelezny-Green, 2014) like smallholder farmers. Naismith, Lonsdale, Vavoula, and Sharples (2004) literature review on mobile technologies and learning suggests the necessity for informal and lifelong activities that support learning outside a dedicated learning environment and formal curriculum. Hence, this thesis offered an understanding of mobile learning practices in non-formal contexts. The non-formal context has been classified as a learning environment outside the formal curriculum (Nampijja, 2017). In the non-formal smallholder farmers' activities, learning happens in the farmer's usual environment, often authentic, situated, and addresses the learners' needs.

The thesis has adopted Sharples et al. (2007) mobile learning definition as personalized and learner-centered, collaborative, and highly situated. Whereas this classification of mobile learning is not new and thus questions contribution to knowledge, the context where the framework is employed makes a new contribution. According to El-Gazzar (2016), applying a framework to a new context is counted as a contribution to that framework. In line with mobile learning in non-formal contexts, no study has qualified mobile learning to work for farming communities, making this contribution profound. However, I add highly experiential/problem solving as another attribute that resonates with smallholder farmers' mobile learning activities. Below are the qualities that explain mobile learning in the non-formal:

i) *Personalized and learner centred.* By employing new mobile technology features, learning can be more personalized for the different learning contexts. Learning materials can be customized to learners' learning styles, physical location, time, and activity (Isabwe, 2014). The L3F project case depicts how personalised learning addressed different learning contexts. The fact that some farmers were illiterate, sharing of audio messages in different dialects was in consideration of the farmers' context. The importance of learner centredness was evident in findings from the USAID CC project and Grameen CKW project mobile phones that availed content on different livelihood activities. This offered farmers choices to select from what to learn, thereby supporting learner centredness. Although mobile devices' mobility affordances support personalized learning anywhere, anytime, in the non-formal context, the technology does not entirely define the learning. The learner decides what to learn, which explains the notion of learner involvement through mobiles.

ii) *Collaborative.* Collaboration means engagements, interactions, and sharing within the confines of learning. In principle, “technology does more than [information sharing], as learners’ choice and ability to connect to one another informs mobile learning activities” (Sharples, 2006, p. 12). Reychav and Wu (2015) consider mobile collaborative learning as the ability to use mobile technologies to facilitate and support collaborative group activities in learning processes. The fact these studies report about experiences in classroom activities, in the non-formal with smallholder farmers, the mobile phones supported collaboration amongst groups of farmers. Findings from the Grameen CKW project report about collaborative activities between CKWs and the farmers' groups. In the L3F, not all farmers received mobile phone information. This meant that those with mobile phone content shared with others in different groups. Moreover, given the availability of non-literate farmers in some groups, mobile phones supported learning with conversational affordances. The available caller user groups in the USAID CC project and the L3F project supported conversation learning as farmers called one another to share about farming.

Technology supported collaborative learning not only focuses on the technology; the educational and social perquisites for allowing collaboration to occur are also significant (Kirschner, Strijbos, Kreijns, & Beers, 2004). Considering the smallholder farmer context, while knowledge sharing was at the heart of all projects in the three case studies, the social prerequisites defined mobile learning. The use of CKWs who translated mobile phone content in English collaboratively worked with other farmers who could not translate the messages. Moreover, the scarcity of smartphones in most rural communities meant that those with smartphones collaboratively worked in a community of practice to learn about new farming methods (Nampijja, 2017). Within mobile learning in the non-formal confines, collaborative activities are embedded in highly authentic and situated learning environments.

iii) *Highly situated/Authentic.* The learner and community centredness aspects take care of learning in situated, contextualized, and authentic environments. With mobile learning, learning can be connected to a location to support place-based information sharing. This is termed as contextualization of learning (Sharples et al., 2007). Mobility, availability, connectivity, and portability attributes in mobile technologies facilitate contextualized learning where learners produce context-based learning materials. In this study, videos and instant messaging features on mobile technologies enabled real-time contact with farmers through social networks. The use of WhatsApp to share about location based farm challenges by the CKWs supported authentic learning. Further, mobile phones carried information that was context specific to solve authentic livelihood challenges. Authentic learning requires that 'learning tasks are practical and in real-world contexts' (Herrington, Reeves, & Oliver, 2014b, p. 401). Addressing real-life farmer challenges augments learning and supports the adoption of new knowledge amongst farmers. In non-formal learning, learners are given a chance to use their experiences, considering that learning is problem-solving and highly embedded within the learner's locales.

iv) *Highly experiential/problem-solving*. This thesis adds experiential and problem solving to mobile learning classification. The study findings show how experiential learning is essential for livelihood support (Nampijja, 2017). Whereas Grameen CKW and USAID CC projects installed new knowledge on farmers' mobile phones and laptops, it was clear that farmers' experiences formed part of this content. Experiential learning offers a holistic perspective on learning and is orientated mostly on adult learning principles. In experiential learning, "learning is the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 38). Thus, experiential learning capitalizes on the relevance of the learner's social and cultural attributes to make learning meaningful. Learning with the smallholder farmers relied on farmer's everyday life experiences through critically reflecting on content shared on mobile technologies. This translated into action, visible in farmers' ability to adapt to new knowledge. Therefore, in this thesis, farmers' interaction with mobile technologies was first, to appreciate and check the previous farming experiences, and second, to attain new ways of responding to current challenges experienced.

Mobile learning attributes of learner centeredness, collaboration, situatedness, and experiential learning have been highly used in formal learning. In this study, while the same classifications can be carried forward in the non-formal, integration should be contextualized to address different learners' needs. Such contextualization offers an understanding of how mobile technologies are cognitive tools that carry content for the actor to use. Essentially, information technologies like mobile technologies are tools for interactions and organization. "You cannot use them to till the soil or to hammer, but you can use them to plan the tilling, to control and administer the hammering" (Hetland 1991, p. 92). In line with this affirmation, mobile technologies are not used to manipulate nature; but rather manipulate cognitive and interactive processes essential to contribute to human well-being (Ibid). Thus, to view information as an actor, technology as a tool, and knowledge as power, there is a need to recognize the constructive force that it affords participation in contributing to the actors' reality. This participation can be analyzed in appreciating non-formal learning and assessment practices among smallholder communities.

**The Relevance of Non-formal learning opportunities for smallholder farmer communities**

The choice of applying the non-formal learning over the informal learning approach in this study is based on the realizations that "the term 'informal' is associated with so many other features of a situation - dress, discourse, behaviour, diminution of social differences […] its colloquial application as a descriptor of learning contexts may have little to do with learning per se" " (Eraut, 2000, p. 114). Therefore, to avoid this confusion, non-formal learning was prioritized and contrasted to formal learning. The intention to learn and the deliberate learning activities set aside for a purpose is a fundamental characteristic of non-formal learning. There is growing evidence of how non-formal education activities can benefit communities in resource-constrained settings (Katahoire, 2014). In this study, smallholder farmers lacked access to actionable information to support their livelihoods. Activities from all the case studies responded to the urgency of information and knowledge access through mobile technologies. Non-formal learning was considered as a supplement to existing agriculture extension services that were inadequate in rural communities. The intention was to enhance meaningful humanity through knowledge enhancement.

Hence, non-formal learning offer opportunities for improved quality of life through organized learning (Blaak et al., 2013). This thesis shows how some learning activities were organized to facilitate farmers' adoptions. In the USAID CC and Grameen CKW projects, the use of CKWs to interact with farmers, the sharing of monthly farmers reports, and CKWs monthly uploads to the Grameen portal depict organized activities that facilitated farmers' learning. Therefore, even in the non-formal, the relevance of planned activities to measure impact is essential. Integrating such activities offers an understanding of whether those undertaking any learning gain from it. This brings in the notion of assessment and or evaluation in the non-formal activities (Merriam et al., 2007).

In this thesis, assessment and, or evaluation are considered essential for non-formal learning. The use of assessment over evaluation is prioritized because, firstly, assessment focuses on the systematic progress of documenting the learner's progress. Second, assessment entails an interactive process between the learner and facilitator. Hence assessment is a learner-centered activity concerned with feedback that improves learning (Angelo & Cross, 1993). In contrast, evaluation is judgemental and product oriented (Ibid). In evaluation, the teacher is concerned about the final product where the emphasis is on the grades attained. The teacher uses methods and tools to measure students' learning and often happens at the end of the learning. Because non-formal learning is situated, authentic, and socially constructed through different communities of practice, assessment needs to appreciate how learners participate in collaborative processes of sharing and allotting expertise to other group members (Strijbos, 2011).

Ideally, in any type of learning, the underlying assumption to measure learning that has taken place is to show individual knowledge competence. While this might seem relevant for adult participants, we suggest the relevance of group knowledge acquisition given the strength of social capital among farmer communities and the need to sustain farmers' learning ecologies. This collaborates with the social constructivist view of assessment where learning is more important than performance. Performance goals aim to help learners accomplish a task while learning goals help learners gain know-how and appreciate the entire process of learning (Adams, 2006). In the latter, attention is on the process rather than the outcome. Learning in the farmers' context involves showing what has been taking place during the learning interactions. Farmers are interested in seeing the impact of their learning transform into improved farm yields, proper pest control, and good farm management practices.

In line with Herrington, Reeves, and Oliver (2014a) idea of authentic assessments, learning environments ought to provide farmers with opportunities to demonstrate their sufficient knowledge acquaintance in collaboration with 'others' in real-life situations. Therefore, to successfully implement assessment for learning in non-formal contexts, a learning culture that points to a changed mindset where (farmers and facilitators) have a shared and joint expectation of what makes sense is essential. To further appreciate the impact of mobile learning in the non-formal, an appreciation of the existence of other supportive technologies and systems that support learning is worth consideration.

**Mobiles and other support systems**

Project based evaluations about mobile phone use suggest how mobiles can effectively work within a mix of technologies (Duncombe, 2012). Whereas studies have recorded increasing mobile phone benefits, none has claimed exclusive benefits realization from mobile technologies. In this thesis, mobile technologies alone cannot impact learning for livelihoods.  An appreciation of other support systems to complement mobile technology usage is significant. The study findings acknowledge a range of other supportive technologies and strategies like laptops, solar panels, charging grids, farming manuals, study sites, farming tools, nutrition kits, and the control centre that facilitated learning on mobiles. Therefore, mobile technologies do not work in isolation with other support systems. Mobiles are part of a powerful network of devices that link with other systems to improve service delivery (Best, 2009). This implies that analyzing their singular contribution to learning is observing just part of the phenomena. In the livelihood discussion, available network resources like print media, radio talk shows, community sensitizations, and meetings that supplemented mobile learning need to be emphasized.

Musungwini (2018) study on mobile phone use among Zimbabwean smallholder farmers showed how mobile phones were not actively used by smallholder farmers to access agricultural information. While he points to the existing mobile agricultural platforms, none of the households in the study had heard of or used any available platforms. This implies that to make mobiles extend actionable information to smallholder farming communities, other support systems must be prioritized. Duncombe (2016) further asserts that creating mobile content applications for rural agricultural development is insignificant. The Zimbabweans case findings are not so different from the Ugandan smallholder farmers since those who managed to use mobile phones to access agricultural related information were farmers who enrolled in M4D projects. Thus, content applications that network with other contextualized support systems are indispensable in rolling out mobile workability for rural smallholder communities. The next section hinges on a reflective livelihood discussion that M4D projects need to appreciate in scaling up mobile learning initiatives among rural farmers.

### 7.1. 3 Livelihoods and M4D implications

Today, livelihood is a catchy word in development discourse. There has been a global recognition regarding the importance of livelihoods, and consequently, a shift from addressing people as poor to livelihoods. Looking at those who need help as poor was demeaning. Therefore, in respect to with this livelihood shift, there is a need to broadly understand the term and explore what it contains and whose livelihood is at stake. In this thesis, this shift takes into consideration that smallholder farmers do not only take part in a single activity. Their well-being and survival depend on an array of activities given their exposure to many vulnerabilities. Diversifying livelihood activities is a resilient strategy to help communities adapt to changing situations. Amidst this shift towards livelihoods, there are several development aid cases promoting only one aspect of livelihood, not integrating the plurality of livelihood activities. Such a mode of development makes many projects less impactful and unsustainable.

This study raises a question as to whether learning for livelihood support a concern for smallholder communities. A reflection from the study findings confirm that formal education has been one of the government's priorities in Uganda. In rural areas, however, there are several undesirable factors like few primary and secondary schools. While the situation seems to be improving, the current dropout rates are significant, crippling economic and social development due to the limited learning alternatives available in the countryside (Tukundane & Zeelen, 2015). This situation is even worse for young girls as poverty and other social-cultural factors, like early and forced marriages, produce a generation of young mothers whose situation is rarely considered by government provisions. Most school dropouts often end up as smallholder farmers, living in the communities that engage in the different livelihood activities for survival. This group of dropouts may also comprise the group of young innovative mobile users in rural areas if given mobile training. Thus, many community volunteers, change agents, village health trainers, and community knowledge workers in rural areas stem from this group of school dropouts. While questions regarding their effectiveness in service delivery might be justifiable, in communities where the majority are non-literate, they have proven to support several development initiatives.

"Education, in its deepest sense and at whatever age it takes place, concerns the opening of identities by exploring new ways of being that lie beyond our current" (Wenger, 1998, p. 263). In line with learning for livelihood support, any learning that happens at any stage in a person's life opens new possibilities for change. It has been documented that a combination of ICTs with increased access to learning is closely associated with lower incidences of poverty as ICTs have significantly contributed to improved livelihoods (Ssewanyana, 2007; Thapa, 2014). Technology has significantly influenced the current transition to a more knowledge economy. The need for critical thinking and the desire for learning to learn is essential for a learning society. The key question then is, who is responsible for cultivating a learning society that responds to societal challenges?

**What development and whose responsibility?**

To ensure learning about new farming methods is primarily the responsibility of the country's agricultural extension system. But, given the failures within the system, many farmers are not reached, and often, the technical content brought to the farmers is not adequate. In rural Uganda, the minimal contact between the farmers and the agricultural extension services makes one believe that the agricultural extension system has ceased functioning. The study findings indicate that the extension worker to farmer ratio in the country is 1:12,000, which is inadequate (Nampijja & Birevu, 2016). On top of being few extensionists on the ground, those available lack adequate facilitation from district departments. The limited access to actionable information from the government to the farmers creates a niche for NGOs, both national and international, to address. The available extension activities of distributing seedlings to different farmers are one way to extend the physical assets needed to plan for the next seasons. However, the lack of proper training on how to best manage the seedlings for increased productivity remains underscored by Uganda's extension department. For example, when some farmer groups were given chicks to enhance poultry activities, they were not given adequate training, which resulted in the deaths of most chicks due to poor management.

This thesis contends that capacity building among farmers plays a vital role in supporting government initiatives. ICTD projects need to go beyond service delivery by supporting transformative learning opportunities (Traxler, 2018). One way to strengthen and transform capacity building among smallholder communities is to deploy mobile technologies. This was the actual situation in all the three M4D projects and a considerable measure to extend farmers' access to up-to-date actionable information. The use of farmers within these localities was thought of as an avenue to offer basic extension services. However, given the limitations of this approach, government ought to take up the responsibility to manage the mobile content to sustain activities of CKWs in different districts. In this setting, complementarity relations between government, NGOs, and communities is one way to plan for the sustainable exit of available M4D initiatives.

**The relevance of synergistic relationships**

This thesis agrees with the view that government partnerships with the private sector and NGOs are pertinent for livelihood support. "The scope of rural households to construct their own pathways out of poverty is heavily dependent on institutional environment, including private sector behaviors, the working of markets, and social and cultural norms of expectation (Ellis & Freeman, 2005, p. 369). Observations from the M4D case studies show that even when government partnership was mentioned at different levels, government's practical involvement was not felt during execution of different activities. And yet, to enhance the livelihood of many rural households, "it is necessary to bring together all resources available…[through] optimizing the use of existing government programmes, obtaining grants from a variety of organizations, attracting private businesses, and maintaining the centrality of grassroot organizations" (Figueira-McDonough, 2013, p. 131).

Complementarity allows for synergistic relations between the state, the community, and international development actors. The ideal in this complementing relationship is the realization that it is government's responsibility to provide collective goods to facilitate community well-being. Collective goods like agriculture extension can be complemented by international development initiatives in a more mutually exclusive relationship. In this study, agitating for 'complementarity' does not underscore government involvement in all the M4D projects. But its activities were not visibly seen on the ground. To develop mobile content contextualized to farmers' activities, there were embedded relationships where projects worked with teams from government ministries and local level leadership. As Evans asserts, embeddedness entails "ties that connect citizens and public officials across the public-private divide" (1996, p. 1120). In all projects, government personnel and private sector involvement from project inception was visible. However, using the Actor-Network Theory, this study observed limited complementarity and embedded relationships between government and M4D projects during project implementation. Like the smallholder farmers noted, these projects were purely international development initiatives that supported farmers' rural livelihoods.

Complementarity and embeddedness are parity approaches that need to be streamlined in many development efforts. The evidence of thriving economies due to state-civil society synergy and citizen trust in government alludes to synergy even in the developing world (Evans 1996). Such synergistic relationships allow for making governments accountable for the social services they offer to communities. To extend access to actionable information is the responsibility of the national extension departments. But because some governments in developing regions have relegated power to international actors, their concern for the poor is often never attainable (Ellis, 2000). Once citizens see that their plight is left to international actors, some conceptualize this as a deliberate government tact to keep the majority in poverty. One key informant who was dissatisfied with the country's extension system narrated that '*maintaining the poor majority has been one of many autocratic regimes' strategies to stay in power*. *Maybe, for Uganda, with a president* *who has stayed in power for over 35 years, relegating the poor would make him stay in power. After all, these are easily brainwashed to vote for the ruling party come elections'.* Whereas narratives like this illustrate limited government support to smallholders, I argue for strong government partnerships in all international development initiatives beyond basic consultations. Moreover, amid all these synergies, recognizing the relevance of local actors, the farmer in this context is privy to supporting livelihoods in rural locales.

**Local actors' voice matter**

What affects local actors' participation in on-going initiatives is the poverty challenge that limits their competence and capacity to act (Figueira-McDonough, 2013). The study observed that limited competence makes local actors inferior and, consequently, perceive what comes from outside in the form of support as 'superior.' Current development practices encourage strategies that popularize local actors' involvement in livelihood initiatives. With reflections from the smallholder farmers' mLearning practice, the limited competence or lack of competence on certain matters does not mean no-competence. Smallholders' competence can take the form of coping and survival strategies needed amidst heavily constrained resource challenges and a hazardous, unpredictable environment. Development agencies need to appreciate such farmers' recollections and learn to incorporate them into livelihood initiatives. To cultivate this deeper community understanding, it is always beneficial to learn about the community, applying as best as possible, an insider's perspective. This insider's view is essential in exploring how local people live, how they perceive reality, and what influences them to act. It is essential to be aware that communities have values and traditions, knowledge, and experiences that project interventions need to prioritize (Ibid). During this study, the farmers who did not participate in project initiatives had values, past recollections, and customs that hindered them from joining Grameen CKW activities.

In the Grameen CKW project inception phase, the organization staff asked target communities about their most pressing problems. The presence of international participants pre-empted trust among some farmers in regard to the questions about land acreage, size of livestock, and the number of children that were asked. The 'Bafuruki' group, for instance, had fears related to land grabbing as they had seen farmers that had suffered from such bad experiences. This is not an isolated example from Africa. In their writing about biofuels, land grabbing, and food security in Africa, Matondi, Havnevik, and Beyene (2011) report land grabbing as a serious challenge at the epitome of many developing regions. As a local smallholder narrated, *'seeing whites made me unsure since we have heard stories from different places about how the government is working with NGOs to take away land from the rural people in the form of new projects.'* This observation is in line with a similar argument that most rural people have lost land in the name of the skewed government and private deals to increase investment (Mutopo, Haaland, Boamah, Widengård, & Skarstein, 2011). Such past experiences have an implication on the level of trust people attach to incoming development initiatives. While the Grameen policy was to learn about the rural farmers' actual needs, some farmers felt otherwise. This bred resistance that hindered some from joining organizational activities. These farmers showed no remorse for having missed the project activities because they felt safer with what they have rather than declaring their pertinent assets like land and cattle to outsiders. Therefore, an analysis of their voices is relevant in understanding why some did not join organizational activities.

**Gender and mobile technologies**

Technologies are not just technologies. Within them lie alterations in agricultural gender roles (Mpiima, Manyire, Kabonesa, & Espiling, 2019). In this thesis, mobile usage invoked several implications for gender relations among smallholder farmers. Therefore, to understand the relationship between mobile technologies and gender, there is a need to view mobiles as "active agent(s) in evolving engendered relationships that must be understood within their culturally embedded everyday use and settings" (Tacchi et al., 2012, p. 529). The gender relationships concern mobiles' role in increasing agency and influence, specifically in this context: women agency. Reflective questions like how have mobiles extended learning to women smallholder farmers? How have mobiles translated learning into increased yields, increased incomes, and, as a consequence, increased women's financial role in their households?

Whereas the prowess of mobiles in development is to secure a positive change in rural livelihoods, from a gendered perspective, it is imperative to note that positive change is not only measured in increasing incomes but includes the ability of women to make choices. The positive changes must, as such, include good relationships in an environment that allows for collective equal opportunities between women and men (Tacchi et al., 2012). The study findings signify that women were the active participants in the Grameen CKW project activities. This corroborates with Burchi, Fanzo, and Frison (2011) claim that using women as change agents for education and knowledge enhancement is of value in projects targeting livelihood enhancement. It can also imply that unlike men, women have enough time to attend organization activities since the majority participate in activities related to their gender roles.

According to Jahan (2017, p. 41), "women have become active in areas where they were not traditionally active, and they have excelled in every aspect of life where they are engaged, even in societies where women have faced great obstacles in overcoming their traditional roles." Whereas women almost everywhere face similar challenges like limited access to property and financial services, cultural hindrances, including unpaid care burden, the women in rural communities face even much stronger challenges given their limited access to educational opportunities. The study findings show that female farmers in the Grameen CKW and USAID CC projects engaged in income-generating activities citing the ability to support their households. Female CKWs, for example, narrated about how the Grameen CKW project nurtured and facilitated a sense of belonging and solidarity in creating internal and external networks within their communities. For instance, most new development initiatives in the communities recognized the activities of several Grameen CKW women groups in their different villages. This, according to women smallholders, bolstered a sense of security and completeness, which helped them connect with other projects in the area.

A particular mobile affordance for rural women was in the area of emotional attachment. Since mobile phones allowed for private calls, women phoned relatives and friends, which consolidated a sense of attachment and belonging (Tacchi et al., 2012). In personal calls lay spaces for connectedness, problem sharing, and access to information where they could learn from one another in case of family challenges. It was further observed that SMS function was not typical in this rural setting since some women were non-literates and the fact that their daily routines could not allow for message texting.

Although mobiles showed a transformative role in extending opportunities to female smallholders, mobile phones “are not a one-size-fits-all technological solution to all the issues of development” (Tacchi et al., 2012, p. 534). In the mobile phones for rural development review report, Duncombe (2016) reflects how several M4D projects have not catered for gender differences in most of their operationalizations. Such a gap in the literature is partly addressed in this thesis. The negative gender constructions (as explained in Chapter 6) depict how mobile technological systems are socially constructed and appropriated. Men patronized and controlled mobile phones that belonged to female CKWs. In very worse scenarios, men denied women a chance to own mobile phones. In this study, amidst such gendered tensions, women faced injustices from not only husbands (males) but also fellow women. The gender relations concerning mobile phone ownership by CKWs created unhappiness amongst some women in the community.

From a socio-technical perspective, this thesis reflects on mobile technologies' role in challenging unfavorable cultural practices. Mobile phones can amplify cultural change processes and address existing injustices to facilitate new discursive formulations (Tacchi et al., 2012). For example, in the USAID CC project, mobile phones are used to challenge patriarchy practices linked to domestic violence, child upbringing, and family planning. Female CKWs testified how gender violence had reduced in their communities, making attribution to available community sensitizations and the fact that women have access to empowerment information. Therefore, even when these projects offered strategies to support both men and women, there is a need for more sensitizations, including awareness initiatives for both men and women to realize their roles in household income. Whereas gender injustices are often part of a culture that may take a long time to change, mobile technologies can be instrumental in ‘unpacking’ some unfavorable cultural injustices.

**Aid and Mobiles for Development (M4D) projects**

The changing priorities within countries and international organizations to achieve the Sustainable Development Goals (SDGs) have contributed to improvements in humanitarian and development aid (Sach, 2012). Likewise, the Ugandan Vison 2040 offers specific functions of development aid. In this study, all three M4D projects were donor funded projects supporting the development of mobile technological systems that would work for smallholder communities. However, in a more critical perspective, one main critique about aid has been the manipulation and political influences inherent in the international development system. For instance, Tucker (1999) defines developments as a “process whereby people are dominated and their destinies shaped according to an essentially western way of perceiving the world.” It is plausible to argue that donors have political aims hidden behind their development policies, and many provide development aid in the pursuit of their ends. In this light, most donors have altruistic motives to benefit from aid programs (McGillivray & Morrissey, 1998). This implies that some policymakers and development practitioners lack genuine will in addressing economic and social inequalities in the developing world. Moreover, the contested nature of international development that is driven by their agenda sometimes at the cost of local actors (Traxler, 2018) questions development aid ability to meet the aspirations of the intended beneficiaries.

While this thesis has outlined this critical position about politics and aid in international development, in this study, development aid was intentioned to support beneficent countries to grow their economies, improve human rights, and reduce poverty and inequality. Therefore, attempts to support communities from a negative situation to a positive can be termed as development. If international aid is believed facilitative in this process, it can be considered development aid. Whereas Ugandan agricultural extension is visible in some parts of the country, extension education has a poor performance leaving large groups of smallholder farmers unreached. Aid provided to strengthen local farmers' capacities to affordable mobile technology content is a means to reduce the digital divide. Nonetheless, overly reliance on aid is likely to raise questions regarding the sustainability of rural-based technology initiatives.

**Sustainability implications**

In Africa, amidst the rhetorical success of ICTD projects, very few are sustainable (Selwyn, 2013). Previous research points to the limited sustainable business models in most technological solutions to support the scalability and sustainability of working initiatives (Duncombe, 2016). The study findings show that even when all projects had sustainability pointers, it looked obvious that some activities would not have the possibility to continue given the way they were structured. Interactions with communities where the projects operated showed how the initiated activities would be rendered futile in the long run. The CKWs were worried about the discontinuity of the learning activities in their areas after Grameen Foundation exit. Like a CKW in Mitooma sub-county noted, ''*where will the cadre of generated knowledge workers go when donor funding ends''*. Another exclaimed, *'I know the project will leave me with this phone, and it will act as a library …but am unsure of reaching out to other farmers since project facilitation stops in few months.'* Some project personnel were also uncertain about the ability of the CKWs to load airtime and access updated content. *'Actually, I see no CKW touching his pockets to update the mobile phone content. They will definitely use that old information since the project will not be supporting them'*, said the community connector officer in the USAID CC project. Whereas most key informants were optimistic that the sufficiently trained CKWs, lead farmers, and community promoters would continue to support farmer groups, continuous learning was uncertain. Literature has indeed highlighted the necessity of sustainability models in most ICTD initiatives; however, in this livelihood discussion, I further argue for integrating contextualized sustainability business models in cognizant of farmers' changing priorities.

Part of the challenge to sustainability is the continuous promotion of westernized technologies to work in third world countries. Fuchs and Horak (2008) argue that promoting westernized technologies may be considered as another form of cultural imperialism that suffocates the growth of many third world countries. Selwyn (2013, p. 155) suggests the need to "scale down our language and expectation for digital technology [by] avoiding the hyper-narratives of a global educational technology and instead develop mini-narratives and localized appeals." This thesis claims that it is necessary to educate the locals using modest technologies to work for them. Mobile technologies are among the befitting education technology solutions within a defined context that can partly address livelihood challenges. However, this is exceptionally unpractical when many projects scaling up mobile digitalization are largely donor funded (Roy, 2018). Moreover, most are only small pilots with limited coverage (Musungwini, 2018). This means, in case of government failure to take up such M4D initiatives, the already started efforts might fail to upscale activities to new regions. Therefore, re-orienting technologies to work towards local solutions and the role of national states in mobile technology initiatives are among the means to reduce the unsustainability impasse.

## 7.2 Thesis Contribution to Theory

This thesis employed four theoretical perspectives - the Actor-Network Theory (ANT), Unified Theory of Acceptance and Use of Technology (UTAUT), the Communities of Practice (CoP), and Social Constructivism (SC). The study application of ANT and UTAUT did not generate more substantial theoretical implications since these theories have been used in similar settings. For instance, several studies (Stalder, 1997; McBride, 2003; Rhodes, 2009; Wright & Parchoma, 2011) have employed ANT to understand technologies and learning; communications networks; adoption of mobile communications; and the ICT telecenter model among women in developing countries. Correspondingly, other studies have explored UTAUT in explaining mobile technologies' adoption and use (Venkatesh et al., 2003; Bagozzi, 2007; Venkatesh et al., 2012; Roy, 2018). Given that the context of this study is rural smallholder farmer communities, previous related studies also engaged with groups of less privileged in developing countries.

As El-Gazzar (2016) observes, applying a theory in a different context contributes to further validation of theoretical insights. This study has identified several critiques of employing ANT and UTAUT, as explained in Chapter 3 (section 3.2.1). Such theoretical critiques are insightful implications that qualify as empirical contributions (Ågerfalk, 2014). Additionally, a synthesis and merger of how theories relate to one another is explained in Chapter 3 (section 3.5). The uniqueness of integrating mobile learning amongst farming communities, and in pursuance of how mobile learning support livelihoods, the CoP significantly contributed to the farmer's non-formal learning practice. From this synthesis, the study sought to qualify CoP as a theoretical lens giving a substantial contribution to farmers' mLearning practice as explored in this section. This does not imply that the other theories - ANT, UTAUT, and Social constructivism were less prioritized; instead, their usage in the study was adequately explored in the theoretical chapter. The summary of their contributions is presented in Table 10.

### 7.2.1 Theoretical contributions to farmers' mLearning practice

Table 10 provides an overview of the theoretical contributions to the farmers' mLearning practice.

