Underneath the Mango Tree

Situated knowledge sharing among subsistence farmers and the innovative CS4D approach

Mango Tree, Market Place; Zanlerigu Village, Ghana (March, 2015)

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Abstract

There is an on-going debate in ICT4D on how ICTs can benefit international development best. The ICT4D debate shifted from a top-down technology transfer approach to a more particular, context specific and locally embedded approach. Both approaches often led to ICT4D project failure. Therefore, the ICT4D debate focuses nowadays more on the question how both approaches can be combined best: a quest to find a pragmatic balance between sensitivity towards local context and a need to standardize between contexts. This thesis provides a contribution to this debate by introducing Computer Science for Development (CS4D) as a new approach towards the ICT4D discourse. CS4D focuses on a more generic understanding of the technological and societal restrictions, requirements and impacts of ICTs enabling rural development. An in-depth qualitative study was conducted in Upper-East Ghana in order to do research on the societal and technical constraining and enabling criteria for developing a low-cost, replicable and easy to use ICT hardware tool (i.e. the 'Kasadaka'). A device that enables the flexible development of contextualized ICT applications. The study shows that local knowledge is situated in practice and contextual embedded. ICTs that enable the improvement of rural livelihoods should take these situated knowledge processes into account. This asks for an agile software engineering approach wherein a rapid prototype platform such as the Kasadaka can function as a valuable means to an end.

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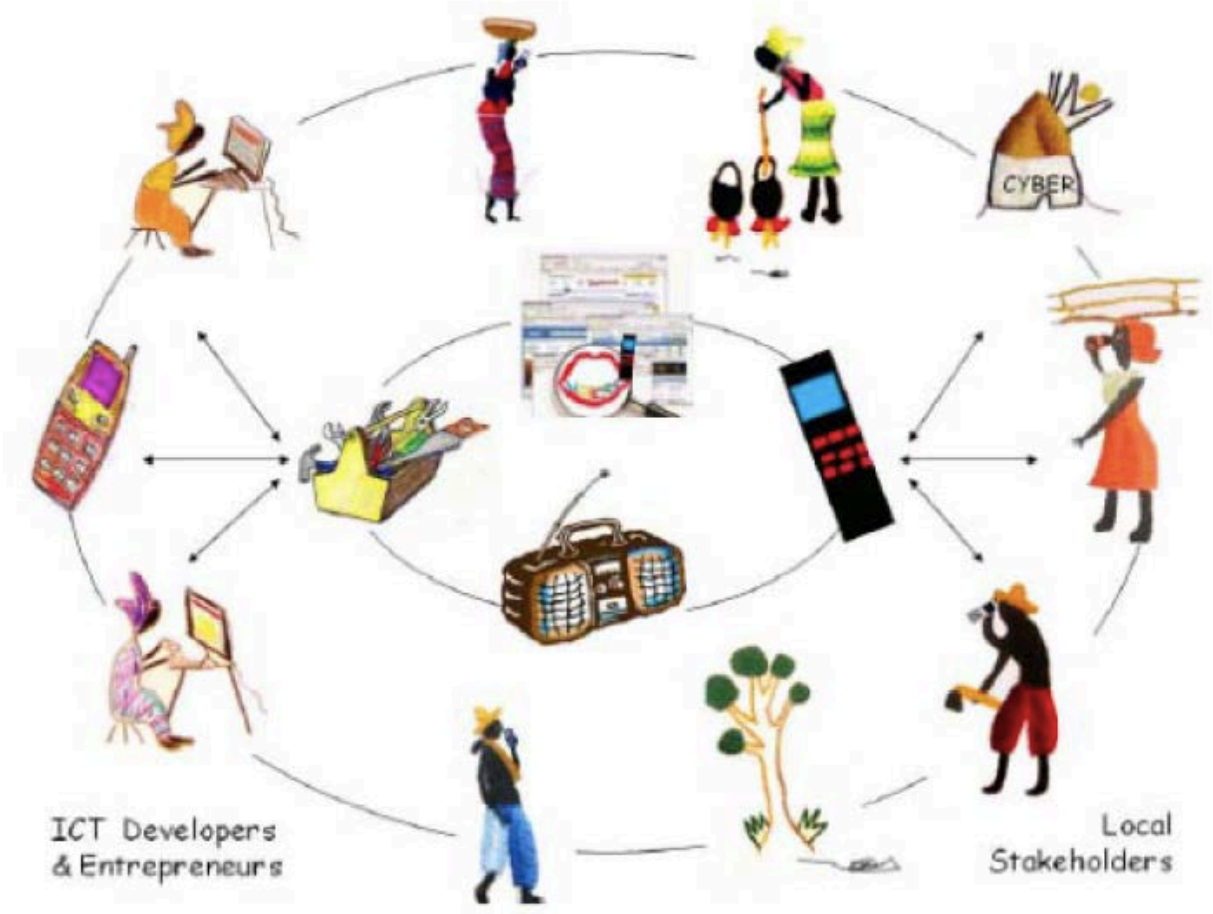


Source: VOICES, 2011

1. Introduction

> *'Are the benefits of digital technology out of reach for the poorest, most vulnerable people in African countries?'*
>
> *'If only all digital devices were actually designed with emphasis on accessibility then perhaps we might find ways in which technology is being used to reach the poorest and most disadvantaged at the moment in Africa'*

The aforementioned is an answer to a highly complex question, which is given by Information and Communication Technology for Development (ICT4D) scholar Tim Unwin (UNESCO Chair in ICT4D, n.d.). It grasps the core ideology of the ICT4D discourse, which is rooted in the assumption that access to information and knowledge sources are important conditions for development, and emphasizes ICT as a critical enabler in this regard (Ferguson et al., 2013). Since the 1990s an ICT revolution took place and has now come to be a significant part of the everyday lives of billions of people (Kleine & Unwin, 2009). However, more than half of the world lives in so-called developing countries who often lack access and the ability to use ICTs effectively (Sahay & Avgerou, 2002; Walsham & Sahay, 2005). This is known as the 'the digital divide' and ICT4D aims to tackle and resolve this challenge by rolling out ICTs to the poor, enabling them to become independent users through connecting them to valued information and knowledge sources (Heeks, 2008). The improvement of access to and use of ICTs is perceived to enhance greater participation from the development beneficiaries, by representing the possibility for the poor to carve out their own spaces for change (Ferguson et al., 2013; Heeks, 2008). However, there has been an on going debate on *how* ICTs can benefit international development issues best (Walsham et al., 2007).