**Table 10: Summary of theoretical contributions**

| Theory | Contributions |
|---|---|
| Actor-Network Theory | *Helped to analyze the central actors in mobile for development projects in rural communities.*<br>- The role of both human and non-human actors in a mobile learning network is essential. Each co-exists with another's actions.<br>- Actors in any network can be both active and passive as their roles keep changing. Understanding the active-passive continuum helps to situate the actual participation of both human and non-human actants.<br>- The Obligatory Passage Point (OPP) is central in assessing interactions of all actors in mobile learning activities. This means that in all socio-technical discussions, analyzing the initial stage of what caused people to converge is pertinent for project sustainability.<br>- The role and interests of macro actors must align with communities' interests and aspirations to make technologies address real perceived needs. Inconsistencies in this alignment render M4D projects unsuccessful and or unsustainable.<br>- The four moments of translation - Problematization, Interessment, Enrollment, and Mobilization are pertinent stages that need adequate attention geared towards sustainable practices in the farmers' mLearning network.<br>- Paying attention to and reverting negative asymmetrical relationships and power dynamics is crucial for the continuity of the farmers' mLearning network. |

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|---|---|
| Unified Theory of Acceptance and Use of Technology | *Facilitated the exploration of factors that explain the adoption and use of mobile technologies for learning.*<br>-Smallholders adopt a technology that improves the performance of their day-to-day activities, thus perceived usefulness.<br>- Gender, age, and experience are influential moderating factors with implications on how people use and adopt mobile technologies. Special attention needs to be placed on how women and older farmers use mobiles for livelihoods.<br>- Mobile phone technology features are easy to use and easy to learn if adopted well to support learning activities.<br>- Social influence has a strong influence on mobile technology adoption and use capabilities. The community knowledge workers' activities were primarily influenced by societal compliance and the need to represent farmers.<br>- The role of facilitating conditions (technical and administrative support) considerably impacted on adoption and use of mobile technologies for learning in rural areas.<br>- Palm-size computer efficacy (judgment on the capability to engage) is not a deterring factor that limits mobile technology adoption and use. Farmers with mobile phones did not complain about mobile phones' small size as utility value (access to digital content) was highly prioritized. |
| Social Constructivism | *Helped to analyze non-formal learning activities among farmers.*<br>- Knowledge is socially constructed and heavily grounded on learner experiences. Learning processes view learners as co-constructors of knowledge.<br>- Learning for livelihoods ought not to only focus on performativity but instead appreciate the actual (deep)learning processes beyond performance indicators. |

| | |
|---|---|
| | - The necessity of paying attention to what hinders meaningful learning to increasing desirable learning is vital for the sustainability of non-formal learning activities.<br>- The facilitator-learner relationship is premised on guidance rather than instruction. Setting a favorable learning environment that cultivates the farmer's self-worth and personal growth is paramount.<br>- Proposes learning that engages farmers in authentic tasks that are of implicit worth and problem-solving in nature.<br>- Uncovering and acknowledging a shared understanding forms a basis for learner assessment. In non-formal learning, assessment for learning is construed as an integral part of learning, with reward systems to understand the social world. |
| Communities of Practice (CoP) | *Supported an understanding of different activities within farmers' mLearning practice.*<br>- Communities of practice do not fall from heaven; some engagement and initiatives from the initiator and local actors are necessary.<br>- International agencies are just conveners and not knowledge givers.<br>- Farmers not only share information but learn from one another through mutual trust and complementarity relationships.<br>- Technologies support, maintain, and sustain interactions. But they do not create the farmers' practice.<br>- In an ideal CoP, everyone acts. The actions are determined by motivation, participation levels, context, and uniqueness of the community.<br>- Communities encompass the diversity of membership, both experienced and inexperienced. Appreciation of farmers' experiences is significant<br>Further contributions from CoP are explored in the next section. |

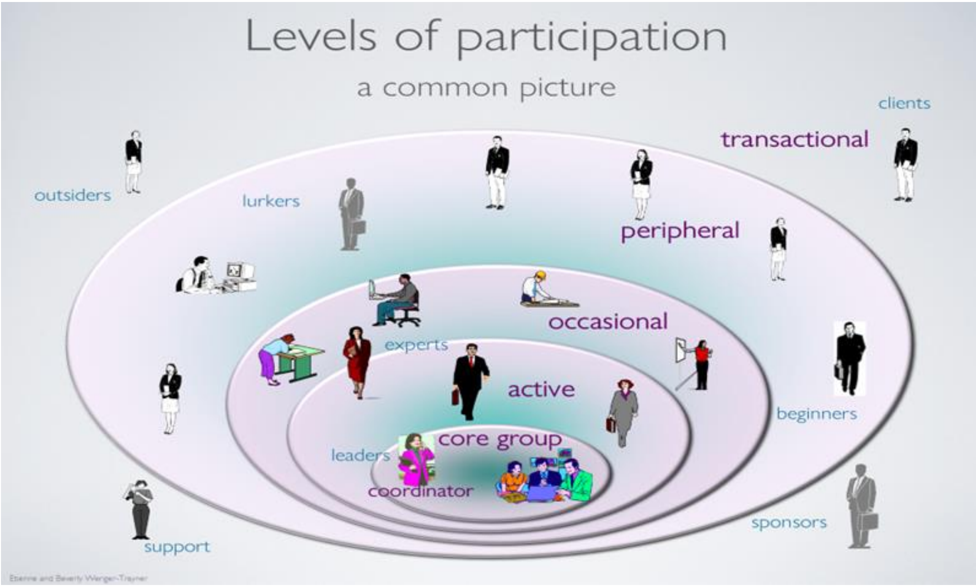
### 7.2.2 Communities of Practice (CoP)

People learn through communities of practice, and mobile technologies increase this possibility (Traxler, 2009). In the CoP, people engage in collective and shared learning where passion and willingness to learn is externally or internally influenced. Wenger and Beverly clarify that “CoP can allow for but does not assume intentionality: learning can be the reason the community comes together or an incidental outcome of members interactions” (2016, p. 2). In the farmers' mLearning context, mobile technologies cannot exclusively create the community of practice but can contribute resources to strengthen the farmers’ learning community. Mobile technologies are actor tools that afford resources to enhance the proper functioning of a community. In this thesis, the significant theoretical contribution in CoP relates to how learning and participation evolved within the smallholder farmers’ mLearning practice. The purpose is not to add constructs on CoP but to avail coherent description and representation of experienced phenomena (Traxler, 2018).

The CoP stipulates three concepts, Domain, Community, and Practice, as sufficiently explored in Chapter 3 (section 3.3). The domain includes relevance, value, and purpose of an initiative. In the farmers' context, domain relates to increased access to information and knowledge to address farming and livelihood challenges. The community entails smallholder farmers' membership, while the practice includes the use of mobile technologies to learn about farming. These concepts are interchangeably used in this section.

To begin with, in the Community of Practice, not everyone acts. Actions of different members are primarily determined by their interests and motivation to learn new things. To exemplify the aspects of membership and motivation, Figure 21 exemplify the different participation levels, ranging from transactional to being a core group member (Wenger & Wenger, 2011; Pharo, Davison, McGregor, Warr, & Brown, 2014). The rationale of the different participation levels in CoP is that " involvement can produce learning in multiple ways, and the domain has different levels of relevance to different people" (Wenger & Wenger, 2011).

**Figure 21: Levels of participation in CoP**




Wenger and Wenger- 2011b

In this study, farmers' entry and exit in a community is dependent on motivation and interest, and on how the domain addresses livelihood options. The more flexible participation boundaries give farmers leeway to choose learning activities that align with their needs. Depicted in Figure 21, the five categories of membership and participation levels in CoP include: the core group participants, the active participants, the occasional participants, peripheral participants, and transactional participants (Ibid). Analysis of participation levels in this study is discussed in relation to the Grameen CKW and USAID CC projects but limited with the L3F project since in the latter, educative messages were directly sent to the farmer's mobile phones.

The *core group* often comprises a few members whose passion and engagement energizes and nurtures the community. The *active group* includes participants recognized as practitioners and whose interests tally with that of the community. The *occasional participants* often participate when the topic is of special interest and when they have something to contribute towards a given discussion. The *peripheral participants* have less engagement because they are still newcomers with less commitment to the practice. Sometimes, their connection to the community includes having personal ties to some members of the community. Lastly, the *transactional participants* are mainly outsiders, occasionally receiving or providing a service or gain artifacts produced by the community in the form of resources, tools, and documents.

These participation categories were significant in the mobiles for development projects. For instance, the transactional participants included project funders, i.e., the Grameen Foundation, USAID, and the Commonwealth of learning for the Community Knowledge Workers (CKW), the USAID Community Connector (CC), and the Lifelong learning for farmers (L3F) respectively. Whereas an actual practice started with the initiators (M4D), activities of other members in the community were dependent on interest, motivation, and relations to the initiator (Walimbwa, 2017). However, much as they seem to be at a distance from the core group members (see Figure 21), the transactional participants had a strong influence on how the community of smallholder farmers operated. The transactional category consisted of the national coordinators, field officers, technicians, community connector officers, service providers, and funders who facilitated the community level activities in the farmers' mLearning practice. While CoP looks at them as occasional service providers, their activities were evident in their daily operations. Moreover, the use of mobile technologies to extend agricultural information in resource-constrained settings required funding and support from the transactional level participants to initiate and sustain the mLearning farmers' practice.

The core level participants in the smallholder farmer's CoP included Community Knowledge Workers (CKWs), farmers enrolled with the CKW groups, children, pregnant mothers, and different households in the USAID CC project. One interesting observation was that even when different farmers and households enrolled as core group members, their actual participation level varied from active to occasional and peripheral. Initially, the intention from the project funders was that all members would be core and active, having suggested what they needed to learn during the needs assessment phase. However, this was not the case. The occasional members, often termed as lurkers, were aware of the farming challenges and other livelihood constraints but still waited for others to join the mLearning practice.

The peripheral participants included newcomers and beginners who formally were not enrolled in the CKW practice but saw how the domain was relevant. In several data collection meetings, some peripheral members became active, moving even into the core group. In line with Wenger and Wenger (2016) observation, when the domain relates to activities, interest and motivation become strong. This justifies why non-members became more active and at the core. The degree of one's involvement partly depends on the members' individual expertise (Walimbwa, 2017). Members with adequate expertise and willingness to learn may emerge as active group members contributing to the core group activities. In one case, two peripheral participants (newcomers) moved from the peripheral to become active level members. As a CKW in Katerere parish explained, *"my two farmers originally not enrolled in the CKW work are very active and will never miss any meeting or group activity. These two are among my adopters and good performers in the group*". Therefore, in this thesis, I argue that members can join and learn from a given practice once they see relevance and value. However, not all peripheral members will move to the centre of any given practice. In the livelihood discussion, farmers' movement will not only depend on the commitment, motivation, and interest but also on the ability to access the necessary livelihood assets. Some farmers and households stayed at the periphery, and circumstances like not having capital (money) and other necessary farm inputs limited the use of attained knowledge.

An interesting observation about the CoP is that within the community of farmers, the beginners are not new members to farming as a domain, but they are beginners making an initial entry to the mLearning practice. Such farmers are termed as peripheral since they, through the social learning environments, try to negotiate their way inwards to the centre of the community. This brings to forth the concept of peripheral participation, which implies that beginners "move from the periphery of the community to the core, and becomes more active, and engaged in culture, and hence assumes the role of the experienced practitioner" (Walimbwa, 2017, p. 40). Peripheral members always move around, given the open and flexible boundaries at each level (Wenger & Wenger, 2011). However, this movement is not unidirectional, that is, from peripheral to the core. But, it happens any time depending on seasonality and other livelihood demands in case of farming communities.

The process of becoming an active member of the group may take several trips to and from the periphery to the Centre (Walimbwa, 2017). This implies that the newcomers, through several engagements and active participation, can be drawn to the centre of the group, thereby solidifying group activities. Therefore, newcomers' activities and tasks should be simplified to allow for the progressive and natural transition from basic tasks to complicated tasks as they grow in the community (Wenger, 2015). Engaging members in authentic tasks that relate to activities within their environment for immediacy or future use (Herrington et al., 2014a) can help beginners become experienced practitioners. In authentic environments, learning includes authentic and realistic tasks that avail opportunities for collaboration. Such contextualization and localization of activities supported and sustained interactions within the farmers' mLearning practice.

The levels of participation in the CoP vary depending on the context and uniqueness of each community. Therefore, there is a caution to what might result as inefficiencies in participation levels, termed the ‘reflags' in CoP (Wenger & Wenger, 2011). First, if the core group members are entirely not part of the community members and locals are peripheral participants, second, if there are no movements across all levels, and where even no new members are seen to join the group, and third, if peripheral members are marginalized, and core participants distracted and overwhelmed by the demands of the peripheral. Such red flags lead to imbalances in participation levels, which deter learning and affect the sustainability of any CoP. Therefore, to allow for participation and movements across different levels, this thesis suggests the need to appreciate the uniqueness of different communities, explore community needs, and find a balance between different actors' demands.

Although it may be true that boundaries enhance greater depth within a CoP, the same boundaries can facilitate power relations that limit an inclusive society. In this study, the fact that all M4D projects target specific groups of farmers limited inclusiveness. But as Wenger and Wenger (2011) note, “if all societies had to generate private competences, the world would be a disaster.” In this thesis, the established boundaries can be a starting point to establish networks that others can use for development activities. Moreover, boundaries offer opportunities for monitoring the impact of learning, which supports improved practice. However, boundaries that prevent new members from entering CoP can be problematic since they limit innovation and change. Some CoP can create little fortresses with a narrow focus (Farnsworth et al., 2016), thereby hindering some from accessing the groups. In the farmers' mLearning practice, while some non-project farmers were all welcome to join the CKW group activities, some groups had created fortresses which affected some members to join. These fortresses were not tangible walls created, but rather groups composed of leaders, educated members, and adequately well-off, which hindered the non-literate and less privileged farmers from joining. This limit in access is destructive and unstainable since, in CoP, newcomers' presence sustains group activities and helps the livelihood initiatives flourish in a given practice.

Certainly, in any practice, context engages individuals in collective problem solving (Wenger & Snyder 2000). The context of mLearning among farmers presents practical implications to the understanding of its practice. Within resource-constrained settings, the farmers' challenges were not only limited to technological availability but linked to the limited or no extension services in their locales. The resource-constrained context presented farmers with multiple perspectives and mediation skills through collaboration and meaning-making (Bannister, 2015). In this thesis, CKWs with knowledge on smartphones worked closely with other farmers who did not access up-to-date content. With just a single mobile phone, the initiated mLearning network of more than fifty farmers enhanced the farming practice in different parishes.

Integrating new technologies in the learning processes within farming communities has been limited, given the context within which they operate. Mobile technologies like smartphones, traditional mobile phones, and laptops are timely and handy technologies to support and extend learning. This thesis contributes to how mobile technologies extended learning capabilities through teamwork and collective action in a rural context. Farmers' testimonies about new knowledge in farming, animal rearing, poultry, health, food security, and income generating activities signify the impact of mLearning on their livelihoods. As Fuller (2017) confirms, context presents an opportunity to declare what people did not know and how useful it is to come out of such a state. Therefore, although the resource-constrained setting was not a good case to be proud of, it opened opportunities for farmers' actions for change.

The outstanding contribution of CoP to the practice of mobile technologies, learning, and livelihoods is to show that all actors in M4D are important, and their participation and movements across different membership groups vary in accordance with motivation, interest, respect, and the availability of essential assets that facilitate action. Although CoP identified factors that support learning in a given practice, analysis of actual learning envisaged among smallholder farming communities was adequately expounded with the social constructivism theory (as discussed in Chapter 3).

## 7.3 Thesis Contribution to Methodology

Research on mobile technologies adoption and use in many developing regions point to the few and "thin" studies in qualitative ethnography and the noticeable lack of in-depth qualitative studies (Duncombe, 2012; Traxler, 2018). Yet, "understanding the lived experiences, traditions and coping mechanisms of a group in a community is essential in grasping the meaning and patterns of grassroot interaction" (Figueira-McDonough, 2013, p. 177) concerning mobile technology use. This thesis employed qualitative approaches in a multiple case study perspective in understanding how mobile technologies enhance learning for livelihood support. A series of ethnographic approaches that entailed interactions and follow-ups of the same study participants over a long period facilitated the acquisition of localized norms and practices about smallholder farmer's interactions with mobile technologies. These long-term interactions entailed naturally constructed groups of farmers who routinely gathered for a common cause. Taking part in smallholder farmers' active learning processes was to appreciate them as vibrant learning communities who adapted mobile phone use to their context. This serves as a contribution to methods since the insights documented entail rich and thick inferences that are contextually bound.

Whereas qualitative studies make no claims to the generalization of study findings, their rigor to understand social and cultural meanings attached to behavior can generate context-specific findings, which can be a basis for further theorization (Duncombe, 2012; Yin, 2018). The choice of multiple case studies was not to generate a theory but rather add breadth to an indigenous understanding of the role of mobile technologies in supporting learning in non-formal contexts. Embracing particularism in research offers different perspectives inclusive of cultural inferences in specific contexts (Davison & Martinsons, 2016). In this thesis, studying mobile learning among smallholder communities avails context-specific insights applicable and useful to smallholder farmers with similar cultures. Such findings can influence practice.

## 7.4 Thesis Contribution to Practice

In my personal view, the most significant contribution of this thesis to practice is a conceptualization of mobile learning (mLearning) for livelihood support. The suggested contribution aims to inform development practitioners, policymakers, educationists, and technology providers on how mobile technologies can extend learning opportunities for better livelihoods. Many development projects are increasingly integrating mobile technological capabilities to support several livelihood initiatives among less privileged societies. Whereas this thesis prioritized mLearning for smallholder farming communities, practical contributions can easily be extended to support similar initiatives in health, education, empowerment, business, and financial literacy. Thus, given the diverse activities that smallholder farmers engage in, mobile phones can support a large variety of such livelihood activities.

In this mobile learning conceptualization, the identified implications emerging from the discussion of study findings are significant to the practice of mLearning in non-formal contexts. These implications include; analyzing the role and function of mobiles for development organizations; understanding mobile technology affordances; exploring learning theories that can work for adult participants; emphasizing the value of learning in non-formal contexts; appreciating the context of the learner; respecting learners' needs, and paying attention to diverse livelihood activities. The analysis of these issues guided the study in identifying six critical factors, as depicted in Figure 22. These include a) organizational support, b) technological resources, c) the needs of a diverse and dynamic learner, d) problem solving and situated learning, e) the community as agency and f) sustainability. While this study aimed to conceptualize mLearning for livelihood support, the suggested factors do not form a prescriptive framework. Instead, they offer insights that can guide the operationalization of mobile technologies and learning among smallholder farmers. Therefore, this study has not verified the applicability of these factors but instead offers insights on how the six categorical factors can support mLearning in a non-formal context. For instance, some factors emerged as recommendations from the study key informants and primary mobile phone users (farmers and local change agents) on how mobile technologies could sustainably support rural livelihoods. The six factors are summarily described in the following manner.

**a) Organizational support**

Organizational support implies an appreciation of the roles played by the mobile for development organizations that use mobile phones to extend support to rural livelihoods. This support, among others, included; conducting a needs assessment on what are the pressing community needs; availing necessary mobile technology tools and other necessary ICTs; identifying experts and researchers that could adopt content in ways meaningful to smallholders' practices; and facilitating all activities aimed at fulfilling organizational goals. Such initiatives are often donor-funded because most governments in developing regions have relegated technological initiatives to national and international NGOs whose resource base is donor aid. Nonetheless, the most necessary support from such agencies to communities is not only to avail financial resources but also to invest in pro-people development activities for communities to realize sustainable livelihoods.

Ultimately, within resource-constrained settings, for any mobile technological initiative, there has to be a macro actor who mobilizes and engages the community in understanding their problems.  In addition, appreciating local actors' relevance, analyzing culture and gender dynamics issues, and working towards synergistic relationships with other agencies is crucial for meaningful mobile technological integration for livelihood support. Therefore, mobile technology-related initiatives cannot focus only on isolated mobile medium. The availability of well-coordinated activities that network with mobiles to create synergies is paramount. These coordinated efforts include, among others, analyzing the technological resources, knowing the learner needs, identifying capable agency available within communities, and ensuring that projects work towards sustaining technological initiatives.

**b) Technology resources**

For technologies to work in rural communities, the choice of learning technology needs to reflect the aspects of affordability, connectivity, availability, and portability. This study has established that the primary mobile technology used in everyday practice by the smallholders is a mobile phone (smartphone and traditional phone). Both Grameen Foundations and USAID CC projects used smartphones in combination with manuals, nutrition kits, farming inputs, periodical reports, and other technologies like laptops to supplement information on mobile phones. The laptops, for instance, stored heavy videos about modern farming practices that could not be uploaded on the mobile phones given the limited storage space.

Similarly, although the L3F project employed farmers' own phones, they too had servicing units that translated farming content into different local languages and a control centre with technicians to support information dissemination. In rural contexts, it is important to consider the usability requirements of mobile technological tools. For instance, the few farmers with access to laptops in different parishes had the solar electric capacity to charge them. However, given the marginal rural settings with lack of electricity, a limited number of farmers would have charging capabilities to support laptops' functioning. Therefore, paying attention to the mobile technological requirements facilitates the ease to utilize them and quickens adoptions. For a mobile technological initiative to effectively facilitate learning for livelihood support, an ICT service unit that coordinates different technology resources, including the support to users of these resources, is pertinent. Mobile technologies cannot offer everything needed for learning but work in synergistic relationships with other ICTs and printed resources. Correspondingly, the choice of technological resources to be used in any given setting has implications on the extent to which the technologies address community needs.

**c) Diverse and dynamic Learner needs**

A critical analysis of the characteristics and the needs of learners is essential in understanding the learners' livelihood priorities. Development projects that engage adults in learning ought to respect the learners' diverse and dynamic needs as the majority are active in several livelihood activities. These activities keep changing depending on seasonality and challenges that farmers need to address. While development projects often support only a few livelihood activities, they (M4D projects) ought to appreciate that livelihood needs are diverse and dynamic, demanding flexibility in organizational operations. In mLearning for livelihood support, attention should be paid to *andragogy* - the art of helping adults to learn. Adult learning credits the learner's readiness to learn and uses learners' experiences in problem-solving learning activities. When smallholders, as adult participants are the learners, the nature of learning and choice of mobile technology tools must be adapted to their needs and capabilities. As such, the learners' characteristics must be central in determining what approach to take. For instance, using smartphones with content in English will require support from change agents and available social networks to translate this information into a language understood by all. For activities that use farmers' own phones, localizing audio and text content in native languages can take care of non-literate adult participants. Technological resources and learner needs should be complementary as choice of tools has an implication on the learners' characteristics. Equally, this will facilitate the appropriate type and nature of learning to use.

**d) Problem-solving and Situated learning**

Learning construed to support livelihoods is largely problem-solving and situated, aimed at change practice. It is concerned with the acquisition of or/and modification in habits, knowledge, and attitudes that enable the individual to make personal and social adjustments. Because learners in non-formal settings engage in different livelihood supporting activities, they require learning that addresses immediate real-life problems. Problem-solving and situated learning take learning activities to the learners' environment where learners' experiences are integrated into learning processes. To a large extent, such learning will determine both the type of mobile technology and the usage of that technology that is most optimal. Therefore, in learning that is facilitated by technologies, what determines the nature of learning is not only mobile technologies but also the learning processes envisaged. Generally, in most rural communities, given the limited familiarity of people to work with mobile technologies for learning, situated learning does not happen on mobile technologies but in the farmers' authentic setting. Mobile technologies offer assistive roles of extending knowledge access and sharing to farmers' learning contexts with support from the available agency within the communities.

**e) Community as Agency**

In rural development context, the community as agency encompasses existing human capital resources that work for various development projects. They may include change agents; significant others like experienced peers, school children; youth in households; and available farmer groups. Community change agents like village facilitators and

Village Health Teams (VHTs) and other team leaders in different projects can support in streamlining new interventions. However, they have to be trained and re-oriented towards new project activities accordingly. Similarly, significant others available within different households, such as youths and school-going children with formal training, also offer the assistance needed in using mobile technologies. For adult participants, the motivation for learning comes when an information platform entails mediation by available and trusted sources within communities (Knoche et al., 2010). Mediation by a trusted agency instills some level of confidence, which supports quicker and sustainable adoptions.

Additionally, the use of available and active community groups within rural communities sustains established livelihood projects. Although some available groups can create boundaries, thereby limiting other members from joining, an analysis of available groups and exploring possibilities of enrolling new members can broaden the existing communities of practice. Creating new groups can equally be helpful, although, as it very often happens, they become less operational when project assistance ends. A significant point of contention is that the smallholders in rural communities who participate in different development interventions, like health, forestry, business, micro-credits, implemented by various agencies, also contribute to the available community agency. Therefore, accentuating partnerships among development agencies within the same community is essential to identify key community actants and enhance social networks. In this study, some organizations portrayed less knowledge about others' existence, despite involvement in similar development activities that targeted the same farmers. Failure to recognize the work of locally available organizations can hinder the proper implementation of mLearning activities. This is especially true when development interventions fail to acknowledge the advantage of using change agents and farmer groups available within communities.

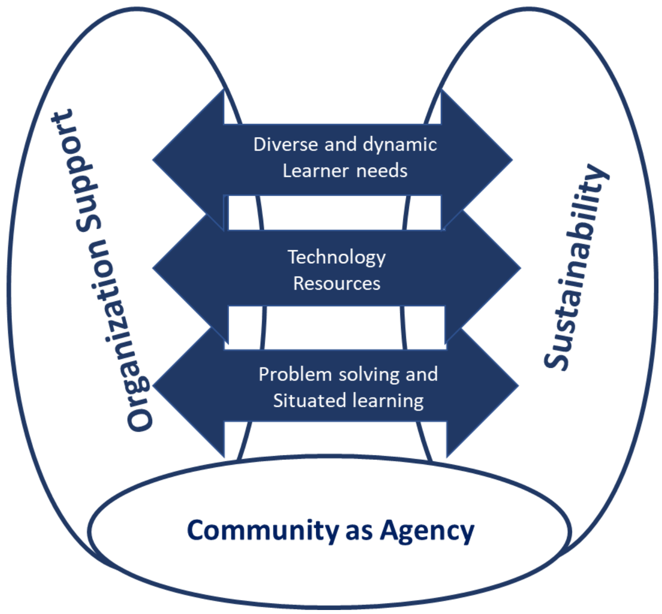
**f) Sustainability**

The sustainability of a project implies at least two things. First, it entails successfully achieving intended organizational objectives, and second, the ability of established activities to continue, even with an end to external support. Whereas some development organizations prioritize addressing project objectives, sometimes, limited attention is given to how communities can sustain these activities after their exit. This, however, does not mean that organizations never include sustainability plans. In this study, the use of local change agents, farmers' own phones, available groups within communities, and small grants of support to farmer groups were among the sustainability efforts to ensure continuous knowledge sharing among smallholders. Nonetheless, the uniqueness of ICT initiatives requires technical maintenance that most technology-driven projects have given less attention. This omission often downplays the entire sustainability plans of most rural technology initiatives. Furthermore, the incomprehensive sustainability plans result from over-reliance on donor aid and the fact that most technological efforts are short-term pilot projects that often fail to sustain activities.

There is possibly something that can be learned from integrating sustainable business models in this respect. Such models offer integrative strategies that can make ICTs initiatives thrive and work even after donor assistance. Sustainable business models, among others, include identifying key partnerships available within communities, valuing customers’ (farmers) needs and relationships, and identifying available distribution channels on how farmers can continuously access actionable information. In addition, mapping activities to cost structures, paying attention to revenue streams and critical resources can sustain the available agency interactions within communities. For instance, if project beneficiaries are encouraged to contribute by paying a part of certain technological resources, communities can be empowered to appreciate and sustain established local initiatives. Based on the study, it could be an option that the Community Knowledge Workers (CKWs) could be supported by different farmer groups in the form of paying for airtime to purchase internet data. This is a cost structure that could facilitate constant updates of farming knowledge, weather updates, and market information. Likewise, supporting the change agents’ voluntary services in the form of transport allowances could sustain their motivation to support mobile learning activities among different farmer groups.

To have a more holistic image of the six factors that facilitate mobile learning activities among smallholder farmer communities, Figure 22 visualizes a conceptualization of mLearning for livelihood support. The six identified factors fall within two strands. The first strand entails the three (middle arrowed) factors - diverse and dynamic learner needs, technology resources, problem-solving, and situated learning. These directly relate to the desirable nature and type of non-formal mobile learning necessary for smallholder farmer communities.

**Figure 22: Towards a Conceptualization of mLearning for livelihood support**




The second strand entails three (oval-shaped) factors - organizational support, community as agency, and sustainability, which are cutting edge factors that act as critical enablers to facilitate the integration of mobile technologies for livelihood support beyond learning. Development practitioners interested in either mobile technologies for livelihoods or/and mobile learning for livelihoods can equally benefit from the usage of these factors. However, these factors are mutually exclusive. The suggestive strands cannot work in isolation since each element interconnects to the other. Any mobile technology intervention that prioritizes access to information and knowledge sharing among rural communities should embrace adaptable technology resources to benefit communities. As such, knowledge sharing cannot succeed if organization support and community as agency are not at the centre of any technological initiative. Therefore, to realize lasting livelihood support, mobile technology driven initiatives need to be mindful of their roles, appreciate locally available community resources, and integrate sustainable business strategies in their activities.

# 8. Conclusion, Limitations, and Further Work

This concluding chapter consists of several components. It summarizes the findings from each research question, highlights the study limitations, and offers avenues for further research. Most importantly, the chapter presents concluding reflections of the major findings and, as such, provides a comprehensive theoretical and practical understanding of how mobile technologies can extend non-formal learning activities to support smallholder farmers' livelihoods.

## 8.1 Summary

This study's main objective is to contribute to an understanding of the role of mobile technologies in enhancing learning for livelihood support in rural communities. I have operationalized this objective through the five Research Questions (RQs):

RQ1: What are the perceptions among smallholder farmers on the use of mobile technologies for livelihood enhancement?

RQ2: What are the smallholder farmers' experiences regarding the adoption and use of mobile technologies for learning purposes?

RQ3: What are the possibilities and constraints of applying mobile technologies for learning in livelihood projects?

RQ4: What mLearning capabilities can support food security systems among smallholder farmers in rural communities?

RQ5: What mLearning conceptualization can support smallholder farmers livelihoods?

As discussed in Chapters 1 and 5, the publications in this thesis correspond to the research questions above, whose synthesis offers answers to the general research objective. This section offers brief answers to each research question.

With regards to the *first research question*, mobile phones emerged as the commonest and convenient technologies used to support farmers' livelihoods. However diverse in coverage they are, mobiles use largely depends on the user's ability to see capabilities in them. Farmer's narratives indicate how mobile phones empowered them, facilitated increased farm productivity, availed safety nets, and uplifted their social status. The mobile phones facilitated communications, market channels, financial transactions, business related activities, employment, and learning for livelihoods. The accessibility, portability, and multifunctionality attributes make mobile phones suitable to support smallholder farmers' diverse activities since farming, in its entirety, is not the only source of income, but just part of it in most rural households. While most farmers had a positive perception regarding mobile phone usage, the minority considered them disruptive. For instance, increased burglaries, divorce, theft, and vandalism associated with mobile phone usage threaten peoples' safety and suffocate social capital within communities. Further, some religious and cultural traditions were rigid towards mobile phone usage as mobile technology was associated with satanic codes (666) and the erosion of cultural values.