Nowadays ICTs are widely accepted to be of high potential value towards improving the livelihoods of the poor (Unwin, 2009; Walsham et al., 2007). However, the application of ICTs has not always been successful and has many examples of failure (Walsham & Sahay, 2005). Firstly, many of the failures in ICT4D practice are caused by the tension between standardization and localization. In recent years there is a trend in developing global systems and approaches that aim to transfer best practices and procedures crossing contexts and countries. This caused a tension in developing such a system: 'between the desire to standardize for efficiency and comparability purposes, and the difficulty of imposing the same standards on different local contexts' (Ibid: 5). Take for example Thompson's (2002) research on health clinics in the

Western Cape province in South Africa. He explored the way in which raw data was generated, mostly through manual forms, and noted how this created problems due to a mismatch between the needs of the system and the situated knowledge of the nurses. Secondly, in line with Thompson's (2002) research, most ICTs that enable development are often developed by those external to the poor, effectuating designs that mismatch local realities, and thus often fail (Heeks & Robinson, 2013). Thirdly, Foster & Heeks (2013) point out the so-called issue of scalability. Which relates to how small-scale pilots can be transmitted across a wider geographical compass (Walsham, Robey & Sahay 2007). There is thus a missing middle knowledge gap in ICT4D on how to innovate generic and scalable ICTs that are still capable to be harnessed towards locally relevant problems (Sahay & Avgerou, 2002; Foster & Heeks, 2013). Therefore, the challenge remains to tackle this duality and to find compromising suitable solutions.

According to UNDP (2012), there are almost one billion subsistence farmers worldwide who are often characterized as information poor. These rural poor typically lack access to information vital to their lives and livelihoods (UNDP, 2001) Therefore, it is urgent to seek for the best ways to support these farmers in terms of information, technology, advice, and empowerment (UNDP, 2012). It is argued by various scholars that the incorporation of local knowledge in development practice, such as the knowledge of subsistence farmers, is key in resonating development solutions with the most pertinent local needs (Ferguson et al., 2010; Briggs & Sharp, 2006; Powell, 2006). People's ability to articulate, share and store local knowledge is therefore perceived as an important condition for improving livelihoods (Ferguson et al., 2010). Local knowledge can be understood as knowledge that is situated: what people know is embedded in the daily practices of a particular social and physical context (Sole & Edmondson, 2002; McFarlane, 2006). ICTs that enable situated knowledge sharing should thus also be particular, context specific and locally embedded (Avgerou, 2008; Walsham et al., 2007). However, for various reasons, especially cost considerations, such a perspective is not feasible to work out in practice when involving multiple interconnected sites (Rolland & Monteiro, 2002). Therefore, there is an increasing need for innovative and flexible technology that creates low-cost and easy to use devices intended for supporting local rural information and knowledge needs (ODI, 2002).

Computer Science for Development (CS4D) aims to bridge the missing knowledge gap still prevalent in the ICT4D discourse. For instance, the CS4D discourse focuses on a more generic understanding of the technological and societal restrictions, requirements and impacts of developing and implementing innovative ICTs in a development context. CS4D emphasizes thus a more generic approach towards innovation and design that differs from solely worrying about

specific contextual ICT applications and tools. Through developing low-cost, replicable and easy to use ICT hardware CS4D focuses on grass-roots innovation, enabling local software designers to create application designs that match local needs, resources and context (Heeks & Robinson, 2013) This thesis is based on an interdisciplinary research wherein myself, a social scientist, closely collaborated with Awa Gossa Lô, my associate from Computer Science of VU University Amsterdam. The aim was to gain a deeper understanding of a specific socio-economic rural development context and the existing technical infrastructure. In order to retrieve the societal and technical constraining and enabling criteria for developing low-cost, replicable and easy to use ICT hardware that enables the flexible development of contextualized ICT applications aimed towards supporting and facilitating situated knowledge articulation, sharing and storing. The main question of this research is as follows:

> *How can local, situated knowledge processes be more accurately supported and facilitated through flexible, low-cost and easy to use ICTs, toward the development of subsistence farmers?*

In order to answer this question a qualitative research was employed in Amsterdam, the Netherlands and in Upper East, Ghana. These research sites were selected due to the embeddeness of the research's fieldwork in previous research of the Web Alliance for Regreening Africa (W4RA, attached to VU University Amsterdam) and its close collaboration with the Ghanaian University of Development Studies. The specific research site of Zanlerigu village in Ghana was chosen due to its remote, poor and rural criteria. The study relied on 15 in-depth semi-structured interviews with local subsistence farmers, five in-depth semi-structured interviews with ICT(4D) professionals and two focus group discussions with local subsistence farmers. The study also relied on the everyday observations and experiences made by the researcher, which were documented in a field journal. The study revealed that for most subsistence farmers it was difficult to articulate information and knowledge needs that could improve their livelihoods. A rapid prototype platform that meets generic requirements and is flexible enough to adapt to situated knowledge processes captured in user stories could become a valuable contribution towards the development of subsistence farmers. Such an innovative CS4D approach also enhances the inclusion of local software developers in the development and implementation process of contextual dependent and sustainable ICT solutions.

This thesis is structured as follows: the following chapter provides a theoretical framework towards theoretical and empirical debates towards ICTs enabling development. This includes conceptualizations on development, local, situated knowledge, ICT4D and CS4D. This chapter also discusses the contextual background of rural development, the researched context of Ghana

and specifically the context of Zanlerigu village. The third section provides a detailed overview on the methodology used for study. Section four provides a qualitative analysis of the empirical findings. Section five discusses the findings, relates the findings to relevant theory and foresees in steps for further research. The last section contains the conclusions.

2. Literature review

2.1. Conceptual Background

2.1.1. Participatory Development: controversial but key to development

The realm of development theory and practice originated at the end of the 1940s (Escobar, 2012; Gardner & Lewis, 1996). In virtually all its usages development implies positive change or progress. Furthermore, it also evokes natural metaphors of organic growth and evolution (Gardner & Lewis, 1996). However, the question of what development is, how it should be achieved, what outcomes it should have and what should be the guiding principles, remains debatable until today (Potter et al., 2008). Development is thus a controversial notion, subject to a long theoretical debate, influencing development policy and action (Avgerou, 2008).

Since the 1990s until today the development debate is dominated by the discourse on participatory development, which claims a more inclusive approach towards development issues and practice (Ferguson et al., 2010). The debate inspired the development sector to search for alternatives towards the prevailing top-down approaches (Chambers, 1994). Wherein development was perceived as closely related to modernization: as a process of economic and social change that emerged from the West and should be expanded to the rest of the world (Schech & Haggis, 2000). The *post-development* discourse became therefore a countermovement in the 1990s (Escobar, 2012; Rahnema & Bawtree, 1997). A discourse emerging outside of Western modernity, embracing the knowledge, aspirations and ways of living of the intended development beneficiaries which are the poor and dispossessed of the development countries (Schech & Haggis, 2000).

As a result, mainstream development –everyday development talk in developing countries, international institutions and development cooperation- has gradually shifted from the preoccupation with economic growth towards a participatory and people-centred definition of development (Nederveen-Pieterse, 1998). Within this view development relates to expanding people's freedom and opportunities towards articulating and satisfying their basic human needs and achieving the outcomes that they value most (Sen, 1999; Walsham et al., 2007). These interests and basic needs can relate to economic growth and physical well-being as well as to social and political well-being (Madon, 2000). Furthermore, the agenda setting of development

initiatives constitutes the inclusion of voices and priorities of development beneficiaries (Briggs & Sharp, 2006; Escobar, 2012). The focus of participatory development lays therefore on bottom-up social mobilisation of the intended beneficiaries with more sensitivity towards the situated development context (Mohan & Stocke, 2000; Hickey & Mohan, 2005).

This research is embedded within a post-development theoretical framework. Embracing the ideology of development interventions to be contextually embedded and therefore inclusive. The debate on participatory development also enhanced awareness within the development sector that local knowledge of the intended beneficiaries was often wrongfully overlooked (Ferguson, Huysman & Soekijad, 2010). Participation is therefore understood as follows: the involvement of beneficiaries in the development and implementation of a development project (Gardner & Lewis, 1996). More precisely, development interventions depend to a large extent on the knowledge of the local population and a deep understanding of the socio-economic reality that the development intervention intends to change (Powell, 2006). The development beneficiaries are thus the ones who articulate their own development needs and perceptions by determining the prevalent knowledge gaps and information needs. What particular role knowledge holds within this participation process will be elaborated in the next section.

2.1.2. The central role of situated knowledge in development theory and practice

An important principle of participatory development is the incorporation of local people's knowledge into the development and implementation of development programs (Mosse, 2001). Since the 1990s knowledge and learning became therefore increasingly recognized as significant contributors to the development practice, wherein knowledge of the intended beneficiaries was seen as 'key in resonating development solutions with the most pertinent local needs' (Ferguson et al., 2010: 1798).

Within the discourse of knowledge management knowledge is often conceptualized via two juxtaposed epistemologies, namely the objectivist and the practice-based perspectives (Hislop, 2009). The objectivist perspective views knowledge as a commodity or entity; as formal and static and therefore capable of being communicated or shared through scientific models translatable in computer programs such as ICTs (Ferguson et al., 2010). The conceptualization of knowledge as some form of commodity, which can be made explicit and unproblematically dis-embedded from one context and re-embedded in another, has been firmly criticized within the discourse of knowledge management in recent years (Puri, 2007). Instead, there is a growing emphasis towards a more human-centred approach to understand how different forms of knowledge are created and shared. Knowledge is therefore perceived as context-specific and situated in practice, both

characteristics of the practice-based perspective on knowledge (Gherardi, 2000; Orlikowski, 2002).

Central to the practice-based perspective is the acknowledgement of situated knowledge: what people know is embedded in the daily practices of a particular social and physical context (Sole & Edmondson, 2002). Learning and knowledge both derive from our experience of participating in everyday life. In this sense knowledge is thus understood as a social construct, wherein learning and knowledge are constructed through social interaction with others (Lave & Wenger, 1991). Situated knowledge is thus inseparable from human activity (Orliskowski, 2002), and socially constructed. Within the practice-based perspective knowledge is perceived as subjective and open to interpretation and therefore never totally neutral and unbiased. Both the production and interpretation of situated knowledge requires an active process of meaning making during interaction with others. The acquisition and sharing of situated knowledge occurs therefore typically during immersion in practice and through rich social interaction (Boland & Tenkasi, 1995; Hislop, 2009.). This is a juxtaposed response to the objectivist perspective, in which knowledge sharing is viewed as a transfer of explicit knowledge between a sender and a receiver, as if knowledge is some kind of universal truth (Hislop, 2009).

In sum, when situated knowledge and learning of the intended beneficiaries are perceived as significant contributors to development practice the context specificity, the situatedness in practice and the social-constructivist elements of the practice-based perspective towards knowledge should be taken in mind. The role that ICTs can play in situated knowledge processes also has been subject of extensive discussion in Information System and Organizational literature (Puri, 2007). Namely, despite the fact that ICTs have some added value in terms of development related information needs, ICT can significantly reduce the tacit assumptions and local values that underpin situated knowledge (Ferguson et al., 2010). Thompson (2004) argues therefore that the way in which ICTs are developed and implemented should be highly sensitive to the situated practices and values of the development beneficiaries. This debate will be further elaborated on in the next section.

2.1.3. Bridging the gap within ICT4D: CS4D as an emerging solution

ICT has been acknowledged as particularly useful in facilitating knowledge sharing and gaining access to knowledge (Alavi & Leidner, 2001; Ferguson et al., 2010). Considering the recognition of knowledge to be a significant contributor to the development practice, the development sector also embraced ICTs as important tools for enabling marginalized people to fulfil their information needs fundamental to their development. This developed in the 1990s into a particular

development discourse: Information and Communication Technology for Development also known under the acronym ICT4D (Unwin, 2009). However, even until today there is an on-going debate within the ICT4D discourse that circulates around the question 'How can the potential of ICTs be harnessed to address locally relevant problems?' (Sahay & Avgerou, 2002). The debate within ICT4D is also dominated by two juxtaposed perspectives on ICTs enabling development, which is quite similar to the debate on knowledge within knowledge management (Puri, 2007). These perspectives are known as the technical perspective versus the situated perspective on ICT4D (Avgerou, 2008; Macome, 2008; Walsham et al., 2007).

Over the past decade criticism has spread upon the objectivist perspective on knowledge and its corresponding technical perspective on ICTs enabling development, (Macome, 2008; Van der Velden, 2002), claiming most ICT4D projects to be knowledge and technology transfers from the West that are inappropriate for local development needs. These critics developed an opposing view towards ICT4D, putting emphasis on the post-development discourse. They argue for the idea of situated knowledge, which means that knowledge is situated in practice and is therefore embedded in physical and social contexts (Sole & Edmondson, 2002). ICTs that enable situated knowledge sharing should thus also be particular, context specific and locally embedded (Avgerou, 2008; Walsham et al., 2007). Therefore, Ferguson *et al.* (2010: 1804) argue that 'the implementation of technology should be highly sensitive to the local practices and values of development beneficiaries; otherwise the use of ICTs enabling knowledge sharing may lead to their further marginalization'. However, for various reasons, especially cost considerations, such a perspective is not feasible to work out in practice when involving multiple interconnected sites (Rolland & Monteiro, 2002).

Another significant critique on the technical perspective is based upon the simplistic hierarchical perspective on data, information and knowledge; data being raw numbers and facts, information being processed data and knowledge being authentic personalized information (Alavi & Leidner, 2001). Wherein tacit knowledge often is translated into explicit knowledge in order to make it transferrable via ICTs, and knowledge is perceived to be easily and unproblematic transferable from one context into another (Puri, 2007). This can lead to a serious pitfall by reducing the ability to share local ideas and tacit knowledge significantly (Ferguson et al., 2010). The challenge lays therefore in trying to find a pragmatic balance between the technical and situated approach, which shows 'sensitivity to local contexts, and can yet draw on the benefits of economies of scale and learning that universal approaches provide' (Sahay & Avgerou, 2002: 76).