Consequently, while society and partly media have over emphasized both the good and bad from digital technologies like mobile phones, it is essential to harness their positives and confront the negative implications. As we move towards an inclusive digital culture where mobile phone penetration is high even in rural areas, we need to envisage a balance between caution and encouragement (Palfrey & Gasser, 2011) to harness their use for livelihood support. This calls for an appreciation of the changing mobile technology landscape which sometimes creates an imagination gap among those trying to implement and use technologies (Somekh, 2007). By this, I do not mean to imply that the new and increasing technological developments in ICT are bad for livelihoods. Instead, they create uncertainties in systems and institutions trying to rely on ICT innovations as a way of life. Therefore, to adequately realize mobile phone support for livelihoods, it is essential to continually check the capacities needed to keep up the technological pace and aim at a win-win equilibrium.

In the *second research question,* it was deduced that introducing ICTs like mobile phones to enhance livelihoods is not just a matter of availing the technology. It is essential to consider the key actors (both human and non-human), and most importantly, consider their needs as essential translations in the learning network. The mobile learning challenge in the farmers context cannot just be overcome by merely providing the technology. Technology and connectivity are just one component among many that need to work for rural livelihoods. This means that the available support from community knowledge workers, service providers, role model farmers, and farmer groups' willingness to participate in knowledge sharing activities facilitated increased adoption and use of mobile technologies for learning. Albeit tailoring learning to farmers' real context challenges, the presence of robust organizational support infrastructure, social presence, peer support, immediate learning impacts, and increased farm productivity facilitated farmers' learning. Further, the available and willing 'others' within the social network supported mobile phone integration (Knoche, Rao, & Huang, 2010). For instance, the presence of a relative, friend, neighbor, or school going child in the farmers' network significantly facilitated mobile learning. Correspondingly, like Akers and Mbiti notes, "for economic development to occur, complementarity between mobile phones and other forms of capital" (2010a, p. 229) is essential in trying to negotiate the critical roles of mobiles learning for livelihood support.

In the *third research question*, mobile learning offers a variety of choices available for the different needs and situations of different groups of learners. In the smallholder farmers' context, mobile learning is conceptualized as the use of mobile technologies like mobile phones (both smart and small end) and laptops to support information access and knowledge exchange among smallholder farmers. Farmers learning with mobiles was not only restricted to technology and mobility but incorporated an appreciation of the active involvement of farmers. Similarly, given that some farmers were illiterate, the process of knowing and sharing with others through mobile phone calling supported conversational learning. Mobile technologies extended and increased access to information and learning resources about farming and other livelihood activities (such as sanitation, gender violence, energy-saving technologies, and food security). Approaches like one-to-one meetings, group meetings, and the use of the call center enhanced mLearning. Content on mobile technologies facilitated farmers' on-site sharing and discussions about different topics. For some farmers like the Community Knowledge Workers (CKWs), WhatsApp interactions facilitated constant feedback and increased collaboration among farmers. To assess farmer learning, strategies like individual farmer assessment, peer to peer group support, service provider visits, project monitoring, and evaluators field visits were used. These were integrated into ongoing farmers' meetings and daily routines to fit the farmers' context.

However, there were notable constraining factors that affected mobile technology integration for learning purposes. These ranged from technology constraints, farmers' inability to use the knowledge on mobile phones, and mobiles as disruptive to society. For instance, mobile phones had character restrictions and technical problems relating to broken screens and charging system breakdowns. The high mobile phone theft; intermittent network and internet connections in some places; patriarchy tendencies; limited literacy skills; and rigidity in knowledge applicability are among factors that constrained learning on mobile technologies. Amidst all these limitations, it should be noted that even in formal institutions of learning, mobile phone affordances are still limited to voice and data (Best, 2009). Mobile technologies offer part of the necessary support to enhance learning. Therefore, in this study, contextualizing mobile technologies to support non-formal learning among farmers is important, given that everything is relative. There is a need to appreciate mobile technology capabilities considering contextual issues like mobile phones increased uptake and accessibility, even to 'last mile' communities.

The *fourth research question* findings reveal that mLearning capabilities of learning at any place anywhere supported learning about food security in situated and authentic environments. With support from CKWs, model farmer groups, and service providers, the mobile phone content enhanced mutuality and farmers' active engagement in the learning network. To learn about certain food security dimensions such as availability, access, and utilization, mobile phones and laptops carried localized content that supported learning about context-specific issues concerning farming, gender roles, family planning, nutrition, and income-generating activities. The mobile phones ignited farmers' discussions on topics like plants and animals, farm inputs, local knowledge, market and regional weather information, water and sanitation, child spacing, alcoholism, family planning, gender-based violence, and male and female participation in household activities. This, in essence, was mLearning as most farmers in the USAID CC project felt empowered to have gained a broader understanding of food security in their locality. The multi-sectoral operations with different organizations as actors, coupled with financial capital inclusion in the project, facilitated mLearning about food security. As this study reckons the relevance of financial capital in rural livelihood initiatives, it was clear that the lack of financial start-ups hampered knowledge uptake and applicability in many Grameen CKW farmer groups. Whereas rural people are sometimes 'handouts expectant,' the L3F and USAID CC projects' financial grants integration supported and sustained farmers' livelihood activities. As one farmer noted, '*it is true to help a man learn how to fish. But sometimes, the fishing processes require money*'.

Furthermore, there is a relationship between gender and empowerment from mobile phone usage. For instance, accentuating women agency in different mobile learning activities was significant in this study. In the Grameen CKW and USAID CC projects, female CKWs were evaluated as the most committed farmers based on the organizational audit reports and opinions from the different farmer groups. It is also true that mobile phones have offered increased opportunities for women agency in activities beyond their traditional roles. However, despite their increased agency, some pre-existing gender dynamics affected female CKWs, and female farmer's activities as analyzed in Paper 5. Men patronized and controlled mobile phones that belonged to female CKWs, and in worse scenarios, men denied women a chance to own mobile phones.

Therefore, to complete the mobiles for development discussion, we ought to understand mobiles' contribution to everyday use and within available social-cultural spaces. While gender injustices are often part of a culture and may take a long time to change, mobile technologies can be instrumental in 'unpacking' such injustices by facilitating new discursive gender formulations. This calls for a rigorous exploration of mobile technologies' fundamental contribution to social and cultural attributes beyond economic empowerment.

In the *fifth research question*, discussions about M4D research should not analyze mobile learning contributions in isolation but instead appreciate their synergistic relationships with other support systems. Learning in the smallholder farmers' context offers great insights into the applicability of mobiles in non-formal learning. The non-formal setting demands respecting the needs of the various categories of beneficiaries while acknowledging andragogical principles. Technology development initiatives often marginalize smallholder farmers, considering them only as beneficiaries at the receiving end (Nampijja, 2017). Yet, organizations pursuing livelihood enhancement initiatives ought to empower such communities in articulating their aspirations (Röling, 1990). The use of mobile technologies to support learning and build agency is one route to farmers' empowerment and poverty reduction. Smallholder farmers exhibit agency and ingenuity to engage in activities that support their livelihoods amid resource-constrained challenges.

To practically contribute to an understanding of how mobile technologies can support learning for livelihoods, this study identified six factors; diverse and dynamic learner needs; technology resources; problem-solving and situated learning; organizational support; community as agency; and sustainability. As discussed in Chapter 7, the proposed factors are, however, not exclusive as each element interconnects to the other. Therefore, for effective mobile integration, everything matters. 'We should not look at things in 'either or position,' but rather, in 'both and both position' (Best, 2009). For mLearning to support livelihoods, it is imperative to appreciate a joint effort through an ecosystem approach with different government and private actors. Further, this thesis observes that mobile learning in the farmers' context ought to be conscious of the existing knowledge sharing platforms. Given the available constraints in line with mobile technology use, specifically in resource constrained settings, mobile learning should supplement conventional knowledge sharing platforms. Therefore, mobiles integration ought to work within existing norms of practices, and more so, work hand in hand with available structures and means to support farmers' livelihood activities. While the sustainability of M4D initiatives has always been questioned (Nampijja & Birevu, 2016; Rhodes, 2009; Traxler, 2018), the integration of mobile learning in on-going initiatives and an appreciation of sustainable business models in tandem with the changing farmers' demographies will meaningfully impact smallholder farmer communities.

## 8.2 Concluding Reflections

This study alludes to two important reflections. The first is whether farmers' access to actionable information and knowledge (learning) is a livelihood concern. Whereas learning for livelihood support is not the 'sole' problem among farming communities, farmers need to learn new ways of adapting, given the fact that many engage in diverse livelihood activities. The current innovations in agricultural knowledge systems to combat recurrent farming challenges presuppose continuous learning to keep abreast of new changes. As evidenced by the literature on livelihood, most smallholder farmers depend on a magnitude of survival resources. Some of these resources are extractive and renewable, whose replenishment implies a shift to another livelihood source for survival. This calls for adaptive learning about new activities and, or opportunities, to facilitate resilience capabilities.

In many developing regions, access to education and learning is considered crucial for helping communities adapt to new challenges. Amid constraining factors like inadequate infrastructure, lack of advisory services, poverty, illiteracy, and high disease burden, evident in many rural communities in Uganda, the use of mobile technologies to enhance service delivery is considerable. The current availability of mobile technologies like mobile phones among the majority in developing regions offers leapfrogging possibilities into the future. The centrality of this dissertation relates to how mobile technologies can support leapfrogs in information access, knowledge sharing, and learning for livelihood support. While previous studies adequately explored how mobile phones support information dissemination, in this study, mobiles facilitated both access to information and learning opportunities that empowered farmers. This learning, conceptualized as non-formal, considered farmers as adult learners with vast experiences and a strong will to learn.

Although mobile technologies supported smallholder mLearning practice, it should be noted that mobile technologies in their entirety do not offer all learning capabilities. Other facilitative factors like social capital, availability of experienced peers, presence of traditional knowledge sharing platforms, access to telecommunication networks, internet facilities, and women agency enhanced mLearning for livelihood support. Moreover, in resource-constrained settings like rural locales, mobile technologies cannot offer all leapfrogs necessary to realize learning. We need to consider them as supportive tools to complement existing knowledge sharing platforms.

The second is whether mobile technologies, like mobile phones, can lead to improved livelihoods. The myths about mobile phones in many developing countries, like Uganda, depict the general misconceptions (both local and international) that people hold about mobile phone usage. As an international student conducting my PhD study in Norway, but also attending international conferences in the US, Europe, and Africa, my interaction with different people raised the following sentiments.

*'There are more mobile phones than water sources in Africa'*
*'Google has provided free internet access to avail internet on mobile phones for Africans'*
*'People can forego meals and yearn to stay connected to the rest of the world'*
*'Poor people are using mobile phones for survival'*
*'Can poor farmers interpret content on mobile phones'*
*'If all farmers are given mobile phones, will they ever get richer'*
*'Is there electricity in rural areas to support mobile phone use'*

On the one hand, these statements allude to some level of certainty on how mobile phones can support livelihoods, and that African communities have heavily prioritized their use. On the other, the sentiments signify how the region is still 'unable' to harness mobile capabilities, and that farmers lack competence in making use of the available mobile technologies. Whereas most of these were international sentiments, even within the Ugandan context, many people expressed uncertainty on how rural farmers could ably make use of mobile technology applications. The unclarity about mobile technologies' potential to facilitate farmers' learning was not only from the international audience as Ugandans also expressed disbelief. This notwithstanding, through a qualitative multiple case study design, this study has unveiled theoretical and practical insights about mobile technologies' capabilities in enhancing learning for livelihood support. Mobile technologies have partly offered opportunities to leapfrog access to updated farming and livelihood knowledge among smallholder communities.

## 8.3 Limitations

This section discusses the limitations of this research study. Limitations to the research approach are stipulated in the methodology chapter.

Limitation concerning generalizability issues. Epistemologically, this study employed the interpretivism approach through a multiple case study design that allowed for gathering case sensitive information among smallholder farmer communities. Even with multiple cases, data collected was limited to specific categories of participants which could certainly limit generalization of the study findings to other contexts. Moreover, this being a doctoral study with fixed deadlines, there is a possibility that the study captured less insights about mobile learning in smallholder communities. Nevertheless, interpretivist research advances how explaining particular phenomena in a specific context can involve generalization of empirical facts, descriptions of concepts, a theory, implications, or rich insight (Lee & Baskerville, 2003; Geoff Walsham, 1995). This study has contributed to indigenous theorization by suggesting context-specific insights (Davison & Martinsons, 2016). I infer the six developed factors (1) diverse and dynamic learner needs, (2) technology resources, (3) problem-solving and situated learning, (4) organizational support, (5) community as agency, (6) sustainability as generalizable to the practice of mobile learning in similar non-formal contexts. In addition, the discussion of findings and study contributions offered relevant insights into the practice and use of mobile technologies for learning among smallholder farmers. These, however, deserve further validation in future.

Another limitation of the study was measuring smallholder farmers' actual learning in the three case studies. While the L3F project was clear about the learning intentions in its objectives, Grameen foundation CKW and USAID CC projects aimed at information access and knowledge sharing for better livelihoods. This means, findings from this study might violate the original aim of these organizations. Likewise, while the study concluded about the impact of how mLearning supported farmers' livelihoods, this happened in short term controlled experimental projects with donor funding. A nuanced understanding of learning in settings where farmers are not given mobile phones with agriculture content is essential. Studying farmer use of mobile phones in a non-controlled setting can offer better insights on how mobile learning can support livelihoods.

The study investigation of how mobiles facilitate better livelihoods applauds mobiles' applicability and use. Yet, other types of technologies and print media supplemented learning on mobile technologies. The limitation is that other avenues and technologies that facilitated learning on mobiles were not considered in this research. Thus, future mobile learning related studies need to accredit the contribution of other networking knowledge sharing platforms that complement mLearning activities.

Given the multi-disciplinary nature of this study, the use of multiple theories to explore the link between mobile technologies, learning, and livelihoods could have limited deeper insights into their application to the farmer's context. While it was hard to idealize a single theory to befit the main study strands, the multiple theories might have had implications to study findings. Nevertheless, each theory was unique to the farmers' context and helped to explain the dimensions that missed in the other. For instance, the Community of Practice helped explore what influenced farmers' interactions in groups, and Social Constructivism helped to analyze collaborative learning among farmers. In contrast, the Actor-network and UTAUT helped to explain how the different actors adapted and used mobile technologies in their learning network. Grounded in empirical data, each theory offered exciting insights to farmers mLearning for livelihoods practice. While the limitation of each theory was explained in Chapter 3, their further use in the farmers' context deserves future validation.

## 8.4 Further Work

The findings, contributions, and limitations from this study offer avenues for future research in the following ways:

Since this study focused on understanding farmers' mLearning practices within controlled settings where farmers were given smartphones with installed agricultural content, future research should explore how farmers' owned phones can support learning. This will broaden an understanding of informal mobile learning practices among smallholder communities to streamline farmers' learning in natural settings. Whereas this study looked at a few farmers not registered in M4D projects, in-depth interaction with how such farmers adopted to new modern farming methods is worth investigation. Certainly, this will unveil social capital practices that support knowledge sharing among farming communities.

To ensure that M4D initiatives work for rural smallholder farmers, future work needs to appreciate the importance of diversification in different livelihood portfolios. For example, in rural areas, it is hard to target a single activity as most people engage in different livelihood activities. Obtaining full knowledge about assets, access, and activities that farmers engage in different seasons will guide practitioners to know what people engage in and when. Therefore, there is a need for a holistic strategy that allows for flexibility to venture into diverse livelihood activities to help communities access and learn about different coping strategies.

Pervasiveness, ubiquity, and cost effectiveness of mobile phones has influenced many local and international actors to initiate projects that use mobile phone applications in their activities. The vast majority engage in single projects, sometimes with less knowledge about other agencies' existence, yet they target the same communities. This creates duplication of roles and use of the same change agents, affecting their effectiveness and productivity. This calls for networking among M4D organizations where new initiatives need to map available actors to reduce ‘community stressing.’

All study case sites were short term experiment design projects with donor funds that question the sustainability of initiated projects. Therefore, there is a need to follow up with active farmers groups when organization and donor funding ends. This means that future work ought to advocate for sustainable business models for technological solutions to work in rural communities. Even when the multiple case studies integrated some sustainability models like using farmer volunteers, engaging in mobile data collection, solar phone charging, and tagging a pay to information advice, some of these seemed not to work, rendering the established projects unstainable. Thus, more research needs to explore sustainable business strategies that can offer solutions to the sustainability challenge of many ICT initiatives in rural areas of most developing regions.

While this study contributes to UTAUT theoretical insights in mobile learning for farmers' context, we suggest another confirmatory study that broadens and applies UTAUT2 constructs of price value, hedonic motivation, and habit to consumer technology use context. Currently, Grameen Foundation CKW activities have been concluded in different areas where the study was conducted. Therefore, to add to the generalizability of UTAUT2, the mobile technologies for farmers learning context with no organizational funding would be significant to understand technology adoption and behavioral intention to use.

To publicize context-specific practices about mobile learning for livelihood support, universities should work with available community-based initiatives to share knowledge about relevant innovations through their outreach arm. This exchange and interaction can improve practice that can support theory building and scalability of similar projects to different areas. Besides, using mobile technologies to facilitate learning processes cut across all disciplines, since most smallholder farmers are constrained by the lack of access to updated information and knowledge. Using cheaper technological solutions and learning from ongoing best practices can support other development projects related to health, literacy, finance, environment, and business.

Similarly, to arrive at a win-win position about how mobile phones can secure a more sustainable living among smallholders, there is a need for deliberate campaigns and sensitizations to educate people about the health implications associated with mobile phones. Studies on the dangers of mobiles to human health have been conducted, but this information is inaccessible to smallholder communities. People need to be conscious of the ‘how and how well’ to use mobile phones to reduce the likely health-related risks resulting from poor mobile usage.

Finally, findings from the USAID Community Connector project point to how the multi-sectoral project approach with different agencies supported smallholder farmers' livelihoods. Future research needs to study different agencies and their roles in an ecosystem approach. This will help new development interventions to work as teams and reduce roles duplication that come in the name of empowering communities.

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# Appendices

## Appendix 1. NSD Ethical Clearance Certificate

**Norsk samfunnsvitenskapelig datatjeneste AS**
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Dianah Nampijja
Institutt for global utvikling og samfunnsplanlegging Universitetet i Agder
Postboks 422
4604 KRISTIANSAND S

Vår dato: 19.06.2015 Vår ref: 43510 / 3 / AMS Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 19.05.2015. Meldingen gjelder prosjektet:

| | |
|---|---|
| *43510* | *Mobile Learning for Enhancing Livelihoods in Developing Regions* |
| *Behandlingsansvarlig* | *Universitetet i Agder, ved institusjonens øverste leder* |
| *Daglig ansvarlig* | *Dianah Nampijja* |

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 01.09.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Anne-Mette Somby

Kontaktperson: Anne-Mette Somby tlf: 55 58 24 10
Vedlegg: Prosjektvurdering

*Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.*

*Avdelingskontorer / District Offices:*
*OSLO:* NSD. Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no
*TRONDHEIM:* NSD. Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. kyrre.svarva@svt.ntnu.no
*TROMSØ:* NSD. SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. nsdmaa@sv.uit.no

# Appendix 2: Research Letter of Introduction

UNIVERSITY OF AGDER

Date: 30. June 2015

Visiting Address: Gimlemoen 17
Telefon: 3811763
Fax: +47 38 14 10 28
e-mail: arne.o.oyhus@uia.no

**To Whom It May Concern**

**Letter of Introduction for Ms. Dianah Nampijja**

Ms. Dianah Nampijja is a PhD student at the Department for Global Developmenty and Planning at the University of Agder (UIA), Norway.

The topic for Dianah's PhD project is *Mobile learning for Supporting Livelihoods in Developing Regions*. Dianah's project is part of a collaborative research programme between UIA and Makerere University, Uganda.

Dianah's main supervisor at UIA is Professor Arne Olav Øyhus, with Assoc. Prof. Christian Webersik as her co-supervisor. Dr. Paul Muyinda is her local supervisor at Makerere University.

Dianah will conduct data collection, mainly in the form of fieldwork, in Uganda between June 2015 and January 2016. We will appreciate any type of support you may give her during her stay in Uganda.

Best regards

Arne Olav Øyhus
Professor,
University of Agder,
Norway

## Appendix 3: Grameen Foundation Letter of Introduction

GF GRAMEEN FOUNDATION

Connecting the World's Poor to Their Potential

Plot 54, Lugogo By-pass
Rotary Avenue, Kampala
P.O. Box 35495
Kampala, Uganda / tel: +256 392-00002
www.grameenfoundation.org



July 9, 2015

Dianah Nampiija
0772415535

Dear Dianah:

**Re: Permission to inter-phase with Grameen Foundation Field based Intermediaries**

This letter serves to acknowledge your request to interact with community knowledge workers (CKWs), in order to help inform on your research project regarding *Mobile learning for Supporting Livelihoods in Developing Regions.*

The CKWs are currently active in three (3) districts of Masindi, Kasese and Greater Bushenyi covering the districts of Rubirizi, Sheema, Mitooma and Bushenyi.

You are free to choose any district of your choice.

We (GFU) would be interested in knowing and sharing of your findings after your field trip.

Yours sincerely,

Simon Okot

## Appendix 4: Participation Consent Form

UNIVERSITETET I AGDER

**Faculty of Social Sciences**
**Department of Global Development and Planning**

### Participation Consent Form

| | | |
|---|---|---|
| Project Title | : | Mobile Learning for Enhancing Livelihoods in Developing Regions. |
| Researcher | : | Dianah Nampijja |

☐ **I confirm that I have received, read and understood the information about the project**

☐ **I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected**

☐ **I agree that my personal information may be published during and after project completion**

☐ **I agree to participate in the study**

| Name of Participant | Date | Signature |
|---|---|---|
| ------------------------- | ------------------------- | ------------------------- |

| Researcher | Date | Signature |
|---|---|---|
| ------------------------- | ------------------------- | ------------------------- |

**Contact details of Researcher**
Dianah Nampijja
PhD student
University of Agder,
Department of Global Development and Planning
Gimlemoen 25, 422, 4604 Kristiansand, Eilert Sundt's house (H2 013)
Telephone Contact +4791288979 (Norway), +256772415535 (Uganda)
Email; dianah.nampijja@uia.no, alternative email; nampijjadianah@gmail.com

In case you have questions concerning your rights as a research participant; please contact the researcher above.

# Appendix 5: Participation Consent Form (Verbal)

UNIVERSITETET I AGDER

**Faculty of Social Sciences**

**Department of Global Development and Planning**

## Participation Consent Form (Verbal)

**Project Title** : Mobile Learning for Enhancing Livelihoods in Developing Regions.

**Name of researcher:** Dianah Nampijja

**Name of participant:** ........................................................

I am NAMPIJJA DIANAH, a PhD student at the University of Agder, Norway. I am undertaking a research study aimed at analyzing the role of mobile learning in supporting livelihoods in developing regions. My research is aimed at finding from the respondents about the perceptions and use of mobile technologies in supporting livelihoods in Uganda. The methods of data collection I will employ include qualitative approaches to research like semi-structured interviews, Informal conversations, participants' observation, Focused Group Discussion, and documentary analysis.

I request for less than I hour of your time in the process of inquiry and that it is upon your choice to take part or withdraw from this research at any time in the inquiry process. As a researcher, I pledge to protect your anonymity in presentation of findings and keep utmost confidentiality in keeping the information of all materials I will engage with. And, the information given will only be used for research work and nothing else. I promise to keep the transcribed data well after use, and this study will do you no harm.

## Appendix 6: Interview Guide for Key informants and Gate keepers

UNIVERSITETET I AGDER

**Faculty of Social Sciences**
**Department of Global Development and Planning**

I am DIANAH NAMPIJJA, a PhD student at the University of Agder, Norway. I am undertaking a research study aimed at analyzing the role of mobile learning in supporting livelihoods in developing regions. My research is aimed at finding out from the respondents about their perceptions and use of mobile technologies in supporting livelihoods and how such technologies can promote learning among communities. The aim of this interview is to analyze the role of mobile technologies in supporting people's livelihoods and understand how people learn and share knowledge on these mobile technologies.

1. Briefly tell about what your organization does.
2. What different mobile technologies do you use in your organization?
3. Briefly explain the different benefits of mobile technologies to people in your area
4. What are the social, cultural and economic reasons that explain the increased use of mobile phones in Uganda?
5. In your view, do you think farmers learn from the information shared on the mobile technologies?
6. What learning and information sharing strategies do you use to ensure that farmers use this information
7. How can you know that the farmers are learning and using the information shared on the mobile technologies?
8. Can you briefly tell how farmers' lives have improved with the use of these technologies?
9. Are there any challenges encountered with the use of these technologies in your project?
10. Are there any other ways you feel mobile technologies can better be harnessed to improve lives of many people in Uganda?
11. Any other things you would like me to know about the mobile technologies and development in Uganda?

## Appendix 7: Interview Guide for Smallholder Farmers

UNIVERSITETET I AGDER

**Faculty of Social Sciences**
**Department of Global Development and Planning**

I am DIANAH NAMPIJJA, a PhD student at the University of Agder, Norway. I am undertaking a research study aimed at analyzing the role of mobile learning in supporting livelihoods in developing regions. My research is aimed at finding from the respondents about the perceptions and use of mobile technologies in supporting livelihoods, and how such technologies can improve learning among communities. The aim of this interview is to analyze the role of mobile technologies in supporting people's livelihoods and understand how people learn and share knowledge on these mobile technologies.

1. Briefly tell about yourself and how you relate to the organization
2. What different mobile technologies do you use in your daily activities?
3. Briefly explain the different benefits of using mobile technologies in your life
4. What are the needs and demands of using mobile technologies
5. Are there any social, cultural and economic reasons that explain the increased use of mobile phones in Uganda?
6. What mobile technologies do you use in the CKW/L3F project
7. In what ways are these mobile technologies used and for what purpose?
8. In your view, do you think farmers learn from the information shared on the mobile technologies?
9. Can you briefly tell how your life and that of others farmers' has improved with the use of these technologies in agriculture?
10. Are there any challenges encountered with the use of these technologies in your day-to-day activities?
11. Are there any other ways you feel mobile technologies can be better harnessed to improve lives of many people in Uganda?
12. Any other things you would like me to know about the CKW/L3F project and farmers in your area?

## Appendix 8: Participant Observation Checklist

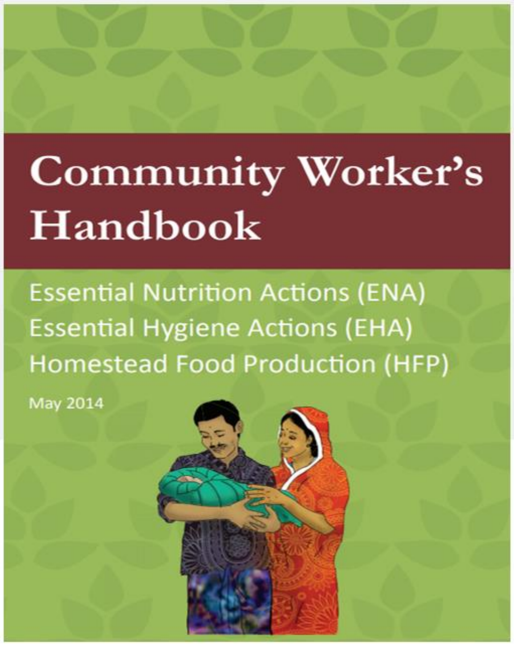
UNIVERSITETET I AGDER

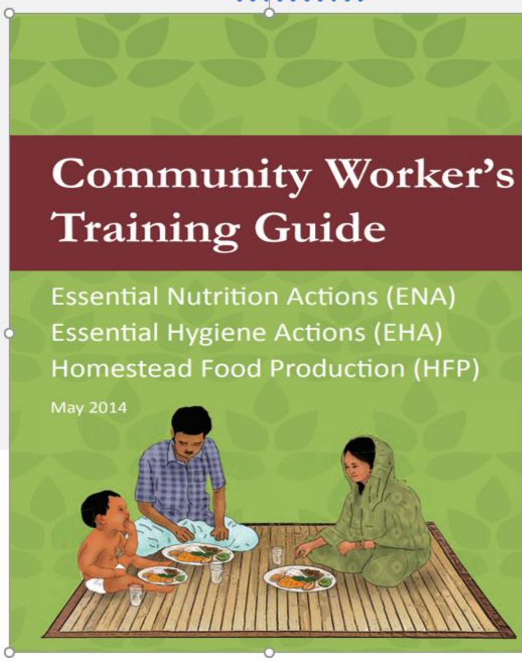
**Faculty of Social Sciences**
**Department of Global Development and Planning**

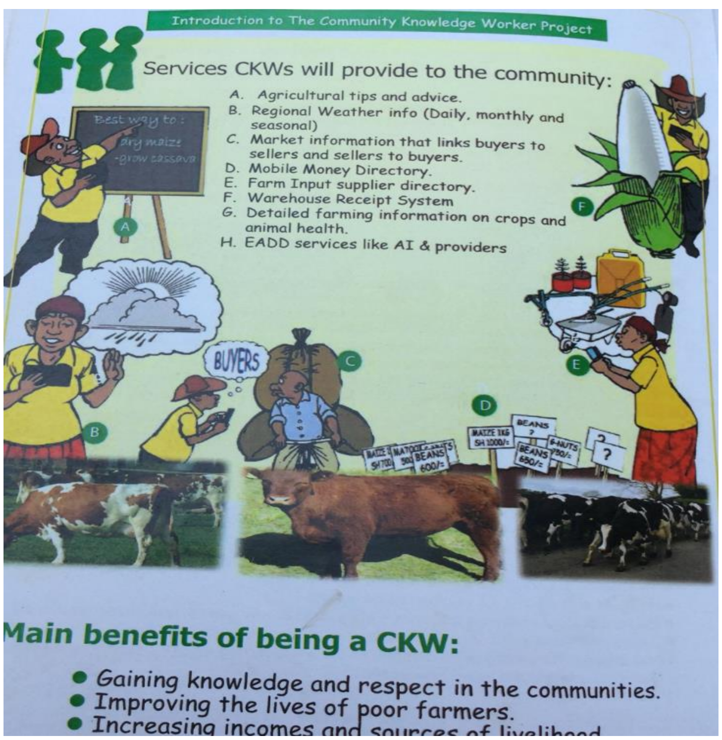
I am DIANAH NAMPIJJA, a PhD student at the University of Agder, Norway. I am undertaking a research study aimed at analyzing the role of mobile learning in supporting livelihoods in developing regions. My research is aimed at finding out from the participants about their perceptions and use of mobile technologies in supporting livelihoods and how such technologies can promote learning among communities. The aim of this checklist is to observe aspects that can contribute to an understanding of the role of mobile technologies in supporting people's livelihoods, and how people learn and share knowledge.