The new discourse of Computer Science for Development (CS4D) is introduced in an effort to address the knowledge gap still prevalent in the ICT4D discourse. The CS4D discourse focuses

on a more generic understanding of the technological and societal restrictions, requirements and impacts of innovating and implementing ICTs in a development context. CS4D research includes existing socio-economic structures as a fundamental requirement for being successful. It acknowledges the fact that most *knowledge sharing* is often contextual and relies therefore not on technology but is more often oral or textual in natural language. In addition, *Knowledge technology* is dealing with how technological tools can support these situated knowledge sharing processes. The CS4D perspective maintains that all knowledge technologies need to be embedded within the socio-economic context and existing infrastructure in order to develop sustainable solutions (Schlobach et al., 2015). However, there are still specific generic challenges towards the design of flexible knowledge technologies that are adaptable towards local contextualities, such as 'lack of infrastructure (Internet access, lack of electrical power etc.); incompatible interfaces (which do not take into account the languages or literacy levels) and the lack of generic platforms for creating situated knowledge sharing solutions' (Ibid: 25). Due to the interdisciplinary approach of this research it is aimed to get an in-depth understanding of the socio-economic restrictions, requirements and impacts of ICTs targeted towards overcoming the aforementioned challenges. In order to obtain an in-depth understanding fieldwork was done among subsistence farmers living in Upper East Ghana. This will be introduced in the next section.

2.2. Contextual Background

In this research I approached the rural poor or more precisely the subsistence farmers in Upper-East Ghana and explored their situated knowledge processes. In addition, I did research on how these situated knowledge processes were interpreted into the design of a CS4D tool developed and implemented by associates from Computer Science both from VU University Amsterdam as the University of Development Studies in Tamale. My choice can be explained by the following factors.

First of all, however the realm of rural development has been central to the development effort, rural poverty persists. Three quarters of the poor still live in rural areas, which make it a relevant level of analysis (Walsham, 2012; Ashley & Maxwell, 2001). Rural areas comprise substantial potential to realise development goals by harnessing knowledge such as reducing inequality, reducing poverty, and empowerment. Information and communication activities are fundamental elements to knowledge: it is information that gives content to knowledge. However, the rural poor typically lack access to information vital to their lives and livelihoods (ODI, 2002). ICTs enhance the power of knowledge for rural development significantly if they are harnessed towards overcoming the barriers of knowledge gaps and information problems (UNDP, 2001).

Therefore the main focus was on how a generic ICT tool could support the development of contextual ICT applications harnessed towards the public good type of information. 'Information can be defined as a public good when it is difficult to restrict, having low excludability, and when it keeps value to individuals regardless of whether others also acquire it because it has low extractability'. 'In the context of rural development this includes weather forecast, basic information on soils and cropping techniques, market prices and food safety etc., all of which ought to be available without restrictions or restrictive institutional controls' (ODI, 2002: 18). Access to these information topics enhance the rural poor to respond to immediate needs, maximise the potential of a particular asset at any moment and reduce the vulnerability to shocks (ODI, 2002).

Secondly, the chosen research context was situated in Ghana, because of the prevailing poverty challenges Ghana still struggles with. Ghana, also known as 'The Golden Child of Africa', is perceived as one of the most 'promising' African countries in terms of economic development. Therefore, significant progress has been made in the reduction of extreme poverty. It is also known for its increasingly stable and democratic governance and is often seen as a model for political and economic reform in Africa. However, the source of economic growth has always been biased in favour of extractive and capital-intensive services sectors, often excluding the poor, remote and rural areas (UNDP, 2015). According to statistics provided by Indexmundi (2015), almost half of the Ghanaian population lives in rural areas up to a percentage of 48,13, most of them spread out through the Northern and Upper-East region. These poverty endemic areas are often constrained by basic infrastructure that links their economic activity, which is mostly farming, to urban market centres. In addition, as it was measured in 2013, there were only 12,3 Internet users per 100 people. However, there were a contrasting 72,6 fixed and mobile subscribers per 100 people (UNDP, 2015). All of the aforementioned makes the region an interesting target area to explore in-depth how t ICTs could harness the rural development needs of subsistence farmer living in Northern and Upper-East Ghana.

Thirdly, the specific research site of Zanlerigu village was chosen because of its remote, poor and subsistence characteristics. Zanlerigu is a small village situated within the Bolgatanga district of the Upper East region. The Upper East region is one of the poorest in the country. Bolgatanga district in particular can be seen as a poor, subsistence and agricultural region. There is a low level of development in infrastructure and a lack of job opportunities. Most inhabitants are therefore involved in rain-fed, small-scale farming (Antwi Boasiako, 2012). Zanlerigu village has a population of approximately 2000 inhabitants. It stretches out in about 40 square meters and an estimated 90 percent of its land is under cultivation. Only a small percentage of the cultivated

land is under irrigation and most of the land is mixed and made up of some steep slopes, gentle slopes and some flat terrain (Wayo Seini & Nyanteng, 2003).

In sum, the remote, poor and subsistence characteristics of Zanlerigu village were most suitable for conducting in-depth research on situated knowledge processes and how ICTs could be harnessed towards supporting these processes. Myself as a social researcher did in-depth research in Upper-East Ghana on situated knowledge processes and what type of local information needs could give valuable content to these knowledge processes. My associate Awa Gossa Lô from Computer Science was responsible for the development and implementation of a rapid proto typing data platform aimed towards the development of contextual ICT applications under rural conditions: the black box or 'Kasadaka' – meaning 'talking box' in Twi language - (Bon, 2015). The following chapter elaborates on the research's methodology in further detail.

3. Methodology

This section provides a detailed description on how this research was conducted using qualitative research methods such as semi-structured interviews, focus group discussions and real life experiences or observations written down in a field journal. It will provide clear insight of how these methods were applied and later analysed. Therefore, it will furnish a structured and clear overview on how the gathered data provided me with an answer to my research question:

> *How can local, situated knowledge be more accurately represented and disclosed through ICT-enabled knowledge sharing, toward the development of subsistence farmers**?***

3.1. Qualitative research

> *'The key to good research relies not in choosing the right method, but rather in asking the right question and picking the most powerful method for answering that particular question'* (Bouchard, 1976: 402).

In order to answer the question of *how* rural farmers' knowledge sharing and creation processes are constructed in their everyday lives and *how* this can be translated into a generalizable ICT tool aimed at supporting these local contextualized processes, I conducted qualitative research. This research is rooted within a social constructivist ontological and an interpretative epistemological perspective. Within this research knowledge is addressed as a social process of interaction (constructivist) and as situated in a certain context (McFarlane, 2006). It was my aim to interpret these socially constructed processes on the basis of the informant's view of the situation being

studied and try to make sense of it (Creswell, 2003). According to Pratt (2009) qualitative research methods are suitable for addressing these *how* questions that deal with the perspectives of informants.

Our project partners from W4RA have done prior research on the topic of Information and Communication Systems in developing countries, mainly targeted towards countries of the Sahel (W4RA, 2015). However, the majority of the ICT4D literature focuses on the experiences and consequences of ICT development and use, rather than the technical and social limitations that inhibit the success of such projects (Avgerou, 2010). Therefore rich, detailed and evocative data is needed to shed light on the technical and social limitations of knowledge sharing and creation processes in a rural development context. Interviews, observations and document analyses are therefore valuable methods for exploring relative new fields. During the research the researcher needs to keep an open mind in order to follow the data inductively, figuring out what is important and what not (Edmondson & McManus, 2007). However, in the first phase of our research I gained insight towards the research topic and context, which was provided by previous W4RA research. Therefore, I developed some stronger sense in advance towards the issues that needed to be explored during the second phase of the research, which was our fieldwork in Upper-East Ghana. During fieldwork I involved in-depth probing and questioning into the conducted interviews that were responsive to the informant's individual experiences and context. On the other hand, because of my prior knowledge on the issues that needed to be addressed, I conducted the interviews semi-structured in order to cover these issues broadly and consistently with all informants (Arthur & Nazroo, 2003). Further on, I kept a field journal to write down experiences of every kind in order to retrieve information on phenomena that seem 'at first not particularly significant but may become so as the research proceeds; or they may reveal meanings different from those that I as a researcher initially assumed.' (Gobo, 2008: 205).

3.2. Field journal

During my fieldwork in Zanlerigu village I kept a journal on my experiences, feelings, small-talk and observations. The journal is therefore ' a reflection of my cognitive 'detour' in entering the unknown to emerge with the new and unexpected knowledge' (Gobo, 2008: 295). During the day I would take fieldnotes on experiences of every kind and write them down in my field journal. In order to avert chaos I categorised these fieldnotes into four categories that contained my observational notes, my theoretical notes, my methodological notes and my emotional notes (Schatzman & Strauss, 1973). Observational notes are 'thin and detailed descriptions of events and actions directly seen or heard by the researcher' (Gobo, 2008: 208). Methodological notes

'are essentially questions or reflections about how to remedy difficulties encountered during applying qualitative research methods in the field' (Gobo, 2008: 210). Theoretical notes 'are ideas, hypotheses and interpretations that come up to the researchers mind during fieldwork. They help the researcher to develop the more general theoretical meaning of observational notes' (Gobo, 2008: 211). The purpose of emotional notes is according to Corsaro (1985: 295) 'to capture the researcher's feelings, sensations and reactions to the specific features of the event observed.' These notes help the researcher's self-awareness on stereotypes and prejudices.

At the end of the day I would sit down as soon as possible, structure and analyse my fieldnotes by writing them down in my field journal as my understandings of the situations and events of that particular day. This nurtured the iterative process of data analysis, wherein hidden meanings were revealed, which I could develop into new themes and questions (Edmondson & McManus, 2007). These new gained insights were then incorporated within my topic guide, which was my main research tool during semi-structured interviews and focus group discussions.

3.3. Individual interviews

The heart of my data collection instruments consisted out of 20 semi-structured interviews. The usage of semi-structured interviews was very helpful with obtaining 'both retrospective and real-time accounts by those people experiencing the phenomenon of theoretical interest' (Gioia, Corley & Hamilton, 2012:19). Due to the method's flexibility it allows the researcher to probe emergent themes or to take advantage of special opportunities that can occur during the interviews (Eisenhardt, 1989). However, a certain structure was still extant because of the necessity to address certain issues consistently with the informants in order to maintain broad coverage. Therefore, I asked some key issues on knowledge sharing and creation in the same way each time and allowed for some probing for further information. The flexibility however remained by allowing myself to alter the sequence of issues or the way in which I phrased them depending on how the conversation was going. A difficulty was that I was depending on two non-professional translators back in Galiwei and Zanlerigu. In Galiwei the informant spoke Dagbani and in Zanlerigu the informants spoke Fra Fra. During the interviews a translator would translate what I was asking and what the farmer was telling. Because the language barrier I was not able to probe immediately into what the farmers were saying. Making it less conversational and more like a static interview from time to time. However, I had to work with the means that were at my disposal and did my best to go as in-depth as possible.

In sum, the semi-structured interviews helped me as a researcher to play a more active role in moving the conversation through specific areas concerning the informant's experiences and

thoughts on knowledge sharing and creation processes and how ICTs could support these processes. At the same time there was still scope for informants' to move on this areas spontaneously, and I remained open towards issues raised by informants (Legard, Keegan & Ward, 2003). However, the language barrier caused the interviews not to be as in-depth as I hoped for. In order to conduct the data I used two topic guides for guidance during conversation (see appendix A & B). A topic guide gives the researcher a concise overview of the issues to be explored through the use of single words or phrases. The formulation of the questions happens thus during interviews. This encouraged active interviewing and responsiveness to the situation (Arthur & Nazroo, 2003). Furthermore, all of the interviews were recorded in order to furnish a more reliable data document eliminating the interpretation of the researcher as much as possible, and it enables the researcher to focus more on what is said by the informant than to write notes all the time (Gobo, 2008).

3.4. Focus group interviews

The focus group is 'a discussion-based interview that produces verbal data generated via group interaction. The aim is to build conversation among the participants rather than between the interviewer and individual participants' (Millward, 2012: 413). It is the interaction element that makes the focus group approach different from the individual interview. Therefore, focus group discussions are limited in understanding individual thoughts, feelings and experiences. However, they serve excellent for analysing social interaction (Hollander, 2004). The data was generated by this social interaction between group participants. The latter present their own views and experience, but they also hear from other people. 'They listen to and reflect on each other, and in the light of this consider their own standpoint further. Additional material is thus triggered in response to what they hear' (Finch & Lewis, 2003: 171). As the discussion progresses participants' responses will become more sharp and redefined. Eventually moving to a deeper and more considered level.

For my research I organized two focus group discussion sessions with subsistence farmers living in Zanlerigu village. Due to the language barrier I also used translators during the focus group discussions and both sessions were recorded. In order to structure the gathering of data I used a topic guide as a guideline for discussion (see appendix C). In the first topics I explored the awareness among the participants concerning the local processes of knowledge sharing and creation and how ICTs could support these processes before I introduced information on what our project aim was. This generated more discussion as participants reflected on how the given information related or not related to their preconceptions (Arthur & Nazroo, 2003).