1. Nature of organization
2. Different mobile technologies used to support farmers activities
3. Activities farmers engage in
4. How people use mobile technologies
5. Tangible benefits from mobile phone use
6. Nature of information shared on the mobile technologies
7. Nature of learning and information sharing strategies used in all organizations
8. Nature of facilitation used by CKWs
9. Interactions between farmers and CKWs
10. Interactions between farmers and farmers
11. How farmers support others
12. Role and place of expert advice in the projects
13. Available mobile related infrastructure in the organization
14. Other non-technological systems used to support information and knowledge sharing
15. Mobile technologies related challenges (Age, gender, and education factors)

## Appendix 9: The CKW Support Tools



## Appendix 10: CKWs Monitoring Tool showing Farmers Gaps

**STRICTLY 1-on-1 (FARM VISITS) LIST FOR BUSHENYI**

| Dry conditions are expected to continue up to early August when isolated outbreak of light showers is expected to get established through Sep until the end of the season | | | | | | Sep GAPS to be covered per farmer | | | |
|---|---|---|---|---|---|---|---|---|---|
| No | CKW Name | Farmer Name | District | Village/LC1 | Farmer Type | GAP 2: Coffee desuckering, pruning and stumping | GAP 5: Proper Coffee farm record keeping | GAP 6: Group production/ marketing | GAP 7: Proper and timely weed control |
| 1 | Luke Barigye | Alsen Ndemire | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 2 | Luke Barigye | Jacenta Katushabe | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 3 | Luke Barigye | Manuel Mucunguzi | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 4 | Luke Barigye | Silverio Kwehangana | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 5 | Luke Barigye | Siver Ndyomubandi | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 6 | Luke Barigye | Atanazio Byarugaba | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 7 | Luke Barigye | Elias Turyakira | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 8 | Luke Barigye | Geresiano Mbeine | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 9 | Luke Barigye | Gerevazio Turyatemba | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 10 | Luke Barigye | Hilario Muhozi | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 11 | Luke Barigye | John Tumuhimbise | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 12 | Luke Barigye | Joseph Arinaitwe | Rubirizi | Mugombwa | Coffee | | | | Proper and timely weed control |
| 13 | Luke Barigye | Julius Twahirwa | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | Proper Coffee farm record keeping | | Proper and timely weed control |
| 14 | Luke Barigye | Mariciari Muhimbibwa | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | Proper Coffee farm record keeping | | Proper and timely weed control |
| 15 | Luke Barigye | Matayo Ndyabayunga | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | Proper Coffee farm record keeping | | Proper and timely weed control |
| 16 | Luke Barigye | Peter Masereka | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 17 | Luke Barigye | Sabastian Mwesigwa | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 18 | Luke Barigye | Silver Tumukunde | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 19 | Luke Barigye | Vanansio Tumwijukye | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 20 | Luke Barigye | Vincent Karuhanga | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | Proper Coffee farm record keeping | | Proper and timely weed control |
| 21 | Luke Barigye | Vincent Monday | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 22 | Luke Barigye | Vincent Owakubariho | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 23 | Luke Barigye | Vincent Rugyema | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | Proper Coffee farm record keeping | | Proper and timely weed control |
| 24 | Luke Barigye | Wilson Mutungirehi | Rubirizi | Mugombwa | Coffee | Coffee desuckering, pruning and stumping | | | Proper and timely weed control |
| 25 | Luke Barigye | Yorinim Bagarukayo | Rubirizi | Mugombwa | Coffee | | | | Proper and timely weed control |

## Appendix 11: Research Publications

(I) Nampijja, D., Øyhus, A. O., Webersik, C., & Muyinda, P. B. (2021). Access to Learning through Mobiles: A Socio-Technical Tale of Mobile Learning Actor-Network Among Smallholder Farmers. In *Perspectives on ICT4D and Socio-Economic Growth Opportunities in Developing Countries* (pp. 252-277). IGI Global.

(II) Nampijja, D. (2018). “If you take away my phone, you take away my life...” Community Narratives about the Social Implications of Mobile phone Usage for Livelihood Security. In *Interactive Mobile Communication, Technologies and Learning* (pp. 368-384). Springer, Cham.

(III) Nampijja, D. & Muyinda, P., B., (2016). Adoption and Use of Mobile technologies for Learning among Smallholder Farmer communities in Uganda. Proceedings in *Interactive Mobile Communication, Technologies and Learning (IMCL), 2016 International Conference on* (pp. 83-87). IEEE

(IV) Nampijja, D. (2017). Mobile Technologies as Tools for Learning in Non-formal Contexts. Experiences with Smallholder Farmers in Resource-Limited Settings. Conference proceedings in *"Smart Universities: Education's Digital Future." (Pages 107-115), λογος*

(V) Nampijja, D. (2017). Mobile learning in Non-formal contexts. Exploring the nexus of practice and use of mobile technologies among smallholder farming communities in Resource limited environments. Proceedings in the *9th International Conference on Education and New Learning Technologies Barcelona, Spain. 3-5 July 2017. ISBN: 978-84-697-3777-4 / ISSN: 2340-1117.doi: 10.21125/edulearn.2017.* IATED

(VI) Nampijja, D., Øyhus, A.O., Webersik, C., Muyinda, P.B. (Under review). ‘It is not only about food, but food of nutritious benefit’. Mobile Learning Possibilities for Food Security among Smallholder farmers in Uganda. Paper submitted to Springer Journal - Agricultural and Food Economics

# Chapter 10
# Access to Learning Through Mobiles:
## A Socio-Technical Tale of Mobile Learning Actor-Network Among Smallholder Farmers

**Dianah Nampijja**
*University of Agder, Norway*

**Arne Olav Øyhus**
*University of Agder, Norway*

**Christian Webersik**
*University of Agder, Norway*

**Paul Birevu Muyinda**
*Makerere University, Uganda*

## ABSTRACT

*The common myth that mobile learning cannot propel in a rural setting is null and void. The influx of modern ICTs like mobile technologies can revolutionize information access among the less privileged in many African communities. Using the Actor-Network Theory as a methodological tool, the chapter explores opportunities of increasing knowledge access through mobiles, by understanding the networks involved in farmer's mobile learning practice, with reference to Uganda. The chapter reveals that mobile technologies offer affordable individual and group learning opportunities to smallholder farmers. Learning is a socially constructed activity, where farmers with access to ICTs like mobile phones share knowledge*

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*among those with no access. Through a socio-technical discussion, technological initiatives ought to be pro-people where farmers' needs are key considerations in the mLearning actor-network. For sustainable impacts, all actors need to work collaboratively, negotiate different realities, and appreciate the local challenges within which mobile technologies can support learning.*

## INTRODUCTION

Information and Communication Technologies (ICTs) have great potential to facilitate growth and development in many developing regions (Heeks, 2008; World Bank, 2016). While the contribution of ICTs has been noticeable in ICTD research, there has been a remarkable breakthrough regarding the rise and use of mobile communication technologies (Castells, Fernandez-Ardevol, Qiu, & Sey, 2009; Svensson & Wamala, 2012). This has given rise to new research fields like Mobile for Development (M4D) (Svensson & Wamala, 2012). M4D falls within the broader ICTD research, whose origin emanates from mobile phone usage that offers a range of possibilities to empower and transform people in developing regions. The influx of modern technologies has revolutionized information, making it possible to avail knowledge and awareness to the end-users (Oladele, 2011). Modern ICTs, like mobile technologies, offer solutions to developing regions like Sub-Saharan Africa since such technologies require less infrastructure investments and are equally available in many African communities (Duncombe, 2011; Oluwatobi & Olurinola, 2015; Traxler, 2018). These new technologies have been considered a chance for Africa to blend into the world of better economic activities and social wellbeing (Alzouma, 2005). There is considerable emphasis on personal media as opposed to mass media given the vantage that lies in its portability and low cost. In personal media, the individual has access to educational content any time anywhere, which aids learning processes (Ekanayake & Wishart, 2014; Garcia-Cabot, de-Marcos, & Garcia-Lopez, 2015; Elsafi, 2018). What matters is not the nature of technology and how sophisticated it may be, for as long as that technology is simple, cheaper, and reliable. Mobile Learning (mLearning) to support farmer's livelihoods fit this overall view of more affordable and reliable technological solutions. Correspondingly, instead of introducing new ICTs to address citizens' challenges in developing regions where the cost of ICT installations has been a challenge, using mobile technologies communities possess can support learning for better livelihoods (Young, 2009; World Bank, 2016).

Currently, several Mobiles for Development (M4D) initiatives in Africa integrate mobile technologies to support the continent towards its development drive path. For instance, Mobile Alliance for Maternal Action (MAMA), a public-private partnership initiative in South Africa helps single mothers, pregnant mothers, and HIV infected women to receive mobile text messages as reminders about their medication requirements (Mobile Alliance for Maternal Action, 2014). Eneza Education in Kenya delivers instruction materials to engage school-going children in remote communities to read textbooks from mobile phones (Eneza Education, 2019). Praekelt Foundation uses mobile technologies to extend essential information on relationships, sex education, and HIV/AIDS to curb the spread of the virus (Praekelt Foundation, 2017). Several of such similar initiatives have been evident in many developing regions like Rwanda, Tanzania, Ghana, Nigeria, and elsewhere (Oluwatobi & Olurinola, 2015). In Uganda, with a need to bridge the digital divide where most mobile learning efforts concentrate on formal education systems, many learning initiatives are now targeting communities like smallholder farmers. For instance, the Lifelong learning project sends text messages to rural farmers to educate them about improved farming methods, good marketing strategies, and financial management (Atieno, 2013). The USAID Community Connector project through an integrated approach uses mobile phones to support agricultural productivity, health initiatives, and food security (USAID, 2014). The Grameen CKW project (which is the focus of the study) employs android phones to send actionable information about new farming methods, weather updates, and market updates to farmers in rural Uganda (Grameen Foundation, 2015). In all these projects, the central component is the mobile phone which is accessible to most communities.

On the other hand, despite these mobile technological efforts (Baumüller, 2013; Manske, 2014), smallholder communities in developing regions still grapple with many development challenges. Local adaptation strategies used by societies for generations are no longer responding to the current climatic challenges as seasons are changing, with prolonged droughts, heavy rains, and new pests and diseases (Mohamed & Avgoustos, 2014). In Africa, where over 80% of people rely on subsistence farming, the lack of access to adequate extension systems coupled with changes in seasons and rainfall patterns make such farmers prone to persistent farming challenges. Yet, successful adaptation strategies presuppose knowledge transference, integrated science and local knowledge, and increased awareness (Gwali, 2014). While it is true that mobile technologies have supported smallholder farmers to get access to actionable information, many still lack access to updated agricultural knowledge (Duncombe, 2012; Musungwini, 2018). The need to uphold investments in education and training is one way to address livelihood challenges, as there is no other region in the world that needs urgent access to information and training like Africa (Omolewa, 2008; Evans, 2018)

The current integration of mobile technologies for development projects in developing regions increasingly focuses on information dissemination, with less emphasis on how such technologies can offer learning spaces to propel development. To date, the body of knowledge on the use of mobile technologies for development is growing (Alzouma, 2005; Aker & Mbiti, 2010; Furuholt & Matotay, 2011; Porter et al., 2012; Crossan, McKelvey, & Curran, 2018), but there exists less literature on how to integrate mobile technologies in learning to support livelihoods. Information availability must be complemented with learning capabilities for people to practically engage with the knowledge obtained (Edwards, 2002). More so, in most ICT projects targeting smallholder farmers, capacity building and information sharing are seldom mentioned as aspects supported by mobile technologies. Smallholder farmers lack access to relevant information and learning opportunities (Nampijja, 2017), which mobile learning can partly address.

The emerging field on mobile learning (mLearning), given the rapid growth of mobile technologies, has immense potential to revolutionize education in the classroom, in the workplace, community, and many informal learning environments (Traxler & Leach, 2006; Hashemia, Azizinezhad, Najafia, & Nesari, 2011). This development has made education and learning accessible and affordable for everyone (Mohamed & Avgoustos, 2014), including smallholder farmers. However, most literature and research on the applicability of mLearning mostly concentrate on formal and informal learning classroom-related activities (Clough, Jones, McAndrew, & Scanlon, 2008; Stockwell, 2013; Pimmer et al., 2014; Khaddage, Müller, & Flintoff, 2016; Elsafi, 2018). Dedicated studies in pedagogical integration of mobile technologies in teaching and learning mainly focus on formalized education systems, neglecting the substantial majority in society (like smallholder farmers) who are not formally educated (Zelezny-Green, 2014). Equally, the paucity of qualitative empirical studies that analyze the role of mobile technologies' support for livelihoods makes this study relevant. The changing trends in technologies and the need to learn new adaptive strategies often limit the capacity to use technology as a platform to help communities get access to actionable digitalized content. Therefore, on the premise that systematic integration of mobile technologies facilitates knowledge access and sharing, the key motivation of this study is first: to unveil opportunities afforded by mobile technologies in increasing access to learning, and second, to analyze the mLearning actor-network among smallholder farmers, with specific reference to Uganda.

The study focus on increasing access through mobiles to support learning raises both ethical and moral considerations (Walsham, 2012). Ethically, mobile technologies like mobile phones act as inclusion platforms to extend new knowledge to the marginalized in society like smallholder farmers. The moral dimension, on the other hand, focuses on how mobile learning integration can appreciate locality through taking learning to where 'those in need are reached.' Scanty research in mobile learning for farmers in developing regions like Uganda depicts a misconception that mLearning is not feasible in rural Africa (Brown & Mbati, 2015). For example, Elias (2011) claims that mLearning systems are not feasible in rural settings given the poor infrastructure like low bandwidth restrictions. While there are notable challenges regarding the application of mobile learning systems in rural settings, mobile learning offers cheap and reliable affordances to support the less privileged (Göksu & Atici, 2013; Oluwatobi & Olurinola, 2015; Traxler & Leach, 2006). Often, when new technologies reach the education scene, they rarely transcend to the less privileged like smallholder farmers. Access and possession of technological tools is a crucial dimension in everyday life, including learning. Smallholder communities have access to mobile phones that can support learning for different livelihood activities (Atieno, 2013). Amidst notable constraints like language and cultural barriers (Traxler, 2018), if mobile technologies are well integrated, rural people can learn informally and non-formally. As Walsham (2012) re-echoes, ICT solutions should not only target formal sectors and the economically well off. Smallholder farmers can harness mobile learning integration whose involvement can stretch from subsistence agriculture to social wellbeing and improvement in livelihoods.

Mobile learning (mLearning) has the potential to support smallholder farmers' livelihoods (Nampijja, 2017). mLearning allows learning to take place in the learners' usual environment, fosters people engagement, promotes learner centeredness, knowledge centeredness, and community centeredness (Sharples, Taylor, & Vavoula, 2005). Smallholder farmers need to learn new knowledge on how to cope with the different changes; they need to learn new ways of working together, and they need to learn new adaptive strategies (Mohamed & Avgoustos, 2014). Such learning can take place on mobile devices (like mobile phones) which farmer communities have access to (Aker & Mbiti, 2010). This paper contributes to the body of knowledge as it depicts the role of mobile learning as a strategy to increase information access and knowledge sharing among smallholder farmers. To achieve this, the paper has employed the Actor-Network Theory (Law, 1992; Latour, 2011), both methodologically and theoretically, to map out and understand connections and networks involved in farmers' mobile learning practice.

The next section of the paper explains mobile technologies and learning concepts. The Actor-Network Theory and its application on the Grameen Foundation Community Knowledge Worker (CKW) initiative then follows. The farmers' socio-technical abilities about mobile learning actor-network are discussed, as well as an outline of the theory limitations. The paper ends with a conclusion that suggests the need to make farmers' mobile learning initiatives pro-poor as a strategy to increase learning for all.

## Mobile Technologies and Learning

Mobile technologies are part of the blossoming technologies in the world today. The mobile technology sector is among the rapidly growing sectors (Crossan et al., 2018) to support service delivery. The latest technologies and updated features included in handy mobile devices like mobile phones have assisted in ensuring access to information anywhere and at anytime. Mobile technologies have the potential to reach larger audiences and are rendered useful for capacity building to end-users (Oladele, 2011). Mobile technologies facilitate dialogical communication, which in turn leads to collective knowledge sharing. The current discourse about the increasing mobile technology usage in many developing regions offer avenues for understanding the social and economic impacts of mobile technologies for livelihoods. Moreover, this understanding surpasses 'just providing access' to exploring the actual derived benefits from mobile technology use for development purposes.

In this paper, mobile technologies considered are mobile phones. Mobile phones have been touted as the commonest and widely adopted ICTs in availing pertinent information to many people in most developing regions (Heeks, 2008; Knoche, Rao, & Huang, 2010). To Grimus and Ebner (2013), the mobile phone network has a wide distribution, people owning phones know how to use them, mobile owners value their phones and are willing to take care of them, mobile phones are shared, and that people carry mobiles along with them. These mobile phone capabilities make them effective tools to support learning anywhere and at anytime. Portability, connectivity, and affordability are central features that explain increasing access and availability of mobile phones in developing regions. Current mobile applications like WhatsApp, Facebook, and Twitter can support learning, as well as enable the sharing of up-to-date digital information (Muyinda, Mayende, Cheryl, & Cheryl, 2016). Thus, among the feasible and effective ways to deliver information in most rural areas is through mobile phones because they can work even in settings where there is no reliable electric power supply (Knoche et al., 2010). This justification does not rule out the fact that phones require electricity, but compared to other ICTs, mobile phones can work even in places with no/low rural electrification. "…if people are able to own or use a mobile phone yet choose not to improve the state of sanitation or water sources, it is a clear case to re-analyze the assumptions that currently exist within development studies of what is necessary within these household's livelihoods" (Diga, 2007, p. 4).

Mobile learning (mLearning), although a relatively new field, has varying definitions and qualities to be analyzed. It can be defined in accordance with the context, learner mobility, and technology applied. Mobile learning can unconfine the learning activity as it allows for flexibility and learning at any place anywhere. To Sharples et al. (2005), mobile learning is learning that is personalized, informal, contextual, with the aid of mobile devices that allow for spontaneity of the learning process. Mobile learning is not only restricted to learners' mobility but incorporates the active involvement of learners in different contexts (Brown, 2010). The significance of mobile learning lies in its ability to un-confine the learning activity and support flexible learning at any place anywhere. Besides, Sharples, Taylor, and Vavoula (2007) consider mobile learning is a process of knowing and sharing with others through conversion across multiple contexts. In this dimension, the learner and the technology are not the center of attention, but rather, the communication interactions that go on informs mobile learning.

It should however be noted that mobile learning provisions need to be understood within defined contexts (Traxler, 2018). For instance, mLearning in Sub Saharan Africa is quite different from mLearning in the other parts of the world (Grimus & Ebner, 2013), given the unique affordances concerning accessibility and connectivity issues. There is a need to analyze contextual issues and design appropriate mechanisms to make mobile learning work for such communities. The urgency is to think about different impacts on communities, informal learning, mother tongues, and indigenous knowledge (Traxler, 2013; Traxler, 2018) in the appropriation of mobile learning. To posit mobile learning among smallholders, an analysis of networks that support learning in such contexts is vital. The next section explains the Actor-Network Theoretical frame, research approaches, and methods used in analyzing the smallholder farmers' mLearning network.

## The Actor-Network Theory

Understanding the local and contextual challenges before identifying any technology is critical in proposing impactful solutions to support livelihoods. Using the Actor-Network Theory (ANT), this paper explores how human networks support information sharing and use among smallholder farmers. The advantage of using ANT is the realization that networks are crucial for communities employing mobile technologies in resource-constrained environments like rural areas.

*ANT provides a framework of ideas for describing the process of technology adoption and developing stories which explain technology take-up. ANT suggests that technology is as much a product of social construction as of technical innovation. Technology adoption results from the build-up of fluid networks of heterogeneous associations between actors. (McBride, 2003, p. 266).*

Developed in the 1980s by Bruno Latour, Michel Callon, and John Law (Law, 1992; Latour, 2011), the Actor-Network Theory emphasis is on both human and non-human actors in the network. Research exploring mobile technologies for development mainly focuses on non-human actors (mobile phones and mobile content), with less focus on people (human actors) who make use of these technologies. The choice of ANT in this study lies in its emphasis on how to re-echo the role of humans and their cultures in the technology adoption process. Social processes are as important as technological processes in understanding events (McBride, 2003). In this regard, to ANT, the social, as well as technical aspects of any entity are inseparable (Walsham, 1997).

The 'Actor' analogy in ANT implies acting or doing or engaging, and here, the theory helps to understand what people do, how much they do, and how the 'doing' affects those around them. Actors are critical stakeholders in the network who impact on the activities of a particular entity (McBride, 2003). Actors are both human and non-human, the latter being technological artifacts (Ibid). Considerably, we need to understand that not all who are named 'actors act,' since acting largely depends on the ability of the available technology to be aligned with the interests of the actors and other stakeholders in the network (McBride, 2003). It is important to note that actors do not act alone; they act within a network of activities. As Latour puts it, "an actor is nothing but a network" (2011, p. 800). ANT does not define an actor since actors can also be receptive (Mol, 2010). Receptive implies being passive recipients of information in the network. In addition, actors can be both passive and active as their roles keep changing in the network.

With the 'network' analogy, "actors are afforded by their ability to act by what is around them" (Mol, 2010, p. 258). Actors do not act alone; they afford each other's existence and capabilities, where the environment affords what people do. Networks explain how actions are allocated and located (Latour, 2011). Networks are open with no clear hierarchical relationships to depend on, as they keep changing: rendering them stable or unstable (McBride, 2003). Law (1992) advocates for heterogeneous networks where society, agents, and machines, are generated through network patterns that grow and elucidate one another. Actors are adapted by their associates in the enacting process (Mol, 2010). Such networks entail understanding the coexistence involved and how they influence one another in the process. Therefore, the Actor-Network Theory provides us with lenses of how to visualize networks of human and non-human actors in any development intervention.

ANT has been used in contributing to mobile learning literature (like the Actor-network theory and adoptions of mobile communications by Neil McBride 2003). However, in this study, understanding mobile learning networks in a livelihood discussion will contribute to the body of knowledge that explores how mobile phones can increase access to learning among smallholder farmer communities.

Moreover, actors in terms of discourses, logic, mode of ordering, and practice differ from one network to the other (Mol, 2010). This also applies to how actors differ from one context to another. Therefore, studying networks during the technology adoption process may provide guidelines on how to advance technology adoption in the future (McBride, 2003). McBride offers thresholds to look at while using the ANT theory in the mobile technology arena. For example, the key actors in the mobile learning network need to be profiled, their cultures identified, nature of relationships examined, perception of the usefulness of technologies analyzed, the ease of using technologies explored, key activities they engage in mapped out, as well as quality and nature of their relationship. This characterization implies that to ensure the sustainability of initiated actor-networks, working together, negotiating different realities, and trust are key parameters that maintain any network.

ANT has been regarded as a theoretical and methodological tool. As a theory, "…it provides theoretical concepts as ways of viewing the real world… [and as a methodology] it suggests exactly these elements that need to be traced in empirical work" (Walsham, 1997, p. 469). As a methodology, ANT explains concepts like actors, actor-networks, translator, Obligatory Passage Point (OPP), and the four translation moments (problematization, interessement, enrolment, and mobilization) (Rhodes, 2009) as explained in the subsequent sections.

## RESEARCH CONTEXT AND METHODS

### Research Context

There are not many visible projects in developing regions that are using ICTs like mobile technologies for learning to support livelihoods (Nampijja, 2019). A single case study allows for an in-depth analysis of the discussion about how mobile technologies can increase access to learning for people in rural communities. In the case study design, researchers get immersed in the activities of the studied case to obtain an intimate familiarity with their social worlds in pursuit of meaningful interpretations (De Vos, Delport, Fouché, & Strydom, 2011). Using lenses of the Actor-Network Theory, the Grameen Foundation - Community Knowledge Worker (CKW) initiative in Uganda was selected to examine how networks are crucial in understanding mobile learning for livelihood support. The project relies on mobile phones as a tool to extend centralized expertise through "feet in the field." (Van Campenhout, 2013). The ability of the project to impact livelihoods and sustain activities in very remote communities defined our choice of the case. Moreover, not many studies have qualitatively engaged with smallholder farmers to explore how mobile phones can support learning. Hence, understanding socio-technical tale

*Table 1. Concepts in the Actor-Network Theory*

| Actor (or Actant) | Actor-networks |
|---|---|
| Actors imply doing, acting, or engaging. Actors are both human (people) and non-human (mobile technologies). | Actor-network entails heterogeneous networks of aligned interests, including people, organizations, and standards (Walsham, 1997). Networks explain how actions are allocated and how relations are organized and networked (Rhodes, 2009). |
| **Obligatory Passage Point (OPP)** | **Translator/macro actor** |
| OPP forces people to converge and act. It is a solution to the problem that affects future alliances and controls resources needed to achieve the actant's outcome (Rhodes, 2009, p. 5). | A translator can be an individual or group of individuals that act as representative spokespersons -also named macro actors. To Rhodes (2009, p. 5), macro actors create new OPPs and<br>● become the spokespersons for the entities they constitute, such as land, equipment, people, processes, and technology.<br>● provide an initial definition of roles and distribution of roles. |
| **Four Translation moments** | |
| **Problematization** | **Interessement** |
| This is where the macro-actor defines the interests of other actors that are consistent with their interests (Rhodes, 2009, p. 6). | This is a process where macro-actors employ devices to convince actors to accept their point of view through translating, compromising, and persuasion (Rhodes, 2009). |
| **Enrolment** | **Mobilization** |
| This involves "creating a body of allies, human and non-human, through a process of translating their interests to be aligned within actor-network" (Walsham, 1997, p. 469). | This advocate for a commitment to problematize cause of action (Rhodes, 2009). The legitimacy of the macro-actor is highly emphasized. |

narratives about farmers' experiences could only be obtained by interacting with farmers in the Grameen CKW project.

## The Case: Grameen Foundation Community Knowledge Worker (CKW) Initiative

Grameen Foundations' goal is to help the world's poorest reach their full potential, through connecting their determination and skills with the resources they need. Grameen Foundation's Community Knowledge Worker (CKW), launched in Uganda in 2009, serves farmers in remote communities through a network of peer advisors. The initiative combines mobile technology to help smallholder farmers get accurate and timely information to improve their businesses and livelihoods. Smallholder farmers in Uganda often have low literacy and lack access to relevant information that can help them make informed decisions to improve their livelihoods.

Grameen Foundation saw the proliferation of mobile phones in Africa as a way to get information and services to and from poor communities in rural Uganda who would otherwise never have had access to this information.

Community Knowledge Workers (CKW) are trusted local intermediaries serving farmers who frequently lack basic access to up-to-date information on best farming practices, market conditions, pest and disease control, weather forecasts, and a range of other issues. These intermediaries, who are also farmers themselves, use mobile technology to deliver agricultural information both to and from the smallholder farmers. The CKW model is designed to improve farmers' lives by enabling them to get the information they need to improve yields and have broader access to lucrative markets. By creating a network of CKWs throughout Uganda, Grameen Foundation aims to revolutionize agricultural knowledge-sharing and, in turn, improve yields, reduce losses, and increase incomes of poor smallholder farmers in the country. In addition, CKWs collect agricultural information from farmers, providing a vital link between farmers, government programs, non-governmental organizations, and other entities focused on improving agriculture in Uganda and beyond. The phones are powered by batteries that can be recharged in a variety of ways, including solar and bicycle. The phones use their GPS satellite signal to record the exact time and location of each query from a farmer. Adapted from Grameen Foundation (2015).

## Methods

To explore how mobile phones have increased access to farmers' learning, an ethno qualitative study with fifty farmers in Grameen Foundation CKW project was conducted to obtain primary data. The study site was Katerera sub-county - Bushenyi District, a rural populace in western Uganda, where 80% of residents rely on agriculture for their livelihoods. Fieldwork lasted for ten months (November 2015 - August 2016), where in every month, the researchers followed up activities of CKWs and other farmers. There are minimal studies that employ ethnographic approaches in understanding ubiquity and prevalence in practice. Yet, it is essential to investigate how learners associate and interact with mobile technologies on the day to day basis (Wright & Parchoma, 2011). Through interviews, focused group discussions, and participants observations, in-depth insights about farmer's views on how mobile phones have contributed to part of their learning were obtained. Likewise, such qualitative methods helped to observe the actors and available networks in the project. Field interviews lasted between 20 and 55 minutes, and some were tape-recorded. For collective views about how mobile phones supported farmers' activities, focused group discussions with farmers, project leaders, and non-beneficiaries were conducted. Thematic analysis with NVivo software aided the analysis of the field data through code classification themes like uses of mobile phones, key actors in the CKW project, nature of learning, and the impact of mLearning on livelihoods. To check on reliability and validity, several follow up discussions with study participants were conducted through making phone calls, debriefing meetings with farmer groups, and engaging with some farmers on WhatsApp.

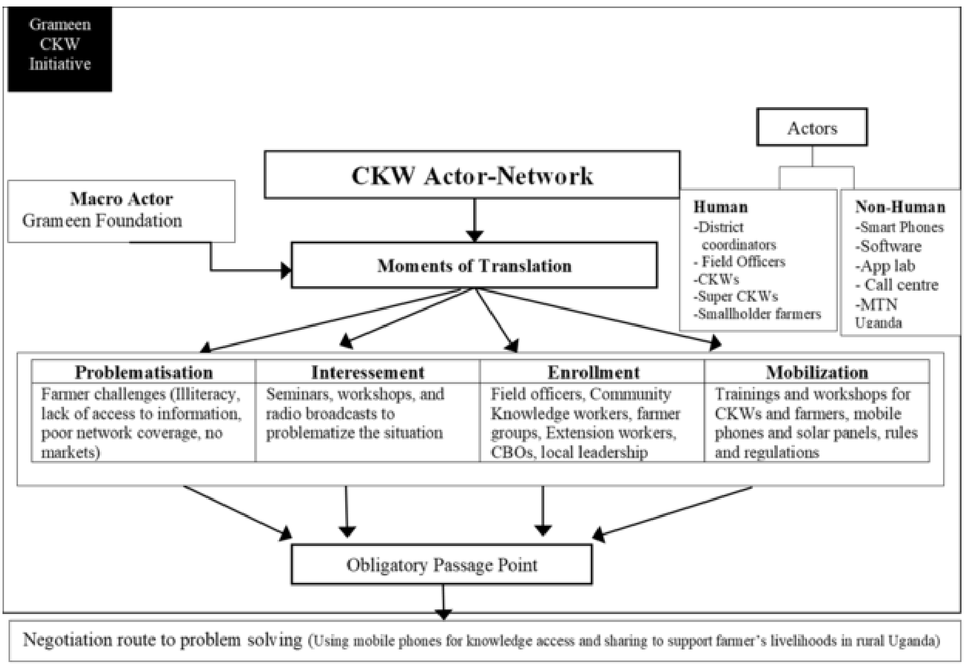
## STUDY FINDINGS

Introducing ICTs like mobile technologies to enhance livelihoods is not just a matter of availing the technology; instead, there must be capacity builders, technicians, and content developers to support such initiatives. ANT does not only explore how networks are formed, but rather, how formed networks fall apart. The Grameen Foundation CKW initiative avails mobile technologies to smallholder farmers in rural Uganda, where access to infrastructure is a challenge. Exploring the networks involved to enhance learning in such an initiative does not only add to the body of knowledge that tries to locate mobile learning affordances for communities in developing regions but guides development practitioners on how to leapfrog mobile learning to smallholder communities. Below is an application of ANT to the Grameen Foundation CKW initiative.