3.5. Sampling methods

The fieldwork was embedded within existing research of Web Alliance for Regreening Africa (W4RA) and its close collaboration with Ghanaian University for Development Studies (UDS). Due to their previous research concerning ICT4D in remote and rural areas in North-Ghana they've already made way for my associate from Computer Science and me in easing the process of accessibility to the field. In advance it was determined that our research field would be the small rural village Guabuliga, situated not far away from the city Walewale in Northern Ghana. In this village our project partners from UDS and W4RA already did research back in December 2014. However, during our research in Ghana the research site changed from Guabuliga to Zanlerigu village due to facility and organizational issues. Thankfully, our contact person professor Saa Dittoh from UDS arranged accommodation for us with his relatives in Zanlerigu. Further on, the small village complied with our research setting criteria of remote, poor and rural. Eventually I spend four weeks at this research setting were I lived with the Dittoh family, conducted 14 semi-structured interviews and had two group discussions.

After the setting was chosen it was time for selecting the individuals and groups for the interviews. For this process I used the method of purposive sampling: 'the members of a sample were chosen with a 'purpose' to represent a location or type in relation to a key criterion. In order to ensure that all key constituencies of relevance to the subject matter were covered' (Richie, Lewis & El am, 2003: 78). According to the socio-demographic characters -of subsistence farmers, gender and age- the informants were chosen. Within this process I received a lot of help from my Ghanaian gatekeeper Anthony Dittoh, who is the older brother of professor Dittoh and head of the household of our accommodation in Zanlerigu. He provided me the social access needed for obtaining participants and informants. He had an important role in the rural community of Zanlerigu village and knew almost everybody.

Anthony Dittoh provided me with fourteen individual interviews. Consisting out of three women and eleven men, all inhabitants of Zanlerigu village. He also arranged one focus group discussion consisting out of 29 participants. The second focus group discussion was organized with the help of one influent farmer called Fousseyni. He was one of the farmers I interviewed individually and managed to gather 105 participants for the second focus group discussion. Before we went to Zanlerigu I also had the change to interview a subsistence farmer living in Galiwei village near Tamale. Besides interviewing farmers I also interviewed three system administrators of UDS in Tamale during two interviews and four ICT4D researchers attached to VU University Amsterdam during three interviews. They provided me with a more professional and technical

insight towards the possibilities of ICTs supporting local and situated knowledge sharing in a rural context.

3.6. Data analysis

Within the theoretical field of ICT4D towards CS4D very little has been written so far. The qualitative analysis approach of Grounded Theory is therefore most suited (Gobo, 2008). The Grounded Theory approach involves the generation of analytical categories and their dimensions, and the identification of relationships between them (Spencer, Ritchie & O'Connor, 2003). The main goal is to build a vibrant inductive model that is grounded in the data, which is a model that captures informants' experiences in theoretical terms (Gioia et al., 2009).

During my research in Ghana every week two interviews were transcribed verbatim. Because I was interviewing on a daily basis and the time consuming job of transcribing, I did not manage to transcribe every conducted interview in the same week. However, transcribing helped with getting a head start in analysis and with letting me to take advantage of flexible data collection. While transcribing I took notes, which led to new insights and adjustments during the data collection process (Eisenhardt, 1989).

In order to manage and make sense of the transcriptions I made use of Atlas.ti software for coding. The maintained coding procedure was based on the procedure proposed by Strauss and Corbin (1990:59 in Gobo, 2008: 227), which can be divided into three steps: deconstruction (open coding), construction (axial coding) and confirmation (selective coding). This enabled a systematic and efficacious analysis that is of the essence for an inductive study with 'qualitative rigor' (Gioia et al., 2012). Therefore I used the Gioia methodology (Gioia et al., 2012) during data analysis, which is a systematic approach to grounded theory articulation and credible interpretations of data. The first phase of the analysis is called first order analysis. During this first phase the researcher collects a myriad of informant terms and codes (Gioia et al., 2012), examine the data for folk concepts that can explain the observed phenomenon (Gobo, 2008). This phase is also known as open coding (Gobo, 2008). Subsequently I analysed the data again and filtered out the codes I aimed to explore further. I gave these codes descriptions and started to think on possible structures hidden underneath. This phase is also known as axial coding (Gobo, 2008).

The second phase is called second order analysis where one seeks to find the theoretical level of themes and dimensions. This is also known as selective coding (Gobo, 2008). Wherein one seeks to find an answer to 'what is going on here?' You ask yourself if the emerging themes suggests theoretical concepts that might help you describe and explain the phenomena observed (Gioia et al., 2012). Therefore I developed themes derived from theory wherein I attached the

codes abstracted from the first order analysis. This enabled me to cluster my raw material theoretically, which facilitated the structured process of writing my findings chapter. The next section will discuss the findings of this research in further detail.

4. Results: knowledge and development in Upper-East Ghana

4.1. Zanlerigu: local life in a poor, remote and rural area

Zanlerigu village can be seen as poor, remote and rural community situated in Upper-East Ghana nearby the city of Bolgatanga. The climate is characterised by one rainy season from May/June to September/October. The natural vegetation is that of savannah woodland with dried grass and some scattered drought-resistant trees. The soil is dry and low in fertility, making erosion a serious problem for farming activities. During dry season the day temperatures are very high and the humidity remains low, making the daytime temperature sometimes very uncomfortable. Because of this most people get up early in the cool morning to carry out their daily obligations and stay inside their homes during the rest of the day.

The majority of its inhabitants are subsistence farmers, meaning that agriculture is the main source for livelihood. Most of the informants depend on rain-fed farming and small-scale rearing of animals. Only a small percentage has the fortune to own farmland with access to ground water enabling the irrigation of their land during dry season. The farmers in this area deal with problems, such as failed crops and animals illness on a frequent basis and often lack solutions to these problems. The land holdings are small and often fragmented keeping the overall production low. In order to gain some extra income the farmer wives are occupied in additional earnings such as Shea Butter production, being a market vendor at the local market or working as a stone carver at the local stone mine. The men are solely occupied with the small-scale breading and selling of animals in order to gain some extra income. Most of the subsistence farmers did not attend school when they were young. Some went to evening school when they were adults. They learned some basic reading and writing in the local dialect Frafra at these classes. However, most of the subsistence farmers were illiterate and did not know the symbolic universal meaning of numbers. In the local dialect they did know the meaning of numbers.

Most of the informants noted they were happy to live in Zanlerigu village. Almost all of them were born there and felt therefore connected to it:

> *"I am connected to the land. I am born here. I am brought up here. My father grew up here. Did everything here."* (Bernartus, male, subsistence farmer, Zanlerigu)

The informants did not feel much for migrating to cities. In Zanlerigu they owned the land from which they could feed and take care of their families. Most of the children did migrate to the cities, but this was mainly for attending school. Something obligated by the national government not so long ago. However, when rainy season starts all the children return home to help their families on the farmland. They come back to their family compounds where the family lives together in extended version. The latter meaning that the family extends beyond the nuclear family; consisting of grandparents, uncles, aunties, and cousins all living together in the same compound. Some nuclear families also consisted out of one father and several mothers. Every extended family has one head of the household. This is often the oldest person also known as an elderly and has the most responsibility in taking care of everyone else. Each family compound has its own plots of farmland divided hierarchically among the several heads of the nuclear families. The property rights of farmland are solely based on inheritance and this hierarchically division among family members.

Nowadays most of Zanlerigu's inhabitants are converted and very devoted Christians. However back in the days they believed in their traditional Gods who permitted men to marry more wives if they pleased so. Today this is socially not accepted anymore because of their Christian faith and morals. Most of the younger households therefore exist of a husband and one wife. Also many important life issues such as sorrow, happiness, fortune, sickness and death were assigned to the Bible and Christianity. Many answers to these issues could be found through faith and devotion. This devotion to their Christian faith is also recognizable in their church attendance level. Every Sunday the whole family gathers and visits the local church service twice a day. During weekdays the church services are also attended twice for bible study. The pastors of the bigger churches, such as the pastor of the Desert Pastures church in Bolgatanga, are often idolized and very popular. Throughout the village one can see many posters and pamphlets with this pastor's picture on it. It is in these churches were one needs to make a financial contribution twice every service in order to receive greater happiness and fortune from God, which is something the faith oblige to in all their devotion.

4.2. Practices of subsistence farming: crop cultivation and animal rearing

In order to abstract what knowledge is situated in a rural development context and how ICTs could be targeted towards supporting situated knowledge articulation, sharing and storing one needs to do research on the everyday practices of a particular social and physical context. This is rooted in the theoretical assumption that knowledge is practice-based (McFarlane, 2006). Considering the fact that agriculture is the main source of livelihood for the farmers of Zanlerigu

it is of the essence to gain a deeper understanding of their daily farming practices of crop cultivation and animal rearing. The following section is divided into two parts because of the major difference of the daily farming practices during rainy season and dry season.

4.2.1. Rainy season farming practices

Due to the fact that most subsistence farmers living in Zanlerigu depend on rain-fed farming almost all of the farming practices are performed during rainy season. When the first rains arrive in June/July every farmer is prepared to farm on his land. As mentioned before the whole family comes back to the village to help out on the land. Some of the farmland is situated around the family compound but most of the farmlands are scattered further away. After the first rains the land needs to be fertilized. Most farmers use the manure collected from their animals. It is an organic fertilizer and it is believed that this is better for your soil than the artificial one. Only when there is not enough manure to fertilize your land are farmers forced to buy artificial fertilizer back in Bolgatanga. Subsequently, farmers have to wait for the next rain to come. The soil became very dry during dry season so it takes some time to become moisturized again. When the farmers think it rained enough they will go to the farmlands with manual farming tools and plough the land. Sometimes they also use donkeys and bullocks for ploughing. Some farmers own these animals themselves or farmers can borrow these animals from each other. After more rainfall it is time to sow, which they will do with mixed cropping techniques. The men will dig the holes with their manual farming tools and the women will put the seeds in the holes. After sowing it is only a matter of taking care of your crops to grow properly. The time to harvest is in September/October.

The most popular crops cultivated in this region are the storable crops of millet (early millet red millet and late millet), maize and groundnuts. These are cultivated in a large quantity and are seen as very nutritious and easy to farm. The harvest of these crops will provide every family the whole year with food and is therefore mainly cultivated for own consumption. In the rainy season they also cultivate garden crops. Some of them are storable, such as pepper, leafs of onions and pumpkins and local vegetables Alevi and Bra. Others are non-storable garden crops such as tomatoes, green peppers, onions, carrots, lettuce, sweet potatoes and cabbage. The latter group has to be consumed quickly from preventing it to spoil. These crops are also sold on the local market just after harvest, however competition is fierce at this moment of the year and the demand is low. The storable crops are the main ingredients of the subsistence farmer's diet. Only when it is the next rainy season and a farmer sees he will have a good harvest he will be able to determine if some of his old harvest of the previous year can be sold on the market:

> *"The main purpose for growing these crops is consumption. But when there is a lot, you know have enough for the family feeding. So when it is getting to harvest season and you still have some remains you can sell this and buy fresh food for own consumption"* (Jawah, male, subsistence farmer, Zanlerigu)

At this time some of the farmer's families will be low in food supply due to a bad harvest in the previous year. The demand at this time of the year is therefore often very high making it profitable to sell your surplus.

Besides farming practices another important daily practice is the rearing of animals. Most of the farmer households rear animals on a small-scale, such as cows, chickens, pigs, turkeys, guinea fowls and dogs. Sometimes these animals are used for own consumption, but most of all they serve for gaining an income. During Christian holidays most animals are sold, because the demand is high at that time. The rest of the year animals are only sold if the family is in need for money. To pay for the children's school fees was one major selling purpose, but one could also think about healthcare costs or buying a new pair of shoes for example. During rainy season all the animals are locked up during the night in order to prevent them from destroying the farmlands. During the day it are mostly the children that take the animals out to grasslands, because the farmers themselves are busy with taking care of the crops.

4.2.2. Dry season farming practices

During dry season almost no farming practices were performed on the farmlands. Only until the end of dry season most farmers would go to their lands in order to prepare for the first rainfall:

> *"There is nothing you can do. You will wait for it to rain and know it is time. But you will need to prepare for this. That will be your daily business during dry season. Preparing the land. You will collect all the rubbish and burn it. Everyday you will look for manure, collect it and compost it."* (Robert, male, subsistence farmer, Zanlerigu).

In the period November to March most farmers don't pay much attention to their farmlands. Only a small amount of farmers have the luck to inherit farmland with access to groundwater. They are able to cultivate garden crops during dry season, which they cultivate mainly for selling purposes. During dry season the supply of garden crops is very low and the demand high making it a profitable enterprise. The majority of the farmers keep themselves occupied with the rearing of animals and collecting the manure for compost. They will do this early in the morning and the rest of the day they will stay inside their homes doing some small activities.

The women are occupied with collecting straws from the farmland and prepare them for fire starters usage or roofing materials. Some of the women will do this the entire day. Another occupation is the carvings of stones at the local stone mine. A lot of the women in the village will leave early in the morning and will be busy with carving stones the whole day. They are paid 100 GHC (an estimated 25 dollars) for a full truck of carved stones, which will take a couple of weeks to deliver. Finally, women are also involved as market vendors at the local market. Some have their own permanent shops and many have their own market spot at the village centre where every three days a market is held. The women that sell on the local market don't sell their own produce during dry season:

> *"I will go to the bigger market in Boku and buy large quantities of pepper, Okro and other things. I will divide these in small proportions and sell it on our own market. There is always profit if you divide it in small proportions."* (Zopakka, female, market vendor, Zanlerigu).