### The Actors

The key actors in the Community Knowledge Worker (CKW) initiative are; Grameen Foundation as the macro actor who negotiated the problem-solving route in the community. Depicted in figure 1, the human actors include the National coordinator, district coordinators, field officers, Community Knowledge Workers (CKWs), and farmers. Among the non-human actors, mobile phones, mobile phone company (MTN Uganda), Google, Grameen App lab, the agricultural content, the solar panels, the technicians, and other collaborating agencies like National Agricultural Advisory Services (NAADS) supported learning on mobile phones. Since ANT avails mega data and numerous analyses, the study focused on mobile technology interactions between CKWs and smallholder farmers. This aided a realistic understanding of the technology adoption process given that these are the primary technology end-users. The CKWs (as educated farmers part of the community) were equipped with smartphones fully equipped with digital content in English. While this appeared an exclusion project targeting farmers with basic formal training, the project was in many ways, mindful of the context given the low literacy levels of many farmers in Uganda. Every month, each CKW worked with a network of fifty farmers through one-on-one meetings and group meetings to share about new farming methods. With the one-on-one sessions, a CKW visited an individual farmer to discuss available farming challenges. In group meetings, twenty to twenty-five farmers discussed a common farming theme under the facilitation of CKWs. These knowledge sharing meetings that were often practical and onsite in the farmers' gardens contributed to learning. Content on mobile phones ignited these discussions and phones acted as digital libraries with regularly updated agricultural information. To further understand the participation of farmers in the mobile learning network, the four translation moments guided this exploration.

*Figure 1. The community knowledge worker actor-network*
*Adapted from (Rhodes, 2009)*




## The Four Moments of Translation

According to the ANT, the four moments of translations are crucial in sustaining any network. Problematisation, intressement, enrollment, and mobilization are critical stages in understanding the operations between human and non-human actors. As depicted in Figure 1, the translation level largely depends on the Obligatory Passage Principle (OPP), an initial phase that forces people to converge to solve a problem (Rhodes, 2009). Here, the macro actor - Grameen Foundation was central in defining interventions that would work to support community livelihoods in rural Uganda. OPP allows local networks to set up negotiation spaces and is central to future operations of any network. Once this initial translation stage is ill-defined, there can be interaction challenges of actors in the network (Rhodes, 2009). Based on documentary analysis and interviews with CKWs, OPP was rightly defined since the project has improved the livelihoods of some farmers. Most smallholder farmers testify an increase in farm yields, better access to markets, and prompt and real-time advice from the CKWs. The CKWs acted as experts in their community, offering free educational advice. *'We were not aware of how to control pests and manage our banana and coffee plantations. All we had was old knowledge yet we had new pests and diseases we never understood. Our plantations were diminishing day by day and yet, no extension officer comes to meet us in our plantations like the CKWs. Thanks to Grameen',* said a rural farmer. Several other farmers showed how the presence of CKWs addressed a felt gap in their communities.

## Problematization and Intressement

Problematization is a state where the macro-actor defines the identities and interests of other actors. Grameen Foundation uses ICTs poor communities have access to, and for Uganda's case, it saw the proliferation of mobile phones as a way to get information and services to and from poor communities. Grameen's initial passage point was to see how its belief in the use of mobile technologies can help poor communities. This observation reinforces the argument that macro actors define problems that are consistent with their operations (Rydin, 2012). The problematization phase started in 2008 when Grameen Foundation with support from other local organizations like NAADs, Mbarara University, and MTN Uganda, conducted community surveys to come up with village translations (problems affecting communities). The challenges identified included inadequate expert agricultural advice, limited access to market information, poor health services, lack of up-to-date and accurate information as most rural populations were dependent on farming as a source of livelihoods (Grameen Foundation, 2015). During intressement, Grameen Foundation employed devices to convince people as actors were persuaded, frightened, and cajoled to join this alliance of interest to solve a problem (Rhodes 2009). Strategies like seminars, workshops, and radio broadcasts to problematize the situation and to strengthen the associations between actors and structures within the network were employed.

## Enrollment and Mobilization

During the Enrolment phase, the CKWs were selected as intermediaries to extend the problematized situation. After the realization that rural communities had less literacy skills, there was a need to identify members who would act as resources to avail up to date digital content. Through community consultations, CKWs were identified and trained to act as change agents. Training in the use of android phones, communication and facilitation skills, content management, and use of the Grameen portal to upload farmers' monthly progress reports were aspects prioritized. Since the trained CKWs were not the only actors to use mobile technology, other farmers in the community were identified. This marked the mobilization phase, where district officers, field officers, and CKWs mobilized farmer groups to join the network. These farmer groups were sensitized, registered, and also equipped with skills on how to use their mobile phones to contact the CKWs for agricultural advice. During the needs assessment, each farmer identified a critical farming challenge he/she needed to address through learning. The intention was to support knowledge sharing and collaborative learning processes between CKWs and farmers. As noted earlier, CKW and farmer interactions stretched beyond activities on mobile phones since learning happened in the farmers' garden. Mobile phones ignited further discussions in the farmers' mLearning network. An essential element in the translation process is the ability to tailor problems to local situations.

Learning in the Grameen CKW project was socially constructed and conversational, where other farmers approached CKWs with mobile phones through making phone calls to address problems at hand. From the findings, although the Grameen foundation has a call centre, fully equipped with resourceful staff, only two farmers called to get information from the call center. To a great extent, farmers relied on the CKWs in their locality, but where the CKWs failed to address a challenge at hand, they consulted the call centre for advice. In all this, we see knowledge access and sharing supported by mobile phones, which contributed to conversational learning. Further, in this project, the CKWs do not only provide knowledge to the farmers but rather, collect information from different farmer groups involved in the network. This local knowledge is later fed in the database to increase the adoption of local farming practices in the CKW network (McCole 2014; Van Campenhout, 2013; Grameen Foundation, 2015). The aspect of local indigenous knowledge was part of the content on mobile phones. This was observed in their face to face meetings were not only content on mobile phones informed their learning but also farmer's experiences with local adaptive measures informed mLearning.

Therefore, aligning smallholder farmer's interests to technological initiatives supports the adoption of mobile technologies, which in turn stabilizes the network. Farmers act well if their needs and interests are aligned to project objectives. Farmers in this project felt impacted by the CKWs activities in the communities. Many improved their productivity, constructed new houses, managed to take children to good boarding schools, and others joined community marketing schemes, credit and saving groups, and farmer associations. A CKW narrated other benefits from the project, stating that "*In 2009 when the project started, a smartphone was no joke. Imagine a solar panel during that time and light in our homes! This Grameen system improved the wellbeing of our households as many of us started charging mobile phones at a fee, registered mobile phone sim cards for different telecommunication companies, and collected field data on mobile phones for many international research students. We have earned a lot from this phone.*". This improvement and change in social wellbeing is indicative of how a felt need for an inactive extension system in the area was addressed with the mobile technology solution. As Latour (2011) emphasizes, aligning community needs is central in sustaining networks. Once farmers see the essence of working with mobile phones to learn about farming, they strengthen and maintain connections in the mobile learning network. There is also a tendency for most technological solutions to have a western orientation where the cultures and values of operators in such projects mimic western driven standards, with less focus on indigenous knowledge (McBride, 2003). Just like Alzouma (2005) emphasizes, some technological initiatives in developing regions are aimed at extending western supremacy and local elitism over the poor communities. In the Grameen CKW project, local knowledge was integrated into mobile content. More so, the project contextualized most provisions to suit local circumstances. Nevertheless, not all went well. The next section explores the socio-technical inferences of the CKW mobile learning network.

## STUDY DISCUSSION

### Socio-Technical Analysis of Smallholder Farmers' mLearning Actor-Network

Evidence from the study findings demonstrates how smallholder farmers' activities equally benefit from mobile technological integration. This affirms that mobile technologies do not only support learning in formalized settings as non-formal and informal learning environments can be supported (Grimus & Ebner, 2013). Previous studies on ICT information needs for smallholder farmers in developing regions indicated the lack of knowledge and information regarding agricultural advice, modern farming ideas, and weather information (Ndiwalana, Scott, Batchelor, & Sumner, 2010; Oladele, 2011). In this study, smallholder farmer's narratives demonstrate how mLearning increased access to information and knowledge that supported their social and economic wellbeing.

In the socio-technical discussion, mobile learning is a social rather than a technical issue (Vavoula & Sharples, 2009). This implies that "technology is as much as a product of social construction as of technical innovation and advancement" (McBride, 2003, p. 267). Farmers continuously construct learning through negotiating knowledge and meaning while interacting with context and technology. Therefore, technologies are just tools used to achieve community interests and as Ingold notes, "technical instruments conduct, but do not constitute socially directed activity" (1986, p. 28). Understanding how learners appropriate the use of these technologies in their day to day activities helps to situate the nature of learning in a particular context (Wright & Parchoma, 2011).

Moreover, humans are social beings who cannot be separated from any development intervention, be it technological. Focusing on technology use in its entirety is failing to realize that technology is to knowledge and skills and not to instruments used (Ingold, 1986). In the farmers' context, emphasis should be on knowledge and skills relevant to support livelihoods and not on mobile technologies alone. It is important to consider mobile technologies as not detached from the users but rather as part of the users. As Ingold points out, "…the relationships between tools and the environment in which they are deployed cannot be considered in isolation from the technologists, the society of individuals who use the tools" (Ingold, 1986, p. 7). We cannot understand mobile learning affordances without looking at how people perceive and create meaning from these technological interactions. The CKWs cherished the fully equipped mobile phones given to them. Many appreciated their use and support in their day to day activities. Explicitly, some CKWs showed how these smartphones elevated their social status in the community. *'This phone made me become someone in this village. I am now respected, and everyone knows how I have farming knowledge on my phone. Even other organizations now can approach me about my advice on how to mobilize people in this village'*, said a CKW. Whereas some older CKWs had challenges in updating the phone's software and uploading field forms to the Grameen system, the presence of organizational support helped in solving such technical problems. This signified some level of contextual preparedness on the part of the project: a justification of adoption and use of mobile phones by CKWs.

Further, in analyzing the socio-technical elements of mobile learning, it is essential to explore how social processes among farmer communities unfold. Ingold argues that "social structures unfold in purposive action" (Ingold, 1986, p. 28). The degree to which an innovation will be consistent with the existing values and the needs of the actors will determine the level of technology adoption (Rogers, 1983). Technologies alone cannot create impactful changes; understanding technological processes in the light of the technology users (farmers) can support livelihoods. Questioning about how and for what people make use of the mobile technologies instead of asking what mobile technologies are availing to such communities (McBride, 2003) should be at the back of our investigative roles. In the CKW project, it was clear that the farming content on mobile phones was tailored to addressing part of the socially directed farming needs. Most farmers in the project were coffee and banana growers who engaged in other livelihood activities. Therefore, in consideration of what mobile learning offered and its impacts on communities, it should be noted that additional support like the use of experts who occasionally monitored farmers' activities also supported this learning. Besides, the availability of experienced role model farmers and educated youths were essential social structures that complemented farmers learning on mobile phones.

This, however, does not mean to imply that all went well with mobile learning in the farmers' network. While mobile technologies are touted tools that require less infrastructure, there were available narratives about how mobiles constrained learning. For instance, the available technical, social, and network-related challenges affected mobiles use for learning. Technically, mobile phones broke down due to fragility and breakage in the phone charging systems. Socially, the increased phone theft and the fact that some farmers were not using knowledge shared affected learning. The network challenges related to inadequate network coverage and intermittent internet connections in some places. Although the mobile phones were designed to operate in low network zones, some CKWs found it challenging to upload field forms and update agricultural content. These however, were handled by the Grameen team through available quick response systems to ensure that CKWs extended knowledge to farmers. Reflectively, to explore how established mobile learning networks can continuously empower farmers, the sustainability of Grameen Foundation as an international NGO that relies on donor aid to support CKW activities is questionable. International agencies fund most mobiles for development projects, and once funding stops, such projects operations end (Grimus & Ebner, 2013). Truthfully, some national governments in Sub Saharan Africa have not embraced the mainstream operationalization of mobile technologies; despite the opportunities such technologies offer the region (Ibid). Perhaps, deliberate efforts to advance mobile integration in service delivery can motivate national governments to sustainably support mobile for development initiatives.

Whereas the study prioritized the use of ANT, several critiques have been leveled against its application. Firstly, ANT fails to offer an exploratory framework that can guide social variations, it does not give explanations or a consistent perspective for research guidance, it focuses less on causal explanations with a profound emphasis on repertoire, and lacks a consistent methodology that guides analysis (Mol, 2010). These same critiques can also offer opportunities for using ANT. For example, because it does not propose a consistent procedure to follow, the theory provides opportunities for researchers to appropriate their studies differently; and more so, tailor them to their contexts. "ANT art is not to repeat and confirm, but to seek out cases that contrast with those that came earlier" (Mol, 2010, p. 261). To counter this limitation, smallholder farmers in the Grameen project presented a unique setting that required unfolding events, relations, and phenomena enacting processes of both human and non-human actors. Secondly, ANT has been criticized for producing mega data which generates weaker analyses (Mol, 2010; Rhodes, 2009). While this might be true, for this paper, the aim is to identify the key actors in the CKW initiative and how the theory offers thresholds for understanding how mobile phones can increase access to learning for farmers. This analysis was delimited to exploring networks and relationships among smallholder farmers and the community knowledge workers' mLearning actor-network.

Similarly, Wright and Parchoma (2011) question the experimental proofs of mobile learning studies as the majority are marked by control experiments where researchers appropriate their devices to communities and exclude those (devices) owned by the people. The Grameen project, for example, equips CKWs with android phones to effectively deliver the educational content to farmers. On this same note, Herrington and Herrington (2007) suggests that mobile learning platforms should not be arenas where educators revert to old pedagogies as they come to integrate new technologies in their teaching and learning activities. To counter this position, challenging mobile learning research in controlled experiments is to limit ourselves to not foreseeing the restrictions of following up learners informally. While there is a need to reconsider technologies owned by communities, in some instances, issuance of better tools to extend support is justifiable. In this study context, CKWs and farmers also used their personalized phones to support learning processes. Further, this experimentation of mobile learning unveils analytical strategies regarding the implementation of mobiles for development initiatives before being tried out in other settings.

Suggestively, in resource-constrained environments where accessibility to technological equipment is still a challenge, availing devices to those out of reach is ethically permissible. And above all, mobile learning for development is a relatively new field. Experimenting mobile learning activities among smallholder farmers contributes to the indigenous theorization by suggesting context-specific insights (Davison & Martinsons, 2016). The Grameen project is a controlled experiment of mobile learning activities that has impacted farmer's livelihoods. The project is a critical case of how mobile technologies are aligned to the interests of the farmers who support one another in the learning network. Insights from the study findings can be generalizable to other smallholder farmers communities with similar cultures.

## CONCLUSION

The advent of new ICTs like mobile technologies offers a chance for Africa to exploit the learning benefits that can be afforded by mobile technologies. Researching mobile learning among smallholder farmers in developing regions is to realize that mobile technologies offer learning spaces that can address livelihood challenges. Mobile learning allows learning to take place in the learners' context, facilitates collaboration, and people centredness. The paper has employed the Actor-Network Theory to explore the project translation moments of problematization, intressement, enrollment, and mobilization and how they facilitated learning on mobile phones. ANT has the potential to refocus, reframe, and re-problematize the already established networks. The increased emphasis on diffusion of innovations and the hurried leapfrog of ICTs to work for the poor and contribute to economic development has led to many ICT projects end up as trajectory failures. The Actor-Network theory offers possibilities of intervening and unpacking the taken for granted assumptions that once the technologies are appropriated, they will lead to change in livelihoods. This paper advances the discussion that introducing ICTs like mobile phones to support smallholder activities is not just a matter of availing the technology. It is vital to consider the primary needs of the actants in this network and most importantly, to appropriate contextualized technological initiatives. To ensure sustainable impacts of most ICTD projects, there is a need for actors to work together collaboratively, negotiate different realities, and understand the local challenges communities face in trying to enhance their livelihoods.

The Grameen Community Knowledge Worker initiative reports successes in supporting rural livelihoods. Based on the study findings, it is evident that some smallholder farmers in the project are reaping benefits from the project, although farmers not part of the project claimed to have missed such opportunities. The socio-technical aspect of the CKW actor-network makes the project profound. And to ensure that mobile technologies contribute to learning for all, new initiatives need to be pro-people, where smallholder farmers' needs are central considerations in learning. Outstandingly, the projects' reliance on donor support questions the sustainability of farmers mLearning actor-network. A comprehensive exploration of CKW activities in already established CKW actor-network when donor support ends will be paramount to analyze the stability of the mobile learning networks.

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# "If you take away my phone, you take away my life..." Community Narratives about the Social Implications of Mobile phone Usage for Livelihood Security

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**Abstract.** Smallholder farmers in developing regions like sub-Saharan Africa still grapple with development challenges like poverty, illiteracy, food insecurity, poor infrastructures like roads and limited access to learning opportunities. Moreover, amidst all these challenges, these possess mobile phones as they continuously engage in diverse livelihood activities. Echoed in previous research, mobile phones are the most diffused technologies available in many rural communities. Yet, most mobile technological interventions are urban-based projects neglecting rural locales in harnessing mobile phone usage. More so, mobile for development research uses quantitative methods which limits proper interrogation of real perceived social implications of mobile phones for livelihoods. Thus, this study, with a more qualitative approach, seeks to understand community narratives about the social implications of mobile phone usage for livelihood security. Findings suggest the increased penetration of small end phones, with few smartphones. Noticeable social benefits include improved communication, financial inclusion, employment opportunities, increased business and market opportunities, increased access to information sharing and improved literacy practices. Conclusively, access to learning on mobile phones was an outstanding social benefit, amidst the presence of negative and dissenting voices about mobile phone use, fully embedded in cultural and religious beliefs within societies.

**Keywords:** Mobile phones · Social implications · Livelihood security · Smallholder farmers

## 1 Context

Smallholder farmers in developing regions like sub-Saharan Africa still grapple with development challenges like poverty, high population growth rates, illiteracy, food insecurity, poor health systems, poor infrastructures like roads, lack of access to electricity and most importantly, limited access to learning opportunities [1–3]. Moreover, amidst all these challenges, most smallholders especially those in rural communities have prioritized the possession of mobile phones compared to other available technologies as they continuously engage in several activities to secure and


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sustain better livelihoods. As noted by Furuholt and Matotay [4], the most widely spread Information and Communication Technology (ICT) across the world today, including developing regions, is a mobile phone. Highly documented as the fastest technological diffusion in communication history [5], mobile phones are easily accessible and can support African communities in accessing actionable information that can support adaptation for better livelihoods [6].

Significant and previous studies about the impact of mobile phones [7–11] undoubtedly show how mobile technologies are among means to leapfrog most sub-Saharan Africa states to the next-level development. However, there exists limited literature on how rural smallholder farmers' possession of mobile phones supports their livelihoods. In their study about how mobile technologies impact economic development in sub-Saharan Africa, Crossan and others found how most mobile technologies projects were mainly urban-based [10]. This broadens the digital divide; yet, ICTs like mobile technologies are among means to bridge this digital divide [12] and support those in rural locales. Thus, the potential of modern technologies to avail information access to such communities to act for secure livelihoods is an option worth understanding.

Today, we live in a 'hugely mobilized world as estimates put mobile subscriptions at more than 6 billion globally, with at least 75% of these being in developing countries' [13, 14]. In 2017, 5 billion people were connected to mobile services, where growth in the sector was driven by developing countries in sub-Saharan Africa [15]. The emergence of the connected mobile society with numerous information sources available at work, home, community and schools has arose considerable interests from educators and technical providers to exploit the capabilities these mobile technologies can offer for the new and engaging learning environments [16]. In developing countries like Uganda, there is an increasing trend in mobile phone ownership at 70.9%, with a significant increase at 65.7% in rural Uganda. This hype in mobile phone ownership (depicted in Fig. 1) offers a better justification for this study to explore and analyse how mobile phones impact on smallholder livelihoods in rural areas.

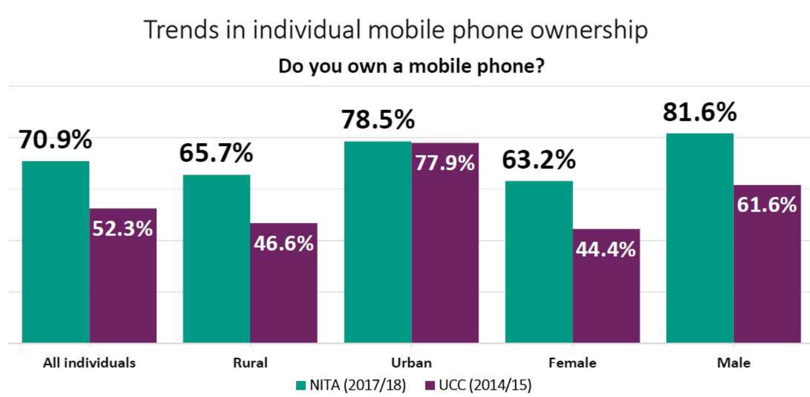


**Fig. 1.** Trends in mobile phone ownership in Uganda 2017. *Source* NITA [17]

Therefore, in this paper, community narratives of the social implications of mobile phones as contribution to their livelihood security are discussed. Current research on 'mobiles for development' focuses on mobile phones' impacts on farming, animal husbandry, availing market information and sharing weather updates; neglecting other social attributes, mobile phones extend or afford to rural livelihoods. Moreover, most of these studies exploring mobile phones' impacts employ quantitative survey methods which limit further interrogation of the real perceived usefulness from those using the technologies. More so, there is less exploration about the dissenting views and negative implications of mobile phone usage among rural livelihoods. Thus, this study seeks to understand the nature of mobile phones available in rural communities, and analyses the social implications of mobile phones for livelihood security in a developing country's context of Uganda. The rest of the paper discusses livelihood security, the concept of smallholder farmers, and engages with the study findings about the social implications (both positive and negative) of mobile phone usage among smallholder communities. A methodological section that discusses the mobiles for development projects and the nature of mobile phones possessed by the smallholder farmers then follows. The paper ends with a conclusion that situates the need for communication, access to learning on mobile phones, and mobile money financial transactions as outstanding social benefits, amidst the presence of negative and dissenting voices about mobile phone usage.

## 2 Livelihood Security

Development literature mainly situated in studies of poverty and rural development has had a different meaning of the term livelihoods. To begin with the English thesaurus dictionary, livelihoods denote the 'means to earn a living'. This implies a way of survival or a way of managing to exist and achieve the basic necessities of life like food, shelter and health.

Being considered 'a mobile and flexible term, "livelihoods" can be attached to all sorts of other words to construct whole fields of development enquiry and practice. These relate to locales (rural or urban livelihoods), occupations (farming, pastoral or fishing livelihoods), social difference (gendered, age-defined livelihoods), directions (livelihood pathways, trajectories), dynamic patterns (sustainable or resilient livelihoods), and many more' [18].

This shows how the term has been used in different development literature to capture different categorizations of resources, people and also occupations. Chambers and Conway [19] define livelihoods as capabilities, assets (in form of stores, resources, claims and access) and activities required to earn a living.

In this paper, by livelihoods, I imply 'the activities, the assets, and the access that together determine the living gained by an individual or household' [20]. More literally, the diverse activities people engage in to sustain a living and secure a socially and culturally acceptable way of living. Hence, the notion of livelihood viability is not only limited to survival and earning basic human needs but rather looks at the totality of how households survive both in the short term and long term. This ability to survive is livelihood security. In relation to mobile technologies, mobile phones are tools used to help people attain livelihood viability. The essence lies in understanding the role of technologies in responding to peoples’ livelihoods options to enhance livelihood security.

Livelihoods in rural communities imply diversification, that is, ‘rural families tend to adopt survival strategies composed of a diverse portfolio of activities that cut across orthodox economic sectors and transcend to rural urban divide’ [20]. Their livelihoods tend to take the form of ‘an asset-access’ of activities where rural communities tend to cope with different circumstances as presented by the different shocks. Most smallholder farmer communities are vulnerable to many shocks, and this explains why most tend to engage in several livelihood activities. The potency rests on their ability not only to cope but rather stay resilient.

## 2.1 Smallholder Farmers

Smallholder farmers’ livelihoods, especially those in rural communities of many developing states, are dependent on agriculture as a predominant activity. Agriculture (mainly crop and livestock) is the most important livelihood strategy and the primary source of income [21]. In the bigger global picture, smallholder farmers in sub-Saharan Africa and Asia occupy 70–80% of the total global farmland, producing 80% of the food that is consumed in developing countries [22, 23]. Smallholders ‘play a crucial role in supplying food to the continent’s population and bringing about economic transformation in rural areas’ [24]. Women smallholders account for 50% of the agricultural labour force of developing countries, and thus, they offer productive resources as men to the different farmlands [23]. This therefore makes it opportune for the agriculture development strategy to invest in smallholder agriculture [25] worldwide. Most smallholder farmers engage in crop farming, livestock and fisheries, and some in export markets depending on the activities, ecological zones and availability of strong bridges and networks within their communities.

In Uganda, most communities are dependent on agriculture both subsistence and commercial. Agriculture contributes to 45% of GDP and supports 75% of the labour force [25]. In the country, over 75% of the agricultural sector is dominated by the smallholder farmers who largely grow at subsistence level as their composition is two-thirds of those engaged in agriculture for livelihoods. The agricultural sector has a development contribution to poverty reduction than non-agricultural growth given its strong linkages to the rural economy and the fact that it supports 80% of many livelihoods in developing regions [26]. In spite of the above observation, smallholder farmers, everywhere, are struggling for their survival as their livelihoods are greatly hampered by poor government policies and practices that are unresponsive to their needs [24]. Disenabling are the diverse weather conditions like droughts, floods, hailstorms and heavy rains given that smallholder agriculture is heavily dependent on rainfed cultivation [27]. Despite smallholder farmers being diverse groups, for this study, rural smallholders were a focus. This means interactions were with smallholder farmers in rural areas, mainly in western Uganda in the districts of Bushenyi, Ibanda and Kabale, majority in crops farming, apiary, with few livestock activities. Most crops were subsistence in nature like banana, cassava, potatoes, rice, millet, vegetables and maize, with some engaged in cash crops growing like coffee and cotton. Other farmer groups also engaged in export activities. For example, in the USAID CC projects, some farmer groups through Ibanda District Apiary Association exported local honey outside Uganda. The next section offers a further description of the multiple case sites of the 'mobiles for development' projects in Uganda.

## 3 Methodology

This study was conducted in western Uganda in three districts of Bushenyi, Ibanda and Kabale between July and December 2016. In these districts, parishes' characteristics of rural locales were purposefully selected, in an attempt to explore how mobile phones impacted on rural livelihoods. A qualitative study through an interpretivist and social constructivist perspective from multiple case studies of three mobiles for development organizations, that is, USAID Community Connector (CC) project, Grameen Foundation Community Knowledge Worker (CKW) project, and Lifelong learning for farmer (L3F) project, was adopted (as shown in Table 1). Six (6) Focused Group Discussions (FGD) with smallholder farmers, both men and women, were used to understand the general community narratives about the social implications of mobile phones' use. More so, given the fact that rural locales are busy, to generate personalized narratives, the study sought to employ forty (40) interviews including key informants, farmers in the case organizations and farmers outside organizational activities. The latter was to analyse how other farmers outside projects' operations were using mobile phones. Participants' observations were used in identifying the actual possession and use of mobile phones by the study participants. In total, 70 participants were a representative sample in a purely qualitative study given emphasis on thick data with socially constructed analyses in a multiple case study approach. NVivo tool aided the analysis of the field data through code classification themes like nature of the mobile phones, benefits of the mobile phones, problems with mobile phones to society and the social experiences about mobile phones in rural areas. For reliability and validity, several follow-up discussions with study participants were conducted. Also, given that some farmers had smartphones, continuous interactions on WhatsApp supported better understanding of mobile phone use for livelihood security.

**Table 1.** Mobiles for development organizations

| | Grameen Community Knowledge worker | USAID Community Connector | L3F (Lifelong learning for farmers) |
|---|---|---|---|
| Macro Actor (Funder) | Grameen Foundation | USAID Feed the future (FTF), and Fhi 360 | Common Wealth of Learning (CoL) |
| Project Goal | Help the world's poorest people reach their full potential, through connecting their determination and skills with the resources they need | Improve nutrition and hygiene, increase access to more diverse and quality foods, increase household assets and incomes. | Responds to a critical need that enables farmers to use ICT—particularly mobile technology—to access information |
| Approach | District project officer<br>CKWs<br>Super CKWs | Community Connectors, CKWs<br>Service providers<br>Grants to groups | Innovative platform leaders<br>Self-help groups<br>Small loans to groups |
| Nature of engagement | One-on-one meetings<br>Group meetings @ 50 farmers<br>Call centre | One-on-One meetings<br>Family health schools<br>Nutritional sites<br>Saving with a purpose<br>CC10 s | Personalized messages (text and audio messages)<br>Trainings<br>Horizontal learning<br>Call centre |
| Mobile phones | Smartphones | Smartphones | Small end phones |
| Livelihood activities | Farming mainly in Coffee, Banana<br>Data collection<br>SIM registration | Farming (nutritional crops), savings, Apiary, poultry | Farming (Irish, Banana, Grapes)<br>Marketing, value addition, credit activities |
| Case study sites | Bushenyi District (Katerera sub-county) | Ibanda District (Kicuzi sub-county) | Kabale (Bubaale sub-county) |
| Partner agencies | National Agriculture Research Organisation (NARO)<br>MTN Uganda | Self Help Africa<br>BRAC<br>Mbarara University | Agriculture Innovations Systems Brokerage Association (AGNSBA) |

## 4 Findings and Discussion

Findings from this study point to an increase in the penetration of mobile phones in most rural areas, citing the availability of network infrastructure and the fact that it is a social issue for one to have a mobile phone. Relatedly, the most mobile phones used by many smallholder farmers are small end phones (traditional non-smartphones), with limited penetration of smartphones. The available smartphones among the rural farmers are mainly those given to different change agents from various organizations using mobile phones for development-related activities. Also, youth farmers (below 25 years) possessed smartphones and occasionally visited online platforms mainly Facebook and WhatsApp for socialization and search for weather and market updates.

## 4.1 Social Implications of Mobile Phones

Many rural livelihoods are built on their ability to engage in a multitude of activities. They cannot just take part in one activity and survive. Thus, mobiles for development initiatives ought to appreciate the diverse portfolio of activities smallholder farmers engage in, as a way to suggest solutions and targets that benefit both organizations and the rural people. Limiting them to a single livelihood activity is unrealistic as their livelihoods are determined by several engagements in diverse economic and social activities. This realization will reduce frustrations from both and increase ways on how projects can be responsive to rural frame of activities. In this paper, therefore, the mobile phones were looked at as tools to help people expedite livelihoods in totality.

In analysing the findings from the study respondents, some of the social benefits of mobile phone use including communication-calling friends and relatives, learning about farming, elevation of the social status, employment, mobile money transactions, socializing and meeting friends, and increased productivity. Figure 2 shows an NVivo node analysis extract about the positive benefits of mobile phones' use in rural communities. Each benefit is further expounded below.

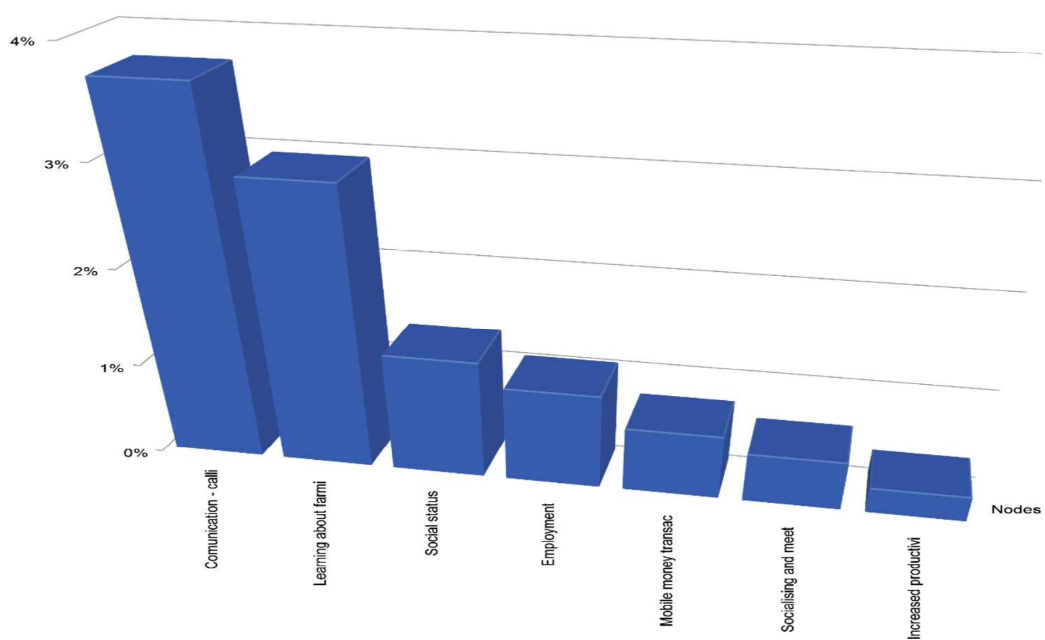


**Fig. 2.** Benefits/uses of mobile phones' NVivo node extract. *Source* Field data

Mobile phones, as pointed out in previous literature, have to a bigger extent facilitated communication. All farmers attested to the fact that they wanted to stay connected with their relatives and friends. This staying in touch was not only limited to people away or abroad, but also to those in the same locales. Even when the phones helped in contacting one another for meetings, it was evident that many people did not use their airtime to contact neighbours. Other local channels of communication were still relevant and majority would meet up in mobile markets, at shops in the evening and at special occasions like weddings, burials and at funeral rites to pass on information. Most calls targeted people outside these communities, especially relatives and friends who worked in town centres, countryside and abroad. This staying in touch was linked to know the health status of the family, general household well-being, as well as managing farm produce.

The phones were considered to have increased farm productivity, through facilitating marketing channels. Farmers would call to find out and negotiate prices of different food items and farm inputs, whilst selling their products to local and external markets. This, in turn, lessened travel costs, thereby increasing farmers' incomes since middlemen (brokers) exploitation was reduced. Financial transaction through mobile money was an essential benefit which the mobile phones extended to such rural areas. Most farmers saw a mobile phone as a bank. For example, most farmers and small savings groups in different villages saved returns on their mobile money accounts. In particular, woman saved on mobile phones to hide from male/husbands' exploitations in case of small personalized savings. The marketing and financial phone capabilities were so significant and like one smallholder in Kabale exclaimed, '*if you take away my phone, you take away my life*'. Another from Kabale town said, '*I feel disarmed without my mobile phone. My phone is my business*'. This shows how some farmers personalized their mobile phones and the magnitude of relevance to their day-to-day activities.

Such personalization was related to how the phones were viewed as tools to enhance and uplift ones' social status. First, for some farmers, it was a 'social fit' to own a mobile phone, thus a social good if one needed to earn respect among peers. Even when one did not have people to call or connect with promptly, their satisfaction was to own a personalized mobile phone. Thus, owning a mobile meant power which in turn earned ones' respect in the community. On the same note, the CKWs who were given smartphones felt empowered within their villages as the mobile phones came along with solar panels, chargers and the solar bulbs which improved their households' well-being. In a focused group discussion, Kato, a CKW narrated that '*...being given a smart phone in 2009 was no simple business to my life. I felt respected and am telling you; this phone has changed the way people look at me. I am considered a respectable person with knowledge on my phone, an educator, and a role model farmer. In this village, other organizations now consult me about mobilizing people and the community looks at me as a key resource. Thanks to Grameen for this opportunity'.* All CKWs felt the mobile phones and other supporting equipment impacted not only the community but also their general household well-being.

Additionally, mobile phones increased employment opportunities given the presence of many mobile phone-related business stalls in different rural towns. In all the study case sites, there were visible mobile phone shops ranging from selling airtime- and phone-related accessories, to availability of mobile phones' technicians. The mushrooming mobile money outlets also availed employment to youths who offered guidance to illiterate farmers to complete financial transactions. A jolting benefit was that mobile phones also acted as safety nets—through acting as security in case of no money. For example, one would use a mobile phone as an asset to get urgent money (in the form of a loan) from moneylenders and friends. More so, mobile phones were used as the main source of light at night for households with no solar lighting. Because the villages did not have electricity connections, mobiles were seen to support retail shops activities and other night transactions. Thus, mobile phones' benefits were incredible in such a rural community.

With the presence of 2G and 3G network coverage, mobile phones supported access to weather and market information. CKWs and some youth farmers with smartphones accessed Internet which allowed access to the weather and market information online from agricultural agencies. This benefit was, however, limited to the educated farmers since it required knowing what site to visit to access the updates. Also, Internet access meant buying mobile data packages to access actionable information which hindered majority. But other farmers with no access to smartphones and data would benefit from such updates given the social networks that existed within communities. Through their different groups, CKWs would alert farmers about the available updates for immediate action. More so, some CKW groups had a marketing strategy where farmers pooled food items and sold at a higher bargaining power which improved profits.

Access to learning on mobile phones was an intriguing social benefit mentioned by most smallholder farmers. As noted by Bhatnagar [28], ICTs have supported literacy practices, especially among the poor rural women in most developing countries. This was noticeable in specific households where mobile phones helped some farmers exercise reading and writing skills, thereby supporting literacy practices. Interestingly, as noted by one farmer, '*… even when the mobile phone is in English, I can write and send messages in my local language. Before I used to fear sending messages. But with time, I managed to learn by myself through doing it*'. This depicts some confidence building and an aspect of learning to read and write. Quite notably, in this study, the three mobiles for development projects all aimed at extending actionable information to smallholder farmers; thus, by implication, the mobile phones farmers used were learning resources.

For mobile phones as learning resources, both smartphones and small end phones had different functionalities and capabilities they afforded to farmer communities. To begin with the small end phones, farming-related information was shared through local dialect, which eased translation. Each farmer who was registered in the L3F—Lifelong learning for farmers programme was sent both audio and text messages on matters pertaining to farming. This information exchange based on farmers needs and thus, it was in line with the farmers' enterprise. While the approach of using the traditional phones seemed an option for project sustainability (that is, using the locally available farmers' traditional phones), the content shared was rather limited. Farmers who got access to this information shared with other farmers which supported horizontal learning—an aspect where the farmers shared information at the same level, highly integrated into their day-to-day activities. The Grameen and USAID CC projects gave farmers smartphones fully equipped with farming information. The smartphones were connected on a satellite and each local farmer—termed Community Knowledge Worker (CKW)—had to work with a network of other 50 farmers in order to engage with the actionable information on the mobile phones.

The most vantage point is that 'as technology becomes cheaper and more powerful, mobile phones provide an affordable platform to access data. Speech interfaces can reduce the required skills, literacy being one of the biggest impediments to access existing data’ [29]. The availability and willingness of ‘significant others’ within the social network support use of mobile phones [29]. For example, even when some people did not know how to use mobile phones, the presence of a relative, friend, neighbour or child was a reinforcing factor for adoption and use of the technology. The use of locally available phones owned by farmers was also a sustainable option in ensuring how mobile phones can facilitate inclusive learning for all. This is especially relevant when thinking of advancing the use of locally available assets to work for the poor. Thus, the need ‘to identify what people have rather than what they do not have’ [30] can be a facilitating factor to advance sustainability of most technology-related initiatives in developing regions. Such a realization strengthens farmers own available resources, rather than substituting, blocking or undermining them [20, 30].

The point to take from this discussion therefore is that both smartphones and small end phones had implications to practice. While it looks justifiably right to agitate for locally available small end phones farmer communities owned, their use for learning was rather limited. On a small end phone, you hardly shared content of more than 30 characters, hence, limiting learning affordances. Besides, in rural areas, many people are still illiterate which justifies the use of significant others to support information–knowledge sharing processes. For L3F, the challenge was to envisage contextual ways of reaching out to the illiterate farmers through voice messaging, which to the project key formants was also costly and unsustainable. The cost of content production was high given the diversity of tribes in Uganda with over 65 languages, which makes it so hard to categorize a region based on a single language. As the key informant from L3F quipped, ‘*…This is one of the biggest problems we are still facing as L3F. You realise that we still need to reach out to a particular category; but because of many languages to translate, not all farmers are reached*’.

Therefore, ‘rather than assuming Information and Communication Technology will always be cost effective and yield a better outcome, a more nuanced understanding of underlying institutional environment and constraints is warranted’ [31]. Such institutional barriers can encompass structural and contextual barriers from within which the smallholder farmers interacted with the mobile phones. For example, cognitive barriers as suggested by [32] also affected the use of mobile phones. Many rural people lacked literacy skills, with limited/no English language command to help them navigate through the mobile applications with ease. This meant that such communities had to reply to those with basic grounding in English. Thus, responding to contextual challenges is the aspect we need to surmount if we are to take mobiles to the next-level discussion that can be inclusive of rural community groups like smallholder farmers.

On the other hand, irrespective of the contextual challenges, the smartphones given to farmers also raised sustainability implications. For example, even when the farmers (CKWs) identified that they had some English training, the approach of facilitating them through staying on the network and giving monthly volunteer allowance raised sustainability questions. At present, most Grameen CKW and USAID CC projects have closed and because of no facilitation in the form of airtime and monthly allowances, very few CKWs still reach out to other farmers. From a focused group interaction with the CKWs, most of them felt uncertain about the sustainability of these projects. One super CKW at Mitooma parish echoed ‘*...we are over 100 CKWs trained and given smart phones with relevant actionable farming information. But, where will the cadre* *of generated knowledge workers go when all the CKW projects close down'*? The CKWs started feeling this gap in fear of the next-level interactions with the different farmer groups. Nonetheless, the few CKWs who continued to reach out to other farmers are CKWs whose groups had income-generating activities in the form of marketing their produce. Thus, a central livelihood activity was a network node that tied these farmers together irrespective of Grameen or USAID support.

The livelihood enterprises were also connected to social bonds and ties a group had, and thus social capital was central in supporting farmer interactions on mobile phones. Mobile technology affordances have supported the socialization of farmers which in a way has widened social networking among those involved in the mobiles for development network. This supported collaborations among peers which in turn enhanced joint and coordinated problem-solving. This type of collaborative problem-solving supported by mobile devices increased farmers' motivation, engagements and interactions in their community of practice. Like Putman notes, organizational structures that build on horizontal linkages will increase trust and cooperative relations necessary to strengthen social capital, better than organizations that use vertical hierarchical linkages [33]. On the other hand, there is a likelihood of social capital breeding negative bonds. In this study, while mobile phones supported social interactions within farmer communities, their continuous usage also exhibited some negative bonds as presented in the next section.

### 4.2 Negative Social Implications of Mobile Phones

As technologies become part of everyday practice, they posit implications which in turn make not all people embrace them. Indeed, 'If you are pointing to the wrong direction, technology can help you to get there' [31]. Technologies have come with disruptions to society, which if well not thought about; soon or very later, we might be crashed by it [34]. One thing about technology is that it is never neutral. 'People will either love it or loathe it' [35]. People will always have different perceptions about a technological intervention, and this explains the need to understand people's perceptions of mobile phones' use in a wider livelihood discussion. Majority will have different expectations about such technologies and strive to relate them to their experiences and just like [35] notes, some technological interventions can change peoples' mindset where they can become open to more external influence than environmental influence.

The negative social implications depict how mobile phones have been a distraction to society. To begin with, mobile phones have facilitated and increased burglaries and theft in different areas, supported murder activities, vandalism, thereby threatening peoples' safety within communities. A significant number of respondents echoed how mobile phones had affected marital relationships making attribution to increased marriage breakdowns in their societies. Dissenting narratives from few people about why they did not possess nor use mobile phones was also relevant for this study. '*if you want to ask how mobile phones are associated with increased crime rates, go ask any police officer in that nearby police station to tell about the mobile phones related cases registered everyday*' said a respondent in Katerera town. While the study main intention was to focus on only smallholders, when it came to what people perceived as dangers from mobile phones, I was prompted to meet the local area village police post as an aspect of triangulation. Mobile phones have declined the stocks of social capital as people are increasingly becoming suspicious about the nature of calls they receive. A married smallholder, for example, had reservations buying his wife a mobile phone. To him, the mobile phone raised a lot of suspicions and he was not only comfortable with leaving his wife with a mobile phone but also the wife receiving calls from other strangers not known to him. This observation cut across as most marrieds felt uncomfortable with who was calling who. Actually, like one observed, ‘*...what I have seen in my friend’s household, I do not want it to come to my house. The phones have caused marital challenges and that is why even at church today, the young couples are advised by the church leaders not to peep or read the others’ messages ...*’ said a senior farmer. This shows how mobile phones’ interactions have caused suspicion even among family members, a justification as to why people (even married) have resorted to creating passwords in their phones—all aimed at limiting access of use.

More so, in rural communities, many people are tied to their cultures and religions. Once technologies like these come up, not all will embrace such innovations as some religious and cult groups did not embrace mobile phone usage. An interesting observation from this finding is that while mobile phones are thought to help rural communities in addressing development challenges, some individuals and groups do not embrace their use given their cultural and religious beliefs, expressed in their increased rigidity towards technology integration in day-to-day activities. In fact, many felt, such newer technologies are coming to destroy humanity. A religion named ‘Abazukufu’ (literary translated as ‘the awakened’) does not believe in any computerized related services. To this religion, ‘technologies like mobile phones are evil and highly satanic with codes of 666’. Such groups therefore dissociated themselves with all activities on the mobile phones as they did not possess any. In informal interviews with 10 participants from this group, only two youths used mobile phones, radios and televisions. Majority relied on traditional means of communication to meet one another and to stay in touch.

Apart from this sect, others felt they need not use the mobile phones since they have caused trouble to many lives of those who use. The other non-use was also associated with gender where men stopped their wives from owning mobile phones. Although some farmers did not own individual mobile phones, they embraced their use through social networking. On a controversial note, others cited some health implications about the use of mobile phones. Like one respondent echoed, ‘*mobile phones have an effect on our health. Women and men put them in the bras and in under wears respectively for fear of being stolen. You can imagine breast-feeding mothers keep their phones next to their breasts and even breast feed while phones are next to the heads of their little ones*’. This disgruntled old farmer cautioned how the poor use of mobile phones had health implications and that people need to be sensitized about good use of mobile phones. This ‘my device, anywhere and at any time’ is coming with implications to human health. There are numerous ongoing viral messages citing dangers of mobile phones ranging from crashing, bursting, triggering road accidents, to causing cancers.

Similarly, the increased penetration of mobile phones’ use presupposes mobile phone masts (base stations) that come with radiation. Thus, ‘people close to mobile phone masts frequently report symptoms of electromagnetic hypersensitivity such as dizziness, headaches, skin conditions, allergies, and many others…' [36]. In Uganda, the mobile phones and many telecommunication masts might be the cause of many unknown cancer cases today. In both rural and urban town centres, the mobile phone masts are living with people, and every day, we take up the share of these ultrarays. Unlike in European states where masts are far away located from residential places, in Uganda, because of lack of space, dire need for bigger moneys and technology investments, we live and stay close to masts day by day. Now, who is there to help people understand such health implications? We do not know, we do not bother, neither does government advise about such health implications. Yet, mobile phones have an implication to the general environment and the totality of human well-being [37]. Therefore, we ought to be conscious about such bad health implications which in turn questions livelihood security in the long term.

Digital technologies such as mobile phones can have radical and disruptive effects for society as well as individual organization [38]. They present both capabilities and consequences to society. While they offer possibilities, there visible forces and consequences of society digitalization. While society, and partly media, have over publicized both the good and bad from digital technologies like mobile phones, we need to be upfront to these challenges and harness the good that comes along with technologies. The same society is still responsible for how to support the young generation, especially the digital natives in trying to bridge the bad and good divide. Therefore, there is a need for a balance between caution and encouragement [39]. Not forgetting the fact that we enter a digital culture, where even in rural areas where technologies were hard to reach, mobile penetration is high. Thus, the essence is to appreciate both positives from digitization, but also embrace and act on the negatives with respect to 'how to appropriately use' technologies in everyday practice. In this way, we shall maximally utilize the inherent benefits from mobile phone usage for livelihood security.

## 5 Conclusion

Understanding how mobile technologies can be effectively integrated into development-related activities requires appreciating that these technologies keep changing. Such evolving technological changes create an imagination gap among those trying to implement and use technologies [40]. I am not meaning to imply, however, that the new and increasing technological developments in ICT are bad, but rather they create a gap which always has to be fixed to keep up with the current technological pace. Ideally, this creates disruptions in systems and puts to task institutions trying to rely on ICT innovations as a way of life, but also, it constantly checks the capacities needed to keep up the pace.

Social implications about the usefulness of mobile phones' discussion are important to understand how mobile phones can support the livelihoods of many smallholder farmer communities. Actually, as emphasized in most mobile technology literature, the mobile phone is the fastest and highly diffused technology in most developing states like Uganda. Most interventions in education, health, agriculture, marketing, business and finance are looking for better possibilities to extend the reach of such services through affordable mobile phones' applications. Thus, understanding what kinds of mobile phones available and what people make use of mobile phones is important to take 'mobiles for livelihoods' research to the next-level discussions.

The view about mobile technologies as tools to support livelihoods is to realize that phones are actor tools that carry content to use; they do not plough or harvest. Like Qvortrup cited in Hetland notes, 'It is too imprecise to analyse information technology as if they only presented [all technologies in general]. Because, essentially, information technologies are tools for interactions and organization. You cannot use them to till the soil or to hammer, but you can use them to plan the tilling, to control and administer the hammering' [41]. In line with this affirmation, ICTs are not used to manipulate nature, but rather to manipulate cognitive and interactive processes essential to contribute to human well-being (Ibid.). In information technologies, information has 'an active role in shaping context [and is] not only embedded within a social structure, but creates that structure itself' [41]. Thus, to view information as an actor, and knowledge as power, we need to recognize the constructive force that it affords participation in contributing to the actors' own reality.

Therefore, in technological interventions for livelihoods, everything matters. It is not only one aspect, but rather a joint effort encompassing different actors can sustainably support livelihoods of many in developing contexts. An ecosystem approach that analyses livelihoods in totality is important, and for ICTs to be effectively utilized, they ought to be integrated within existing norms of practices, and more so, work hand-in-hand within available cultural practices. Therefore, everything is important, and we should not look at things in 'either or position', but rather, in 'both and both position'.

Amidst all the rhetoric successes of most Information Communication Technology for Development (ICTD) projects especially in Africa, very few are yet to be sustainable [42, 43]. In some villages, different farmer groups had concerns about the end of the mobiles for development projects, even others citing the need for other ICTD actors to continue with the ongoing projects. This revelation points to the lack of business models in most technological solutions that work for poorer communities. Besides, even when all the projects had some sustainability elements, it looked obvious that some activities would not continue given the way they were structured. Several interactions with communities where the projects had operated showed how initiated project activities would be rendered futile in the long run. Visible business model strategies like use of local farmers and call centres—where farmers had to incur a cost—were available but no farmer was willing to pay in search for more knowledge. This observation raises practical implications for future adherence of how ICTs like mobile phones can sustainably support development-related initiates.

To summarize this discussion, therefore, rural people use mobile phones in varying ways among which communication, mobile money transactions and learning for livelihoods were significant social benefits. Mobile phones used for learning in rural locales is rarely a researched dimension; yet, smallholders too need new knowledge and skills to secure better livelihoods. Notably, for mobile phones to really impact on equity and access to learning for all, extra support is vital to help such farmers' benefit from growing opportunities for mobile learning. Adversely, just like any technology, mobile phones also generated disruptions to society. The presence of social negative implications and dissenting voices about mobile phone usage among rural populace is worth consideration, as this has implications for sustainability of mobiles for livelihoods interventions. Perhaps, strategies on better use of mobile phones need to be harnessed in mobile for development discussions to enable communities gain better insights about mobile phone usage for livelihoods security.

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# *Adoption and use of mobile technologies for learning among smallholder farmer communities in Uganda*

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**ABSTRACT**
Mobile learning (mLearning) in formal education is getting wide spread but little is known about how to adopt mLearning in non-formal contexts among smallholder farmer communities, who constitute the majority in most African states. These rely on agriculture, yet their livelihoods are affected by immense changes in seasons. Smallholder farmers' access to mobile phones can act as bridges in supporting learning for secure livelihoods. Using the Unified Theory of Acceptance and Use of Technology (UTAUT), we have conducted multiple case studies of the Community Knowledge Worker project in Uganda. The intention was to analyse mobile learning adoption and use practices among farmers. Based on our findings, organisational scaffolding, social influence, peer support, immediate learning impacts, and increased output were key factors that aided learning and adoption of mobile technologies. Although adoption and use practices were facilitated by organisational scaffolding, the future of mLearning use in resource limited environments is promising.

**KEYWORDS**
Mobile learning, Smallholder farmers, Unified Theory of Acceptance and Use of Technology

**CONTEXT**
The world is becoming mobile due to emergence of ubiquitous technologies like mobile technologies that have facilitated the adoption of mobile learning. Today, ninety per cent of the world's population has access to mobile devices and as educationists; tapping into this potential of promoting and extending learning to communities with scarce resources is viable. Mobile learning (mLearning) is one of the avenues leveraged for digital content sharing given the accessibility of mobile devices like mobile phones among resource limited communities, like the case with smallholder farmers. Although the impact of mobile phones among farmer communities has been highly studied, in the mobile learning field, less is known about smallholder farmer's adoption and use of mobile phones for learning. mLearning in formal education is getting wide spread, and extensively researched [1-4], but little is known about how to adopt mLearning in non-formal contexts among smallholder farmers, an aspect of mAgriculture, which of recent is categorically defined in mobiles for development milieus.

Smallholder farmers, who constitute the majority in most African countries have witnessed most food security risks resulting from climate change challenges [5], as their economies heaviliy rely on agriculture, where majority lack access to appropriate extension education. Yet, among the most hit and affected in the world are populations in developing regions [5]. In western Uganda, where over 80% of people rely on subsistence farming, the lack of access to extension system coupled with changes in seasons and rainfall patterns make such farmers prone. This is worsened by the ineffective extension system where the ratio of farmers-to-extension officers in most common wealth countries is 1: 2,000 to 1:25,000 [6]. In Uganda, it is reported to be 1: 18,000 [7]. There have been public cries on the inaccessibility of extension services in some places and as such, over 30 per cent of smallholder farmers do not access extension services. However, it is true that farmers can access information, share ideas, collaborate, and support each with the help of mobile technologies like mobile phones. Conversely, better adoption and use practices of such emergent technologies are critical in the deployment of mobile learning to support farmer's livelihoods. Such adoption and use practices will serve to explore key issues needed for the advancement of mLearning for development framework that will facilitate information sharing and access among smallholder communities.

Many local and international organisations have invested in the use of mobile phones to support communities, given their pervasiveness, adaptability and accessibility in the region [9]. And as such, these projects have explored less on farmer's adoption practices and experiences in the use of mobile phones to support learning. Nonetheless, exploring the likely benefits of emergent technologies in the context of smallholder communities deserves greater attention to ensure that such technologies support learning. In education, it is thus proven that mobile phones have supported learning in developing regions context given their affordability, ubiquitous access, situated learning opportunities, connectivity and convergence [1, 8]. They support individualised, personalised and group learning activities.
Mobile technologies are considered to bring educational and learning opportunities to even marginalised populations [9] in developing regions. They have supported the transformation of traditional societies into knowledge societies [10] and this direction unveils opportunities for investing in mobile learning to support livelihoods.

mLearning has been variously defined where 'mobility' has been central in defining the concept. Al-Emran, Elsherif [4] categorises mobility from a number of dimensions that is;

‘mobility of the technology, mobility of learners, mobility of educators, and mobility of learning’. In this perspective, the educator, the learner, the technology and the learning process defines mobile learning. mLearning is not only restrictive to learners’ mobility, but also incorporates an appreciation of active involvement of learners in different contexts and the frequency of change depending on individual location [11]. Mobile technologies have supported educators and trainers to access learning resources, anytime and anywhere [12]. In this paper, we refer to mLearning as learning supported by the use of mobile phones considering its pervasiveness. mLearning allows learning to take place in the learners’ usual environment, fosters people engagement, promotes learner centeredness, knowledge centeredness, and community centeredness [13].

The above characterisation of mLeanring can avail opportunities about learning for livelihoods among smallholder farmers. Therefore, in this study, we fill a research need, by analysing mobile learning adoption and use practices among smallholder farmers in Uganda. The intention is to map the nature and type of learning afforded by mobile technologies whilst exploring factors that could explain mobile phone use and adoption among smallholder farmers. The study was guided by two research questions

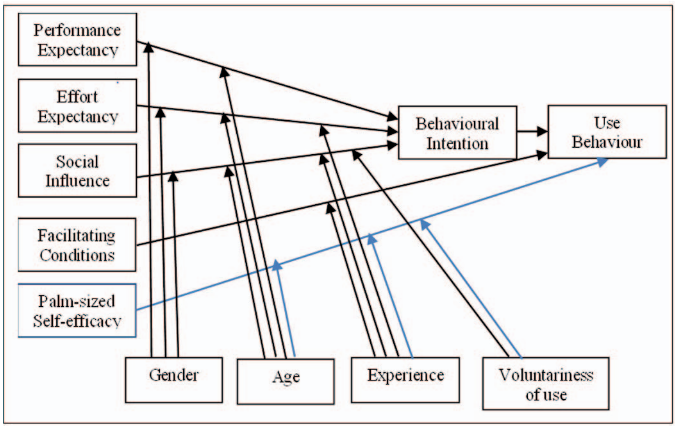
**RQ1:** What is the nature of learning afforded by mobile phones?

**RQ2:** What factors explain the adoption and use of mobile phones for learning among smallholder communities?

## THEORETICAL PERSPECTIVE

### *Unified Theory of Acceptance and Use of Technology (UTAUT)*

To theorise adoption and use of mobile technologies, UTAUT [14] is employed. UTAUT is considered a theory to unify terminology of variables of different models and theories of technology acceptance. UTAUT is grounded on eight conventional models in the field of information technology acceptance research that is; the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model (MM), the Theory of Planned Behaviour (TPB), the combined TAM and TPM (C-TAM-TPB), the Model of PC Utilization (MPCU), the Innovations Diffusion Theory (IDT), and the Social Cognitive Theory (SCT). The assumptions behind the unification of the above theories and models was that Information technology will not be effective if not well adopted and used by the intended beneficiaries.
UTAUT was then founded on four theoretical constructs representing intention to use, and four moderators of key relationships [14]. These constructs are Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating conditions while the moderating variables that influence intention to use of information technologies are; Gender, Age, Experience, and Voluntariness of use [15].
The application and use of the theory is elaborate in the discussion section.




*Adapted Unified Theory of Acceptance and Use of Technology [14]*

## RESEARCH CONTEXT AND METHODOLOGY

### *Uganda*.

Uganda is a land locked Country located in Eastern Part of Africa with a population of 38 millions. The country is predominantly agrarian, with agriculture (75%) the main provider of peoples’ livelihoods. In the country, mobile phone subscriptions have reached up to 19.5 million mobile users, where mobile coverage is up to 90% even in rural areas [16, 17]. Despite the low literacy levels in the country, with english as the formal language, the mobile economy in the country is blossoming than ever before. This study was conducted in western Uganda, in the Districts of Lubirizi and Mitooma which form the Greater Bushenyi region. Agriculture (mainly smallholder) is the main economic activity, supporting over 80% of rural households. The agriculture extension system in the country is at its low performance which makes many farmers lack the necessary agricultural information. The situation prompted both local and international organisations like Grameen Foundation to establish a mobile system that would help farmers access up to date agricultural information, as a way to uplift their wellbeing in the region.

### *The Community Knowledge Worker (CKW) Project*

The Grameen Foundation - CKW project sees the proliferation of mobile phones in Africa as a way to get information and services to and from poor communities in rural Uganda. Launched in Uganda in 2009, the project serves farmers in remote communities through a network of peer advisors (locally termed *CKWs*). The initiative combines mobile technology and human networks to help smallholder farmers get accurate and timely information to improve their businesses and livelihoods. The programme considers phones as a powerful two-way communication device and the organisation puts emphasis in generating innovative ways to collect and disseminate information.
CKWs are trusted local intermediaries serving farmers who frequently lack basic access to up-to-date information on best farming practices, market conditions, pest and disease control, weather forecasts and a range of other issues. These intermediaries, who are often farmers themselves, use mobile technology to deliver agricultural information both to and from the smallholder farmers. The CKW model is designed to improve farmers’ lives by enabling them to get the information they need to improve yields and have broader access to lucrative markets. By creating a network of CKWs throughout Uganda, Grameen aims to revolutionize agricultural knowledge-sharing and, in turn, improve yields, reduce losses, and increase incomes of poor smallholder farmers. In addition, CKWs collect agricultural information from farmers, providing a vital link between farmers,

government programs, non-governmental organizations and other entities focused on improving agriculture in Uganda and beyond [18].

***Research Methodology***

Qualitative methodology through an interpretivist and social constructivist perspective from multiple case sites of CKW project in Lubirizi and Mitooma parishes in western Uganda was adopted. Data collection was aided through interviews, informal discussions, Focused Group Discussions (FGDs), note taking, and participant observations. Primary data collection entailed series of semi-ethnography interactions where the research team stayed and lived with the communities to clearly analyse the nature of learning and learner interactions with the mobile phones. Secondary data sources included organisational reports, local government reports, and locally generated materials from the different parishes. To attain primary data, 40 farmers and 10 key informants were included. The farmers included the CKWs, both men and women aged (25-60 years) with access to smart phones fully installed with agricultural content. 50 participants was a representative sample in a purely qualitative study given emphasis on thick data with socially constructed analyses. NVivo tool aided the analysis of the field data through code classification themes like use of the technology, nature of learning, ease of use of the technology, facilitating factors, and social relations. To check on reliability and validity of information obtained, several follow up discussions with study participants were conducted. This was through making phone calls, but also staying in contact with them on WhatsApp CKW groups. Also, since the researchers interacted with communities every month, it was possible to regularly interact with study participants to check on validity.

## OUTCOMES AND DISCUSSION

***The nature and type of learning on mobile phones***

Current debates in the use of ICTs like mobile phones to avail agricultural information to smallholder farmers in the face of climate change largely focus on market information, and weather updates, with less focus on how such farmers can use mobile technologies for learning. Given the nature of rural terrains, mobile technologies provide learning to farmers in remote locations, where access to infrastructures is a challenge [12]. This learning was informed by ways of managing pest and diseases, how to manage crops, and animals as aspects of extension education. Based on our findings, smallholder farmers learn through face to face individual and group meetings, as well as online interactions. The mobile phones carry agricultural content which they use to ignite face to face conversions. Phones acted as digital libraries which facilitate a spiral over effect in information access and sharing with other farmers. 'Rather than acquiring another technology to receive learning materials, people throughout the world will want to access learning materials on their existing mobile devices' [12]. The online interactions were facilitated by WhatsApp since the phones were connected on internet that supported regular content updates. Social learning among peers and other farmers was visible. The farmers were in a community of practice that used mobile phones to learn [19, 20]. Learning was participation in the social world where individual experiences were integrated in the learning process, with elements of authentic and transformative learning. It was about learning as doing, learning as becoming, learning as belonging and learning as experience [20]. To UNESCO International Commission on Education, learning is a lifelong process and a central aspect in addressing the global challenges like, poverty and food insecurity. The Commission emphasizes four pillars of learning: 'learning to live together', 'learning to know', 'learning to do', and 'learning to be' [21]. Peer to peer learning was visible as farmers were in position to see immediate benefits from their learning supported by mobile phones. *'Before Grameen, my garden produced less bananas and coffee yields. But with knowledge from the CKWs, I can now have big bunched bananas and can take like three bicycles of banana to the market every week'* said a farmer in Lubirizi.

***Adoption and Use of mobile phones for learning among smallholder farmers***

Using UTAUT is not only to benefit from the unified models that explain adoption and use of new technologies, but to expound on how such technologies are used in resource limited settings where access to newer technologies like smart phones is a challenge. UTAUT unifies several theories that have explained adoption and use of new technologies in different contexts, thus its application benefits the study in exploring different dimensions. Although the mLearning context is quite different from the traditional IT context, [22] suggest the need to extend or modify UTAUT when applying it to adoption and use of new technologies like mLearning among Smallholder farmers. This study included the palm-sized computer self-efficacy to broaden intention to use especially in line with affordances of mobile technologies [23]. The key theoretical constructs and how they relate to farmers adoption and use practices are explained here under;

***Performance Expectancy (PE)***

Performance Expectancy *'is the extent to which an individual believes that utilizing an information technology will assist in attaining gains in job performance'* [14]. From Perceived usefulness, a key element in performance expectancy derived from the Technology Acceptance model, people will tend to use the technology to an extent they believe will improve job performance [24]. In the mLearning for farmer's context, farmers will use mobile phones if they only believe that phones will help them to obtain new knowledge beneficial to increased farm yields. The CKWs acted as experts in their communities, offering free educational advice to many. '*We were not aware of modern ways of managing our plantations as well as control pest and diseases in banana and coffee gardens. All we had was old knowledge. Our plantations were diminishing day by day and yet, no extension officer comes to meet us on our farms like the CKWs. Thanks to Grameen',* said a farmer in Lubirizi. Because the content on mobile phones had information relevant to their livelihoods, and allowed for immediate learning benefits, most CKWs utilised the mobile phones for the good of the community. Explicitly, some CKWs showed case on how these mobile phones elevated their social status in the community. *'I tell you, this phone made me to become someone in this village. I am now respected and everyone knows how I have knowledge about farming on my phone. My own gardens are leading by example! Even other organisations now can approach me about my advice and how to mobilise people in this village',* said a CKW. All respondents attested to the fact the phones had content that tackled different enterprises in the region, which in away explained adoption and use. Gender and Age are key moderators to determine performance expectancy and intention to use [15]. In the study context, Men and women, old, and youthful farmers were all using the mobile phones. Actually, unlike other studies that put women at low performance in terms of IT adoption [14], in this setting, women were considered by the project team and the community to be very active in using the mobile phones. All other farmers who had female CKWs and project officers attested to this fact that women were good users of mobile phones, despite males being the majority in the project.

***Effort Expectancy (EE)***

Effort Expectancy is the *'extent of ease to use associated with the information technology'* [14]. If the mobile learning system installed on the smart phones is hard to navigate, farmers will find it hard to use the technology for learning. Whiles as the organisation trained the CKWs on how to use the phones, through constant interactions, it was clear that some had challenges navigating through these phones. Gender, age, and experience being key moderating factors to determine effort expectancy [15], older CKWs (40 - 60) years found it hard to navigate through the different phone affordances. Yet, youthful farmers (below 35) years with previous experience about smart phone features did not find challenges. But again, their intelligence with smart phone features caused the phones to hang since they were installing other new applications which affected the operation of the mobile system installed. Female CKWs needed more scaffolding. In an interview with the field officer, '*older people and women still had some problems not only in locating the forms on the mobile system, but also regularly updating the different applications installed'*. The CKWs who failed to navigate easily were supported by super CKWs, and field offers; an aspect of facilitating conditions to be explained later.

***Social Influence (SI)***

Social influence is the *'extent to which an individual perceives that important others believe he or she should use the new information technology*' [14]. Social Influence has an effect on individual behaviours in terms of compliance, internationalisation, and identification; which in turn determines technology acceptance [15]. Age, voluntariness of use and experience are key moderating factors under social influence. Studies have showed that women are more compliant and sensitive to opinions of others and thus, social influence will be stronger on women more than men [14, 15, 23]. This was evident with female CKWs in the project. These were too obedient and committed to their service unlike male CKWs. Given that people will use the technology if they believe that important others feel it is worth to use the technology, in the CKW project, these important others were central in selecting farmers to receive the smart phones with agriculture content. '*We CKWs are ambassadors selected and delegated by society to use these phones and disseminate information to the rest of the community. Therefore, not working for the community would be betrayal'* said a CKW in a FGD. Therefore, in the project, social influence was a strong element in explaining intention to use. CKWs were being monitored by the community which social aspect controlled the use of phones, although some did not work diligently to the expectation of the organisation given their busy schedules and reliance on other economic activities other than farming. However, peer to peer support was also evident. CKWs in Mitooma parish formed social and peer groups which strengthened and supported one another.

***Facilitating Conditions (FC)***

Facilitating Conditions is the *'extent to which an individual believes an organisation and technical infrastructure exists to support use of the system'* [14]. This is where individuals get some organisational scaffolding to sustainably use the mobile technology. Age and experience are moderating factors determining intention to use. For example, as experience increases, there will be greater use of the technology [14]. In this mLearning context, facilitating conditions were central in determining intention to use of the mobile phones. The project works in rural settings where infrastructure development is still a challenge. The region had no electricity yet, the phones needed to function daily. Providing support both technical and organisational was quite instrumental in sustaining the adoption and use of the mobile phones. The organisation routinely monitored the farmers on ground, where field officers and super CKWs were in close contact with the organisation to continuously provide the necessary support to the farmers in case they had problems with the mobile system. In a FGD in Lubirizi, a CKW in a had this to say; *'We are happy to Grameen to have given us solar panels and trained the Super CKW among us to solve our daily challenges regarding mobile phones technical features'*. Justifiably, '*I cannot miss a call or face to face meeting in two days regarding how to help a farmer with updating software or troubleshooting! I thank Grameen for the training opportunity about maintaining mobile phones'* said a Super CKW in Lubirizi. More so, these CKWs were highly monitored by both the organisation and the community since at every end of month, they had targets to achieve which explains adoption and use.

***Palm-sized computer self-efficacy***

Palm-sized computer self-efficacy is *'a summary judgment of one's capability to engage in some specific computer related activities through a palm sized computer'* [23]. In their study of user acceptance of m-Internet, Wang and Wang [23] noted that palm sized computer self-efficacy played a critical role in determining intention to use of mobile systems. In the mLearning for farmers, farmers who were competent in using a palm sized computer had an intention to use of the technology. Actually, in this resource limited setting where smart phones are still scarce, farmer's familiarity with the smart phones had an impact on use. Age, experience and voluntariness to use the mobile system had an effect on the intention to use. On Voluntariness to use, farmers had no option but to just use the mobile phones given their previous situation in the region. For them, it was from 'nowhere' to 'somewhere' as noted by a male older (55 years) CKW that; *'Even when these phones have tiny content, and sometimes hard to read with my age, I am still grateful for this opportunity. The project moved us from minus to plus. We had no extension officers reaching our area, even down to the farmers' plantations'*. Actually, no one mentioned the need to move from smart phones to tablets, because majority were aware of their rural situation.

While some aged farmers seemed challenged reading content on the mobile phones, it was only excitement to have received the smart phone mobile technology amidst them. The phones became a social issue as it lifted the social status of those who had it.

In a nutshell, the findings indicate that organisational scaffolding, social influence, peer support, immediate learning impacts, and increased output were key factors that aided learning on mobile phones. As of ease to use, mobile phones became part of inbuilt requirements to measure learning and higher performance by the organisation. Based on our findings, even though this appeared routine learning controlled by high organisational scaffolding, the future of their use in resource limited environments is promising and thus, it is feasible to implement mobile learning activities among such farming communities; an opportunity to ensure access to learning for all. About farmers' attitudes towards content and learning approach, majority were grateful to this opportunity although some advocated for finance capital support to sustainably implement the knowledge attained.

## CONCLUSIONS

The advent of new ICTs like mobile technologies offers a chance for Africa to exploit the learning benefits that can be afforded by mobile technologies. Such technologies require less infrastructure investments and are equally available in many African communities [25], thus a great opportunity for the region. Therefore, exploring adoption and use of mobile technologies adds to the body of knowledge that not only tries to analyse how farmer communities adapt and use newer technologies for learning, but also how mobile learning can be a strategy to increase access to educational opportunities among smallholder farmers in resource limited environments.

Employing UTAUT as a theory of analysis; this study fills a gap that unveils the adoption, use, and experiences of mobile learning among smallholder farmer communities in developing regions like Uganda. Such newer technologies will not only help farmers to get abreast with new knowledge to address the demands of the changing climate, but it is also a plea to inclusiveness of such communities in the use of emergent technologies, as a way to reduce the digital gap. Performance expectancy, effort expectancy, facilitating conditions, and social influence were central in explaining adoption and use in the mobile learning for farmers' context. Palm-sized self-efficacy did not seem central in the study, despite its ability to analyse size affordances of the mobile phones. Farmers seemed comfortable with the mobile phones, hence a deviation from earlier studies by [22, 23] that the size of the mobile phones affects adoption and use practices.

Studying adoption and use of mobile learning when the project is still ongoing limits deeper insights in analysing adoption and use practices when the organisation pulls out its support in this rural community. Truthfully, farmers are currently using the mobile phones given their higher performance and seeing immediate learning benefits but this is possible when strong organisational scaffolding is still in the area. What will happen if Grameen foundation pulls out from the area? Definitely, from the project coordinator, '*the farmers will stay with the mobile phones and ably in position to reach out to others but also access and update the agricultural content on the mobile system*'. But what about the facilitating conditions? Will the project sustain its activities with no project officers and super CKWs facilitated? This needs deeper investigation especially to divert from earlier observations by [9] who note that most mobiles for development projects are funded by international agencies and once funding stops, such projects operations end. Sustainability of most ICT projects in developing regions have always been a challenge [26, 27], especially in rural settings. Therefore, there is need for further exploration on factors affecting adoption and use of the mobile phones for learning when Grameen foundation stops funding CKWs. This will help to identify critical issues which can be leveraged to deeply understand adoption and use practices among smallholder farmer communities in developing regions.

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# Mobile Technologies as tools for Learning in Non-formal contexts. Experiences with Smallholders farmers in Resource Limited Settings

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**Abstract:** Recent developments in mobile technologies offer promising opportunities in combating the chasm of educational inequalities, especially in developing regions. Although relative studies trace mobile learning in informal and non-formal contexts; there limited attempts to situate mobile learning in non-formal contexts with farmers. Yet, in the face of changing climate, farmers could benefit from frequent updates about learning for livelihoods which mobile technologies like mobile phones can support. This paper attempts to account for the learning experiences as they evolve when smallholder farmers interface with mobile phones as tools for learning. This exploration traces learning in resource limited settings where marginalisation and limited inclusion in most learning provisions characterise such locations. A qualitative study with Grameen Foundation-Community Knowledge Worker (CKW) project in Uganda was adopted. A total of fifty smallholder farmers and ten key informants was used through data collection techniques like informal interviews, focused group discussions, and participant's observation. Experiences in form of farmers narratives showed that mobile phones allowed learning to take place in the farmers' usual environment, and strongly nurtured farmer engagements. Given their peculiar characteristics; farmers' learning on mobile phones was tailored to address livelihood challenges where knowledge and the knowing process was highly situated, and contextualised. Despite learning being transformative and empowering, negative experiences like; intermittent network, cultural hindrances, limited capital, negative bonds, and unstable weather patterns affected the use of attained knowledge.

**Key words:** Mobile learning, Resource limited settings, Community of Practice, Smallholder farmers

## 1 Introduction

"Underlying many gaps in the current educational framework is the fact that is fails to address education in a holistic and integrated manner. More achievable goals are privileged, and others, such as adult literacy, are relegated to lower priority. The goals are also not adequately targeted to reach the poor and marginalised, thus underserving those in hard to reach" (UNESCO & UNICEF, 2013 P.7-8).

As every month goes by it becomes increasingly clear that there are new technological inventions we need to exploit as educationists. Such exploitation is inclusive of how we can make mobile technologies meaningful, and impactful to the less privileged in society. The post 2015 Sustainable Development Goals (SDGs) came forth after realisation that most communities in developing regions need adaptive strategies to strengthen their resilient capabilities and enhance livelihoods. This study is situated in the SDG Goal 4: 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (United Nations 2015). The current global society needs an empowering and transformative type of education that does not only focus on education in formalized environments but rather inclusive of education in non-formalized contexts; like the case with smallholders in resource limited settings . Smallholders who constitute the majority in most developing regions heavily rely on agriculture at a substance scale; yet their livelihoods are greatly affected by impacts of climate change (Norad, 2013; Wright et al., 2016). These farming communities however have access to mobile technologies like mobile phones that can provide bridges to support learning for secure livelihoods. Mobile learning allows learning to take place in the learners' usual environment, fosters people engagement, promotes learner centeredness, knowledge centeredness, and community centeredness (Sharples, Taylor, & Vavoula, 2007). To attain equitable education and promote learning for all, emergent technologies like mobile devices need to embrace learning for the marginalised in society. Thus, by exploring the nature and type of learning supported by mobile technologies, this study attempts to show case farmers' mobile learning experiences in non-formal contexts. This exploration also recounts for the negative experiences associated with the use of mobile phones for learning in resource limited settings.

The first section of this paper briefly explains the applicability of mobile technologies in non-formal learning contexts, with an overview of mobile learning. The discussion about farmers' mobile learning experiences in non-formal contexts in light with the community of Practice - social learning theory then follows. The paper ends with a conclusion that appreciates the impact of mobile technologies use in non-formal learning contexts. It suggests that appropriating mobile learning in resource limited settings is not only justifiable in such contexts with limited access to better infrastructure, but rather an ethical undertaking in increasing access to educational opportunities; a driver to attaining the lifelong learning opportunities to smallholder farmers in developing regions.

## 2 Mobile Technologies in Non-Formal Learning Contexts

Mobile technologies are considered to bring educational and learning opportunities to even marginalised populations (Grimus & Ebner, 2013) in developing regions. Such technologies have supported the transformation of traditional societies into knowledge societies (Oladele, 2011). In this study, the mobile technologies used are (smart) mobile phones, as these are amongst the fastest technological diffusion in communication history (Castells, 2011). 6 billion people out of the 7 billion on earth have a working mobile phone according to recent global statistics (UNESCO 2014). Mobile technologies are effective tools to support learning and communication to broad range of learners in a variety of contexts (Kukulska-Hulme, 2010), as the case with learning in non-formal contexts. 'Mobile technologies support learning in different contexts and are particularly beneficial in informal and semi-formal learning contexts' (Jones, Scanlon, & Clough, 2013, p. 1). Mobile learning is learning that is personalised, informal, contextual, with the aid of mobile devices (Kukulska-Hulme & Traxler, 2005). Mobile learning is not only restrictive to learners' mobility, but also incorporates an appreciation of active involvement of learners in different contexts (Brown, 2010). Winters (2007) for example has broadened the term to not only focus on the affordances of the mobile device, but rather, capture mobility affordances in multiple contexts. To clearly exemplify how learning on mobile technologies unfolds among smallholder farmers, the case study below depicts the situation in rural Uganda, Greater Bushenyi Region.

## 3 Research Context and Methodology

Uganda is a land locked Country located in Eastern Part of Africa with a population of 38 million. The country is predominantly agrarian, with agriculture (75%) the main provider of peoples' livelihoods. In the country, mobile phone subscriptions have reached up to 19.5 million mobile users, where mobile coverage is up to 90% even in rural areas (Mwesigwa, 2016; UCC, 2014). Despite the low literacy levels, with English as the formal language, the mobile economy in the country is blossoming than ever before. This study was conducted in western Uganda, in the Districts of Lubirizi and Mitooma (Katerera and Mitooma sub counties), greater Bushenyi region. Agriculture (smallholder) is the main economic activity, supporting 80% of rural households. In the country, the agriculture extension system is at its low performance which makes farmers lack the necessary agricultural information. The ratio of extension officers to farmers is 1:18,000 (Balasubramanian, 2013) where, over 30 per cent of smallholder farmers are unreached.

The Grameen Foundation - CKW project sees the proliferation of mobile phones as a way to get information and services to and from poor communities in rural Uganda. Launched in 2009, the project serves farmers in remote communities through a network of peer advisors (locally termed Community Knowledge Workers - CKWs). The initiative combines mobile technology and human networks to help smallholder farmers get accurate and timely information to improve their businesses and livelihoods. The programme considers phones as a powerful two-way communication device and the organisation puts emphasis in generating innovative ways to collect and disseminate information (Nampijja & Birevu, 2016). CKWs who are often farmers themselves, are trusted local intermediaries serving farmers who frequently lack basic access to up-to-date information on best farming practices, market conditions, pest and disease control, and weather forecasts. By creating a network of CKWs throughout Uganda, Grameen aims to revolutionize agricultural knowledge-sharing and, in turn, improve yields, reduce losses, and increase incomes of poor smallholder farmers. In addition, CKWs collect agricultural information from farmers, providing a vital link between farmers, government programs, non-governmental organizations and other entities focused on improving agriculture in Uganda (Grameen Foundation, 2015).

Qualitative methodology through an interpretivist and social constructivist perspective from multiple case sites of CKW project in Katerera, and Mitooma parishes in western Uganda was adopted. Data collection was aided through interviews, informal discussions, Focused Group Discussions (FGDs), note taking, and participant observations. Primary data collection entailed series of semi-ethnography interactions where the research team stayed and lived with the communities to clearly analyse the nature of learning and learner interactions with the mobile phones. Secondary data sources included organisational reports, local government reports, and locally generated materials from the different parishes. To obtain primary data, 50 farmers and 10 key informants were included. The farmers included the CKWs, both men and women aged (25-60 years) with access to smart phones fully installed with agricultural content. The 60 participants were a representative sample in a purely qualitative study given emphasis on thick and deep data with socially constructed analyses. NVivo tool aided the analysis through code classification themes like, nature and type of learning, and farmers' experiences (both positive and negative), regarding the use of mobile technologies. To ascertain reliability and validity of information obtained, several follow up discussions with study participants, and feedback meetings with the CKWs were conducted.

## 4 Nature and Type of Learning on Mobile Technologies

UNESCO views learning as a lifelong process and a central aspect in addressing the global challenges like, for instance, poverty and food insecurity. The Commission emphasizes four pillars of learning: 'learning to live together', 'learning to know', 'learning to do', and 'learning to be' (UNESCO, 2011, p. 6), which are elements visible in the CKW project. Taking the non-formal learning perspective, learning is embedded in practice based context where learning becomes a problem-solving initiative. As Ngaka et al claims, ''opportunities for integrating formal and non-formal education are not ubiquitous, but (rather) deliberate efforts to respond to communities' identified and expressed needs'' (2012, p. 116). Although the CKW project aim was to alleviate poverty through access to actionable information, from an educational point of view, non-formal learning takes. Learning here is informed by ways of managing pest and diseases, how to manage crops, and animals, market and weather knowledge sharing; as aspects of extension education.

Based on the findings, smallholder farmers learn through face to face individual and group meetings, as well as online interactions. The mobile phones carry agricultural content which they use to ignite further discussions. The mobile phones act as digital libraries which facilitate a spiral over effect in information access and sharing with other farmers in the community. Mobile phones also support conversational learning where learning becomes a process of coming to know and the ability to share knowledge with others in the network. For smallholders, 'learning is not just acquiring skills and information; it is becoming a certain person-a knower in a context where what it means to know is negotiated with respect to the regime of competence of a community' (Wenger 2000, p. 2). Mobile learning in this context places learning in people's environment and context which the social learning theory agitates for. Here, learning is participation in the social world where farmers experiences are integrated in learning.

## 5 Farmers' Learning Experiences on Mobile Technologies

To situate learning as a lifelong process, the communtiy of practice theory was used. "Communities of practice are a group of people who share a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2006:1). The CKWs are a 'community of practice' in their locality. These possess a shared passion of learning together with other fellow farmers who have no access to mobile content. In this social learning theory, individuals and social institutions are not a focus of analysis, but rather; communities of practice. The theory explores systematic intersection of learning components: community, practice, meaning, and identity which provide a conceptual framework of analysing learning as a social process (Wenger, 1998). Figure 1 exemplifies the community knowledge worker - community of practice as viewed from project interventions in the rural community visa vie farmers' day to day learning experiences.

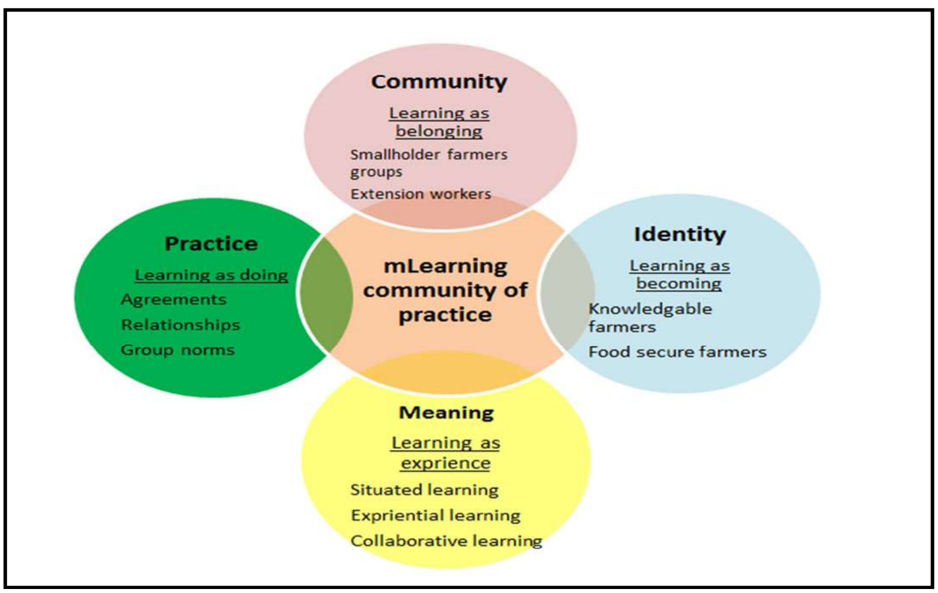


*Fig. 1: Community Knowledge Worker - Community of Practice adapted from Wenger (1998)*

The farmers in Katerera and Mitooma sub counties where the study was conducted deal in similar enterprises like banana and coffee plantations, at a subsistence scale. These similar enterprises situate farmers in the community and identify them as farmers with sameness. 'Knowledge here is about competence with respect to valued enterprises' (Wenger, 1998, p. 4). Learning in this case is defined as 'belonging' and as 'becoming' for the community and identity components respectively. Farmers here want to become not only knowledgeable farmers; but also, food secure farmers who broadly look at farming both for subsistence and as a business. For the 'practice' and 'meaning' strands, ''Knowing is about active engagement in the process of learning where meaning is ultimately what learners produce'' (Wenger, 1998, p. 4). In Practice, learning is about doing and in meaning; learning is about experience sharing. The CKWs share this information with farmers in different villages in form of one-on-one and through group meetings where learning is a shared and highly coordinated process.

In group meetings, the content on mobile phones ignite further discussions which is tailored to local circumstances and takes into account other farmers experiences. The more experienced farmers discuss and agree with the CKWs on what works and what cannot work depending on availability of farm inputs, indigenous resources and money. This working relationship amongst farmers is possible with the availability of agreements, relationships and group norms agreed upon by the community of farmers. For example, each group (usually of 50 farmers) decides to agree on when to meet, where and on whose farm land. These meetings are rotational where at the end of the season; each participant must have had a chance to host a group learning. Quite interesting is that as these relationships advance, they give birth to newer relationships. 'When I host a group meeting, I feel empowered since learning comes to my plantation. This makes me invite my other friends who are not part of the project, but can also benefit from the discussions' said a farmer. Here, learning transcends beyond project boundaries, to benefiting others in the community. Such learning organised non-formally in rural contexts needs to map and maximise the available assets in rural learning ecologies (Hlalele, 2013). In doing this, Hlalele claims the need to exploit the available community assets where innovative technologies like problem solving learning and high level of volunteer support from significant others in communities is vital. In the project, not all farmers have access to smartphones with mobile content. This by implication means that team work and strong bonds facilitate the learning process. 'I am not part of the Grameen farmers, but during group meetings, I asked the CKW to join. So, I have gained farming knowledge and my plantations are looking healthy' said a non-project farmer . Here, learning is a process of coming to know and the ability to share knowledge with others in the network. Learning involves change in knowledge and attitudes, which leads to acquisition of new skills and new ways of relating to practice (Ekanayake & Wishart, 2014).

Authentic learning was visible as farmers interacted with the mobile phones. In this learning, learning tasks are practical and in real-world contexts'(Herrington, Reeves, & Oliver, 2014). Learners are given a chance to use their experiences, where learning is problem solving. 'We used not to have extensionist reach down in our plantations, but with the CKWs, I can learn from my plantation with others which makes learning practical and more meaningful', said a female farmer in Katerera parish. During group discussions, farmers engage in real life hands-on activities that is, learn by doing. Access to expert performances and modelling is central in authentic learning (Herrington et al., 2014). The CKWs, farm experts, researchers, and model farmers show different farming techniques which make it possible for other farmers to model behaviours and replicate on their farms. Reflections, coaching and scaffolding are all available techniques employed in the CKW project which in turn facilitate deep learning among farmers. Also, given that the project had farmers whose livelihoods relied on farming, these came with vast experiences which the project upheld. From a focused discussion with the CKWs, many attested to the fact that, some farmers in their groups had very experienced information, which they too utilised to strengthen learning in group meetings. This is in line with Paul Freire's thinking that 'whoever teachers learns in the act of teaching, and whoever learns, teaches in the act of learning'. Learning amongst CKWs and farmers was reciprocated and highly interactive with other farmers in the community of practice.

However, it is important to note that while as mobile phones supported learning for livelihoods, it is only one element amongst the different technologies and interactions (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sánchez, & Vavoula+, 2009). Mobile technologies do not replace existing technologies like desktop computers, pens and print, but rather, it complements them by adding something additional (Kukulska-Hulme 2010). The mobile phone was not the sole igniter of learning, other factors like organisational scaffolding, social capital and internal motivation of farmers facilitated the learning process. Although Castells, re-echoes mobile communications as the fastest growing technology in world history, he further highlights that ''alongside the development of trends in mobile communication that could be considered global, other trends unique to individual ethnic, cultural, or national characteristics are also found'' (Castells et al., 2007, p. 74). Some negative experiences like unstable weather patterns, and mobile phones creating more digital divide were visible. Those CKWs who had phones were elevated, which left many grumbling as majority felt left out. Internet and telecommunications networks was intermittent in some location, hindering some from access. The older CKWs who had smart phones found it hard to ably trouble shoot them in case of problems, which in away hampered productivity. Also, capital for the farmers to use the attained knowledge was a challenge. “I have gained knowledge on how to manage my banana and coffee plantations, but being a window, I cannot afford to apply all the necessary techniques to improve on my yields’’ said a female farmer. Other factors like female headed households, cultural and religious hindrances negatively impacted on mobile phones for learning.

## 6 Conclusions

‘The widespread diffusion of mobile and wireless technologies, although on a global scale, is certainly not uniform and independent of economic and cultural factors, and offers an opportunity to develop education policies aimed at increasing participation in education…’ (Seta, Kukulska-Hulme, & Arrigo, 2014, p. 162).

The integration of mobile technologies in development comes with challenges which if not well addressed, might impact on mobiles for development discourse. By implication, as we analyse mobile learning, the context, local and societal considerations must be thought through. Mobile learning in developed countries cannot be the same mobile learning in developing regions. In Uganda for example, the context of mobile learning for development presuppose other affordances that mobile technologies can offer to communities in such locations. Religion, culture, policy and infrastructure availability are factors that impact on the uptake of mobiles in resource limited settings; thus, the need to appreciate diversities in contexts visa vie unveiling opportunities to increase access to educational for all. However, if such factors are addressed, mobile technologies like mobile phones which majority possess can be upfront in ensuring increased access to educational opportunities; an avenue for lifelong learning amongst farming communities. Despite heavy appropriation of mobile learning in formal settings, non-formal learning contexts can also benefit from these technologies, where the highly excluded and marginalised like smallholder farmers can attain actionable information to stay resilient and secure their livelihoods. Such a view places mobile learning intervention justifiable and ethically upfront in taking learning to where ‘those in need are reached’.

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# MOBILE LEARNING IN NON-FORMAL CONTEXTS. EXPLORING THE NEXUS OF PRACTICE AND USE OF MOBILE TECHNOLOGIES AMONG SMALLHOLDER FARMING COMMUNITIES IN RESOURCE LIMITED ENVIRONMENTS

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## Abstract

In the field of higher education, emergent technologies like mobile devices have gained momentum and increased popularity as seen from the many researchers and practitioners' recent engagement with them. Various studies have been conducted in the field of mobile learning, but with less focus on how mobile technologies can support learning in non-formal contexts. To address the current global challenges that affect the world today, the education system needs to embrace and utilize mobile technologies to enhance productivity and inclusiveness in learning; even among those in resource limited settings, like the case with smallholder farmers. Smallholder farmer's access to mobile phones can provide bridges to support learning for secure livelihoods. Hence, by exploring the nature and type of learning afforded by mobile technologies, this study attempts to explain the nexus of practice and use of mobile technologies among smallholder farmers in resource limited environments. Analyzing the possibilities and constraints of using mobile phones for learning is part of this exploration.

Methodologically, a qualitative study through an interpretivist and social constructivist perspective from multiple case sites of Grameen Foundation - Community Knowledge Worker (CKW) project in Uganda was adopted. A total of fifty smallholder farmers and ten key informants was used through data collection techniques like informal interviews, participant's observation, and focused group discussions. NVivo aided the analysis of the field data through code classification themes like practice and use of the technology, nature of learning, as well as possibilities and constraints of using mobile phones for learning.

Using the community of practice social learning theory, the study mapped out learning constructs like learning as doing, learning as experience, learning as becoming, and learning as belonging. Based on the findings, it is clear that the CKW - mobiles for development project had reached out to a handful of farmers, leaving the ('other') majority wanting. The project uses smartphones for information access and sharing among farmers. In embracing mobile technologies people have to effectuate their learning affordances, mobile phones worked as digital libraries that facilitated both individual and group learning activities. Learning was a socially constructed conversational activity where those with access to mobile phones shared information and knowledge with those with limited or no access to mobile phones. Despite the type of learning, albeit learning in non-formal contexts, the education system we have to uphold is that which is transformative and empowering to those undertaking it. Farmers noted some benefits from the mobile for development project like increased social networks, development of leadership skills, better farm management practices, among others. They however encountered varying constraints like the breakdown of mobile phones, inability of some farmers to apply the knowledge gained, and intermittent networks and funding. Although all farmers in the project attested to the increased learning afforded by mobile technologies, other factors like social relations and networks among farming communities influenced the use of mobile phones for learning. Therefore, there is a need to further explore the role of such social networks in facilitating and strengthening smallholder farmers' resilient capabilities while using mobiles for livelihoods.

Keywords: Mobile learning, Resource limited environments, Community of Practice, Smallholder farmers.

## 1 INTRODUCTION

*"We live in turbulent times; our world is changing at accelerating speed. Information is everywhere, but wisdom appears in short supply when trying to address key interrelated*


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*challenges of our time…Living in such times has implications for education and learning" [1].*

Globalization has placed much pressure on education where learning has gone beyond acquisition of knowledge and skills to making learners critical, independent, team players, entrepreneurial, and good collaborators (Bjørke et al, 2015). All these attempts to transform education to meet challenges of our times is only possible with realization that new and emerging technologies have a place in transformation of teaching and learning. This current global society needs an empowering and transformative type of education that does not only focus on education in formalised environments but rather inclusive of education in non-formalised environments. Emergent technologies like mobile technologies keep emerging. As the technological revolution continues to evolve, new and newer technologies are becoming available on the global scene, and these undoubtedly are beneficial in teaching and learning in non-formal contexts. These changes in educational technologies are evolving at a superstitious speed. This speed of change affecting globalization and digitalization does not only affect how we think, but affects education in society [1]. 'Wals and Corcoran goes ahead to exclaim! 'what do we educate when changes are so fast where knowledge becomes obsolete before you know it'? And what about learning in non-formal settings, like the case with smallholder farmers who constitute the majority in most developing regions [2, 3].These heavily rely on agriculture, at a substance scale; yet there livelihood are greatly affected by impacts of climate changes. However, such communities have mobile technologies like mobile phones that can provide bridges to support learning for secure livelihoods.

Therefore, to address the current global challenges that affect the world today, the education system needs to embrace and utilize mobile technologies to enhance productivity and inclusiveness in learning; even among those in resource limited environment[1], like the case with smallholder farmers. Thus, by exploring the nature and type of learning afforded by mobile technologies, this study attempts to explain the nexus of practice and use of mobile technologies among smallholder farmers in resource limited environments. Analysing the possibilities and constraints of using mobile phones for learning is part of this exploration.

The first section of this paper briefly explores the concept of mobile learning as used in teaching and learning, with an exploration of the applicability of mobile technologies in non-formal learning contexts. An analysis of the nexus of practice and use of mobile learning among smallholder farmer communities in rural Uganda then follows, in light with the community of Practice - social learning theory.

The section on challenges and limitation of use of mobile learning in resource limited environments then follows. The paper ends with a conclusion that appreciates the importance of mobile technologies use in non-formal learning contexts. It suggests that appropriating mobile technologies use in resource limited environments is not only justifiable in such contexts with limited access to better infrastructure, but rather an ethical undertaking in increasing access to educational opportunities as the case with smallholder farmer communities. It urges the need to look at mobile technologies as not a replacement to the mainstream education provisions, but rather a supplement to existing educational attempts. It recommends the need for further research to explore the role of social networks in supporting and facilitating mobile learning for livelihoods in resource limited environments.

## 2 THE CONCEPT OF MOBILE LEARNING

As an evolving field, mobile learning (mLearning) has been broadly defined by many contenders in this field. To some, it is about the mobile device, while as to others; it includes the aspect of mobility. Winters [4] for example has broadened the term to not only focus on the affordances of the mobile device, but rather, capture the fact that mobile technologies offer mobility affordances which can facilitate teaching and learning in multiple contexts. Clearly postulated by Isabwe [5], connectivity coupled with several networking technologies can be supported from cellular networking to wireless local area networking and personal area networking technologies. Such capabilities make mobile technologies popular in mainstream education today. The network and connectivity affordances permit learners to interact and socialise as a community of practice, there by supporting collaborative activities.

[1] Resource limited environments are regions with limited/inadequate infrastructure to support development processes. In this context are rural communities in Uganda where farmers have inadequate infrastructure to support information and educational services.

Mobile technologies are seen to support new forms of learning like collaborative learning [6]. Learners can move outside classrooms and stay in touch with one another through sharing resources and learning collaboratively. This learning everywhere and at any time supports team work and group activities, which in turn contribute to deeper learning as learners stay online even outside the available learning management system [5]. This communication does not only take place amongst learners, teachers and tutors (trainers) too benefit from these online interactions supported by mobile technologies

Recently, despite a great hype regarding the inclusion of mobile devices to support learning in different context, observed in the new innovations and frameworks about mobile learning research, it is important to note that while as mobile technology is necessary for mobile learning, it is only one element amongst the different technologies and interactions [7]. Furthermore, as suggested by Kukulska-Hulme [6], mobile technologies do not replace existing technologies like desktop computers, pens and print, but rather, it complements them by adding something additional.

## 2.1 Mobile Technologies in Non-Formal Learning Contexts

> *'Mobile technologies support learning in different contexts and are particularly beneficial in informal and semi-formal learning contexts where learners have more control over their learning goals and where motivation for learning is high' [8].*

''Technology is accelerating at an exponential rate, so almost every student now lives with a smart phone'' [9]. The smart phone mobile coverage is still low in developing countries given the costs visa vie more requirements needed in terms of charging capabilities. However, cheap and affordable smart phones have penetrated the market where in Uganda, even in rural communities, 2 in 10 adults have smartphones. The situation is quite different among university students as majority now possess smart phones given their enabled functionalities of better connectivity and networks. Thinking about learners in non-formal context, where majority are semi illiterate, the penetration of smart phones is still low. None the less, with both smartphones and small end phones, mobile technologies are effective tools to support learning and communication to broad range of learners in a variety of contexts [6], as the case with non-formal learning.

The less research about mobile learning in non-formal environments like Uganda depicts a misconception that 'mLearning is not possible in rural Africa [10]. Elias for example makes a claim that mLearning systems are impossible in rural settings given the poor infrastructure like low bandwidth restrictions (Ibid). However, Grimus and Ebner [11] does not coincide with this position. These claim that mobile technologies do not only support learning in formalised settings as non-formal and informal learning environments can be supported by these ubiquitous technologies. Learning for farmers' livelihoods is informal and non-formal and largely authentic in nature, where mobile technologies have supported such activities. In authentic learning, learning is situated in learners context of real world situations, allows learners to use their experiences, and it is problem solving in nature [12]. In learning by doing, it is essential for meaningful learning to take place in a learner's social and psychological environment [13].

Learning organised non-formally in rural contexts needs to map and maximise the available assets in rural learning ecologies [14]. In doing this, Hlalele claims the need to exploit the available community assets where innovative technologies like distance placed learning, problem solving learning and high level of volunteer support from significant others in communities is vital. To clearly exemplify how the rural learning ecologies have emerged with the use of mobile technologies (mobile phones), the case study below depicts the situation in western Uganda, Great Bushenyi Region.

# 3 RESEARCH CONTEXT AND METHODOLOGY

## 3.1 Uganda

Uganda, as a land locked Country located in Eastern part of Africa has 38 million people. The economy is largely agrarian, with agriculture (75%) the main provider of peoples' livelihoods. In the country, mobile phone subscriptions have reached up to 19.5 million mobile users, where mobile coverage is up to 90% even in rural areas [15, 16]. Despite the low literacy levels in the country, with English as the formal language, the mobile economy in the country is blossoming than ever before. The study was conducted in the Districts of Lubirizi and Mitooma in western Uganda, where agriculture (mainly smallholder) is the main economic activity, supporting over 80% of rural households. The agriculture extension system in the country is at its low performance which makes many farmers lack the necessary agricultural information [17]. Getting the right kind of farming knowledge when in remote communities is quite difficult. In such resource limited environments, information travels slowly, and outdated techniques are keeping farmers backwards in terms of recent innovations in farming. Such has prompted both local and international organisations like Grameen Foundation to establish a mobile system that would help farmers access up to date agricultural information, as a way to access actionable information to uplift their livelihoods [18].

### 3.2 The Community Knowledge Worker (CKW) Project

The Grameen Foundation - CKW project in Uganda uses mobile phones as a way to get information and services to and from poor communities in rural areas. Launched in 2009, the project serves farmers in remote communities through a network of peer advisors (locally termed *CKWs*). This initiative combines mobile technology and human networks to help smallholder farmers get accurate and timely information to improve their businesses and livelihoods. The programme considers phones as a powerful two-way communication device and the organisation puts emphasis in generating innovative ways to collect and disseminate information [18].

CKWs are trusted local intermediaries serving farmers who frequently lack basic access to up-to-date information on best farming practices, market conditions, pest and disease control, weather forecasts and a range of other issues. These intermediaries, who are often farmers themselves, use mobile technology to deliver agricultural information both to and from the smallholder farmers through face to face and group meetings. Inherent in such meetings are non-formal learning activities. The CKW model is designed to improve farmers' lives by enabling them to get the information they need to improve yields and have broader access to lucrative markets and weather information. By creating a network of CKWs throughout Uganda, Grameen aims to revolutionize agricultural knowledge-sharing and, in turn, improve yields, reduce losses, and increase incomes of poor smallholder farmers. Additionally, CKWs collect agricultural information from farmers, providing a vital link between farmers, government programs, non-governmental organizations and other entities focused on improving agriculture in the country [19]. These CKWs with equipped smartphones offer extension services to many smallholder farmers in rural areas where extensionists are not easily accessed.

### 3.3 Research Methodology

A socially constructivist qualitative study from multiple case sites of Grameen CKW project in Lubirizi, Kateerera and Mitooma parishes in western Uganda was adopted. Through interviews, informal discussions, Focused Group Discussions (FGDs), and participant observations, data was purposively collected from the prospective parishes. Primary data collection involved series of semi-ethnography interactions where the research team stayed and lived with the communities to clearly analyse the non-formal learning interactions among smallholders with mobile phones as main media. Secondary data sources included organisational reports, local government reports, and locally generated materials from the different parishes. The study reached out to 50 farmers and 10 key informants who were part of the CKW project. These farmers included the CKWs, both men and women aged (25-60 years) with access to smart phones fully installed with agricultural content. For such a qualitative study, the 60 participants were a representative sample given emphasis on thick and deep data with socially constructed analyses. NVivo tool aided the analysis through code classification themes like practice and use of the technology, nature of learning, as well as possibilities and constraints of using mobile phones for learning.

To ascertain reliability and validity of information obtained, several follow up discussions with study participants were conducted. This was through making phone calls, but also staying in contact with farmers on WhatsApp CKW groups. Also, since the research team interacted with communities every month; a constant interaction with study participants to check on validity and reliability of findings was possible.

## 4 NEXUS OF PRACTICE AND USE OF MOBILE TECHNOLOGIES IN NON-FORMAL CONTEXTS

Ethics in education demand that, even those, the poor and the less privileged in society can have access to education and training. The smallholder farmers in this case can be empowered through new technologies like mobile phones to have access to educational content that can help them uplift their livelihoods. Usually and often, infrastructure in such resource limited environments are unfavorable to engineer certain development activities [20]. Yet, emergent technologies like mobile phones can support most development interventions in such regions given their accessibility and affordability.

From the case study above, although the mobile technology project appears to be catalytical in addressing poverty especially through availing information to farmers, from a deeper perspective, this technology offers learning possibilities amongst both farmers and project implementers. Learning in this project is highly categorized as non-formal. And as earlier discussed, majority of the participants in the project are adults, older men and women who are self-driven and highly motivated to engage in new education initiatives. This learning is informed by ways of managing pest and diseases, how to manage crops, market and weather information, as aspects of extension education. Based on our findings, smallholder farmers learn through face to face individual and group meetings, as well as online interactions. More significant is that mobile phones carry agricultural content which they use to ignite face to face conversions. The mobile phones act as digital libraries which facilitate a spiral over effect in information access and sharing with other farmers in the community. Put rightly by Ally, 'rather than acquiring another technology to receive learning materials, people throughout the world will want to access learning materials on their existing mobile devices' [21], as the case with famers in the CKW project.

For smallholders like these, learning is not a matter of getting certificates and job qualifications, learning is about acting on, and addressing the livelihood challenges they face. Put rightly by Wenger [22], 'learning is not just acquiring skills and information; it is becoming a certain person-a knower in a context where what it means to know is negotiated with respect to the regime of competence of a community'. Mobile learning in this context places learning in people's environment and context which the social learning theory agitates for. Learning is participation in the social world where individual experiences have to be integrated in the learning process. Central attention is placed on participation of all learners in a group to achieve a common goal. As Ally and Prieto-Blázquez [23] notes, the use of mobile technologies can develop communities of learners which in turn contribute to collaborative learning.

## 4.1 Community of Practice – Social Learning Theory

"Communities of practice are a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2006:1). The Community Knowledge Workers (CKWs) are a 'community of practice' in their locality. These possess a shared passion of learning together and regularly interacting with other farmers who have no access to mobile phones content. In this social learning theory, individuals and social institutions are not a focus of analysis, but rather; communities of practice. The theory explores systematic intersection of learning components like: community, practice, meaning, and identity which provide a conceptual framework of analyzing learning as a social process [24].

- Meaning implies our ability to experience the world as meaningful
- Practice is about shared historical and social resources, frameworks and perspectives that sustain mutual engagement in action
- Community is social configuration in which our enterprise is defined and our participation is recognizable as competence
- Identity is about how learning changes who we are

Figure 1 below exemplifies the community knowledge workers community of practices as viewed from project interventions in the rural community visa vie the day to day farmers' learning interactions.

## 4.2 Community Knowledge Worker Community of Practice

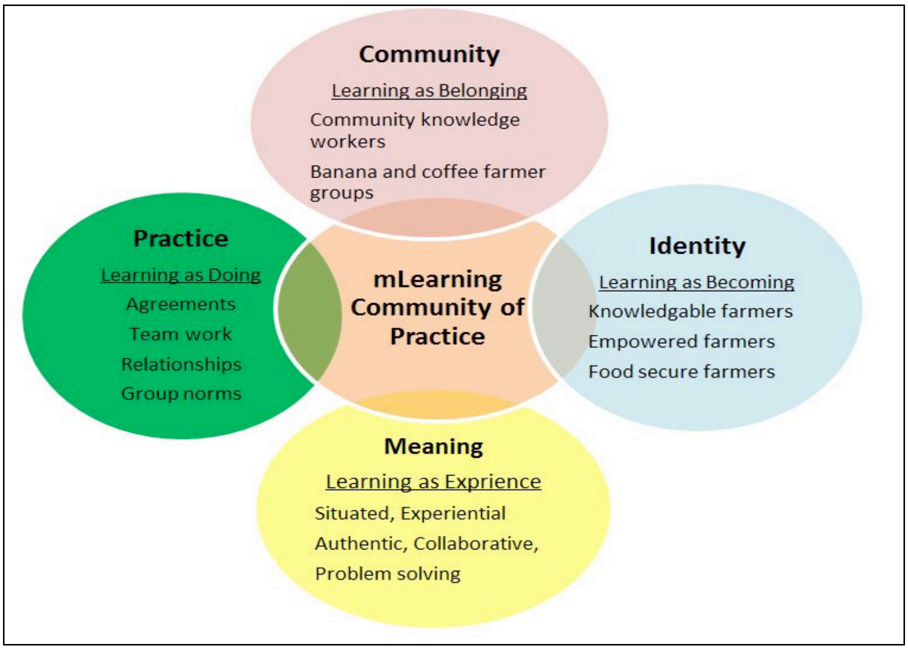


*Figure 1. Adapted from Wenger (1998)*

To juxtapose the above community of practice elements to the mobile learning for farmer's context, central in this learning is that participants are social beings. They belong to a community of farmers defined by a particular identity. The farmers in western Uganda - Katerera, Mitooma and Kitaggata sub counties where the study was conducted deal in similar enterprises like banana plantations, coffee plantations, animal rearing at a subsistence scale, and growing other food crops depending on the season. These similar enterprises situate farmers in the community and identify them as farmers in the same region with particular sameness. 'Knowledge here is about competence with respect to valued enterprises' [24]. Learning in this case is defined as 'belonging' and as 'becoming' for the community and identity components respectively. Farmers here want to become not only knowledgeable and empowered farmers; but also food secure farmers who broadly look at farming as a business.

Second is 'practice' and 'meaning'. ''Knowing is about active engagement in the process of learning where meaning is ultimately what learners produce'' [24]. In Practice, learning is about doing and in meaning; learning is about experience sharing. In the CKW project; although knowledge on the mobile phones seem uni-directional that is, instructivist and one-way, this is not the case in the field. New updates on particular farming enterprises are uploaded on the mobile phones through several consultations with NAADS[2], researchers and the farmers themselves. The CKWs share this information with farmers in different villages in form of one-on-one and through group meetings. During the actual facilitation exercises, the content on mobile phones ignites further discussions which is tailored to local circumstances and takes into account other farmers experiences. The more experienced farmers discuss and agree with the CKWs on what works and what cannot work depending on their circumstances like availability of farm inputs, indigenous resources and money. Such working relationship amongst farmers is possible with the availability of agreements, relationships, team work, and group norms agreed and suggested upon by the community of farmers. For example, each group (usually of 50 farmers or more) agrees on when to meet, where and on whose farm land. These meetings are rotational where at the end of the season; each participant farmer must have had a chance to host a group meeting. Quite interesting is that as these relationships advance, they give birth to new relationships in the community. A case in point is the presence of many village saving groups in the community, all breeding from the CKWs and farmers community of practice.

Conversely, not all farmers have access to smartphones with mobile content. Phones are only accessed by the CKWs who act as change agents in their locality and voluntarily agree to reach out to

[2] National Agricultural Advisory Services (NAADS) is charged with ensuring that the agricultural extension system reaches all farmers.

‘the rest’ through mobile phones. The ones termed as ‘the rest’ are farmers who have not been given smart phones with mobile content, but often have access to their small end (usual traditional) phones. These use their mobile phones to call and interact with the CKWs on issues pertaining farming in case the CKWs are at a distance. This is conversational learning in mobile learning terms. To Sharples, Taylor [25], mobile learning is a process of knowing and sharing with others through conversion across multiple contexts among people. In this regard, the learner and the technology are not the centre of attention, but rather, the communication interactions that goes on informs learning.

> *“…Learning here is a conversational process of becoming informed about each other’s ‘informings’, to cognition as diffused among interactions and reciprocally constructed conversation, and contexts not as a fixed shell surrounding the learner, but as construct that is shaped by continuously negotiated dialogue between people and technology”[26].*

In this perspective, learning is a process of coming to know and the ability to share this knowledge with others in the network. Learning involves change in knowledge and attitudes, which leads to acquisition of new skills and new ways of relating to practice [27]. What’s App is another enabling feature that has supported conversations and sharing amongst the CKWs with a handful of farmers (mainly young farmers) with smart phones. These share ideas amongst themselves on the social media which also supports learning as highly recommended by Paul, Godfrey [28] who believe that WhatsApp has embedded affordances that not only provided learners support but also makes learning fun.

To sum up the observable learning that takes place on mobile phones among smallholder farmer communities, I strongly see features of authentic learning and social constructivism. To begin with, authentic learning is ‘a pedagogical approach that situates learning tasks in the context of real-world situations’ [29]. In this learning, learners are given a chance to use their experiences, place learning in their context, where learning is highly problem solving. Knowledge attained on the mobile phones among the farmers is real life - used to address farming challenges in their locality. During farmer discussions on ground, they engage in real life situations and all farmers are given a chance to have hands-on, that is learn by doing during facilitations exercises. Access to expert performances and modelling is a key element in authentic learning [29]. Farm experts, researchers, and model farmers show different farming techniques which make it possible for other farmers to model behaviors and replicate on their farms. Because CKWs are usually trained and given additional knowledge, they often model farming techniques to other farmers which supports learning. Reflections, coaching and scaffolding are all available techniques employed in the CKW project which in turn support deep learning among farmers.

Second is social constructivism. As a facilitation design, social constructivism largely capitalizes on collaborative learning and learner engagements. Learners become co-creators of knowledge since they know their context best and what suits them. Here, learning is by doing and largely relies on the learners’ experience [30]. To this theory, social events are essential contributors to learning and development. Socially meaningful activity is as important as human consciousness. The social environmental therefore influences cognition through tools like mobile devices [31]. Given that the farmers have vast knowledge base of experiences which any learning needs to capitalize on, in the CKW project, it was clearly visible that some experienced farmers possessed more knowledge than what was available on mobile phones. This made other farmers benefit through collaboration and dialogue. Additionally, farmer’s learning was not limited to only content on mobile phones, they too had a chance to use and build on what they had acquired previously. This concurs with Schunk [31] observation that social constructivism permits the use of material through manipulation of the social interactions. Change results from combination of tools (mobile phones and experience sharing) in social interactions and from internalising these interactions. This is in line with dialectical constructivism because of focal emphasis on peoples’ involvement in the learning process.

## 5 DISCUSSION

> *‘The widespread diffusion of mobile and wireless technologies, although on a global scale, is certainly not uniform and independent of economic and cultural factors, and offers an opportunity to develop education policies aimed at increasing participation in education, … considering that the use of mobile devices, in some respects, transcends age, social status, economic level, gender and ethnic origins…’ [32].*

Although Castells, re-echoes mobile communications as the fastest growing technology in world history, he further highlights that ‘‘alongside the development of trends in mobile communication that could be considered global, other trends unique to individual ethnic, cultural, or national characteristics are also found’’[33]. By implication, as we analyse mobile learning in non-formal contexts, the context, local and societal considerations must be up front. The mobile learning in developed countries cannot be the same mobile learning in developing regions. In Uganda for example, the context of mobile learning for development presuppose other affordances that mobile technologies can offer to communities in such locations. Thus the need to appreciate diversities in contexts visa vie unveiling opportunities to increase access to educational for all.

Taking the non-formal learning perspective, for the Mobile for development projects, I intend to refer to all those running education programmes with elements of informal and non-formal. As Ngaka et al claims, ‘‘opportunities for integrating formal and non-formal education are not ubiquitous, but (rather) deliberate efforts to respond to communities’ identified and expressed needs’’ [34]. Learning in non-formal contexts is embedded in practice based context where learning becomes a problem solving venture that aims at addressing real life context based problems. Several of these programmes have been integrated in the provision of non-formal education in Uganda, famous of these being those organised by NAADs in the agricultural extension system. This paper therefore tries to analyse how new technologies like mobile technologies (mobile phones) can support and extend the provision of these education systems to reach the marginalised and hard to reach populations in Uganda. Usually and very often are the smallholder farmers in these trainings. They form the largest sect of masses in dire need of such educational provisions. Smallholders are less empowered with low literacy levels. They need support on how to update their knowledge to cope with the current challenges as is with farmers in the CKW project. Farmers here noted some benefits like increased social networks, development of leadership skills, better farm management practices, increased farm yields, empowerment, among others. They however encountered varying constraints like the breakdown of mobile phones, inability of some farmers to apply the knowledge gained due to lack of capital, cultural resistances, and intermittent networks.

This age and era of climate change hits these smallholder farmers twice [3]. Most governments in developing countries cannot ably reach out to this majority, and yet, 70% of the world food production emanates from these smallholder farmers. Since these have access to mobile phones that can be used to increase their education and become empowered, development actors need to devise ways on how to exploit technologies people have. This will help farmers thrive and become resilient. Needful to note is the fact that most smallholder farmers engage in different livelihood activities. The common adage *‘do not put all your eggs in one basket’* makes majority venture in several of these livelihood activities. The current fallouts from uncertainties in marketing and seasonal challenges yet, there is no available insurance program in the country to support and insulate such farmers in case of any damage affects majority. This permits multi-engaging and multi-tasking a daily routine. And indeed, no single programme can address farmer livelihoods challenges. An eco-system approach - where different actors network to address different livelihood challenges can help to change lives of such communities.

Most of the ICT programmes in developing regions are donor supported. Few governments in developing regions have taken the lead to establish these programmes, as majority are supported by donor aid agencies and civil society organisations. And because of this, most researches exploring impact of ICT towards learning have tended to focus on immediate impacts; thus, more research is justifiable to measure the long-term social impact of education ICT investments [20]. More so, Kozma and Vota [20] outline tremendous challenges that go along with the implementation of ICTs in developing countries like Uganda. For example, deploying the ICT infrastructure, developing relevant content, leveraging community inclusion to expand impact and sustainability are key challenges facing ICT projects; mobiles for development inclusive.

Most of the projects deploying mobile content in Uganda suffer from digitising the mobile content given the lack of a national language that unifies all people in the country. Each project faces cost implications given the multi-lingual nature of Uganda. This affects impact and scalability, which in turn hinders sustainability as many projects rely on donor funding to have content translated in the over 80 languages in the country. This is indeed a setback, especially when a country like Uganda’s adult population is illiterate. Supported by Kozma and Vota [20], ‘covering the total cost of ownership of ICTs’ is a serious challenge in developing countries’. A case in point is Grameen Foundation, an International NGO that came in the name of helping poor farmers access electronic content on mobile phones. However, the fully equipped smart phones are not accessible by the general public, be it government, including me a researcher who became interested in the electronic agricultural content. It is only for farmers and communities who have partnered with Grameen. A deep inquiry on what explains this position, the National coordinator in the CKW project had this to say,

*'We cannot just allow everyone to access our mobile content. We define and control who has access to it through our ICT system. We have on several attempts asked Government to partner with us and see how we can upscale the project to other districts, but we have met several resistances from government officials. Grameen has invested a lot in this ICT infrastructure; we cannot just let it swing in the public as this will kill our effective system'.*

Therefore, Grameen still has full control over the electronic content and they would rather close down the project in case government fails to fund the already running projects. All this is about the total cost incurred during the implementation of the ICT infrastructure; which stifles further development in the country. So, it is only those farmers in districts where Grameen is operating who benefit from the mobile content, which attempt again increases the digital divide, mobile technologies would have reduced. More research is needed to ascertain this position before conclusions are made!

## 6 CONCLUSIONS

Emerging technologies like mobile technologies are upfront in ensuring increased access to educational opportunities, especially in developing countries, where increase in mobile phones usage has been regarded as the fastest in technological history. It has been noted that mobile technologies play a supplementary role and not a replacement to the existing educational programs. Despite the high regard of mobile technological innovations in teaching and learning in the formal education, non-formal learning environments can also benefit from these technologies. Mobile technologies like mobile phones are readily available to many (including farmers outside formal learning) and if well integrated, they can support learning for livelihoods. With this realisation to include the marginalised, like the case with communities in resource limited environments, mLearning integration becomes not only justifiable, but rather an ethical undertaking in increasing access to educational opportunities; as the case with smallholder farmers in resource limited environments in Uganda.

Needful to note is that in such non-formal contexts, farmers engage in several activities in order to secure their livelihoods. It is typical for smallholder farmers not to specialise in a single enterprise given challenges like seasonal changes, lack of land, capital, necessary farm inputs, and lack of available insurance programs to support them in case of damage. Therefore, no single programme can address all livelihood challenges of these smallholder farmers. Government, private sector and civil society cannot manage alone. An ecosystems approach is needed where a consortium of the different development actors network to support such communities. The challenge therefore is for mLearning practitioners to explore ways on how to create new content, enhance intercreativity, and knowledge sharing among participants [6], responsive to the different enterprises. Most available mobiles for development projects in developing regions are highly donor funded, which questions the sustainability of such projects as majority end up 'limping' when donor funds stop. Although all farmers in the project attested to the increased learning afforded by mobile technologies, visible factors like social relations and networks among farming communities influenced the use of mobile phones for learning. Therefore, there is a need to further explore the role of such social networks in facilitating and strengthening smallholder farmers' resilient capabilities while using mobile learning for livelihoods.

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