Before the women travel to nearby bigger markets, such as Boku or Bolgatanga, they often don't know the price for the merchandise they want to purchase. Sometimes they ask their fellow market vendors if they are aware of the price, but most of the time they just go by themselves and figure out the price at the spot. Sometimes there is a fixed price, but most of the time there will be bargaining. In order to determine their own price the market vendors of Zanlerigu all agree on what price to ask for a certain amount of merchandise. These amounts are not determined by universal weighing methods (KG, pound, ounce etc.), but through local weighing ways such as burlap sacks for large quantities and a tin measuring bowl for small quantities. Another interesting finding was the fact that solely men were perceived to be responsible for selling the animals and women for selling crops. The process of selling animals was seen as something that had to be done by men: a woman selling an animal would not be taken seriously which would affect the price of animals negatively.

4.3. Bottom-up articulation of development needs and solutions

Starting from a participatory development approach (Chambers, 1994; Hickey & Mohan, 2005) an important criteria for development projects is the direct involvement of the development beneficiaries in such projects. Considering the fact that the development beneficiaries are situated in the development context they are best suited for articulating what development solutions will fit their development needs (Ferguson et al., 2010). Therefore, this section elaborates on the subsistence farmers' perceptions on their development problems, needs and suitable solutions. This section is divided into two subsections. The first one focuses on the general perceived

development needs and solutions and the second one on the specific topics of knowledge and information needs.

4.3.1. General development needs and solutions

A major problem all the subsistence farmers of Zanlerigu have to cope with these days is climate change:

> *"So it is like climate change. When we were young the rains used to come better. While growing up the rains kept on reducing. When we were young the rains were better and good. My father used to cultivate a lot. We used to get good harvest, we never lacked food. But as I grew and the rains reduced up to today and now the harvest is no good and sometimes not sufficient for me for the whole year."* (Sepak, male, subsistence farmer, Zanlerigu)

Considering the fact these farmers mainly depend on rain-fed farming climate change has disastrous consequences. Back in the days there was more food security in Zanlerigu, but nowadays, due to irregular rainfall, poverty prevails.

Another major development issue is the lack of financial capital. Some farmers are frustrated they don't have access to capital in order to expand their farming businesses, but most of them struggle with the lack of capital needed for their own survival:

> *"We use our hands to work, we lack capital to hire tractors. So to get income from farming is very difficult. Sometimes, we have to use artificial fertilizer to make the land fertile. Our land is not really fertile, but the fertilizer is very expensive. But if you don't fertilize your land on time. It will be a problem. It will not do the way we want it."* (Butchers' chief, male, subsistence farmer, Galiwei).

Subsistence farmers are not able to farm large plots of land. Something they see as essential in order to create surplus for selling on markets. It is not because they don't own large plots of land, but the land is scattered and sometimes far away from their homes. They also often lack modernised farming tools, such as tractors and ploughing machines, and man-power in order to farm large pieces of land. However, this is all traced back to a lack of financial capital. Putting most farmers in a vicious circle of poverty: they need to farm larger pieces of land in order to get out of poverty, but in order to be able to do that they perceive more financial capital as the only solution.

The farmers agree that they need help from external parties, such as NGOs or government officials from the Ministry of Food and Agriculture (MOFA) also known as the Agricultural

Extension Officers'. However, very few receive direct help from these external parties. The farmers whom have access to ground water, and are therefore able to farm during dry season for economic purposes, receive individual help from NGOs and/or the Agricultural Extension Officers. They are the ones invited to workshops and are sometimes subsidized in order to experiment on new crops or try out new farming techniques. The farmers that don't have access to groundwater and depend on rain-fed farming are often excluded from these possibilities.

4.3.2. Knowledge gaps and information needs

All of the interviewed farmers were struggling with articulating their knowledge gaps and information needs. Every time when the researcher asked questions concerning their knowledge gaps and information needs farmers did not articulate these by themselves. Questions asked on what information or knowledge could help them improve their livelihoods often resulted in something similar to the following dialogue:

> Researcher: "Okay, just ask him what kind of information does he think he needs to be able to improve his farming skills?"
>
> Translator: "speaks Frafra"
>
> Bernartus: *Silence, laughing*
>
> Translator: "Information" "speaks Frafra"
>
> Bernartus: *Silence*
>
> Researcher: Well, maybe I will ask this question later on and give him some examples. Because….
>
> Translator: "He is not getting it. The question"
>
> Myrthe: "Okay, we will ask this later and give some examples."
>
> Translator: "Uhuh"
>
> (Bernartus, male, subsistence farmer, Zanlerigu)

The researcher needed to give some examples first, such as information on rain, knowledge on farming techniques or information on market prices. In addition, the researcher also needed to explain how access to this kind of information could be helpful to their development needs. This would hopefully inspire the informants to come up with their own ideas on lacking knowledge and information needs that enabled their development.

After giving the above-mentioned examples the farmers were able to articulate some of their knowledge gaps and information needs. One of the most important ones was the need for accurate rainfall information. They used to depend on just assuming that it would rain frequently in rainy season. Nowadays, due to climate change, the farmers can't depend on nature like that

anymore. Therefore they would love to receive accurate information on rainfall in order to be able to anticipate:

> *"I would love to hear information on rainfall. If the rain fails you everything fails. If you know about rainfall it cannot fail you. If I know it will not rain for some time I will not start sowing. Last year I sowed three times before it succeeded, because the rains did not come as expected."* (David, male, subsistence farmer, Zanlerigu)

Another important perceived information need was information on market prices. At this time, one needs to travel to the market in other towns to find out what the current price is on certain merchandise. This will cost the farmers valuable transportation fees and time. Some other examples were given on emergency notification information: when there is a national or local emergency such as Ebola or a local fire they would like to receive information on this. Also information on fertilizer types and application would be a helpful addition. Another specific information need articulated was on animal diseases. Farmers depend on the advice and treatments given by vets. Sometimes their help comes too late. It would be very helpful to receive information on symptom identification, prevention and treatment of animal diseases. Furthermore, farmers are also interested in more information concerning farming techniques, such as crop cultivation or irrigation techniques. However, due to lack of awareness concerning what specific knowledge could improve their current farming practices, farmers were not able to articulate specifically what knowledge was still lacking in order to improve their livelihoods.

4.4. Practices of information and knowledge diffusion

This thesis derives from the theoretical assumption that knowledge is situated and therefore practice-based (McFarlane, 2006). Another important theoretical assumption is that learning and knowledge both derive from our experience of participating in everyday life. Learning and knowledge are therefore constructed through social interaction among individuals (Levi & Wenger, 1991). This section foresees therefore in an in-depth understanding of the social and physical context within the researched rural community and how situated knowledge practices unfold within this context. Furthermore, ICTs should be targeted towards supporting these processes and need to be embedded within the existing infrastructure (Schlobach et al., 2015). This section is therefore divided into two sections. The first section will provide an in-depth understanding of the social and physical context of information and knowledge diffusion practices and the second section will give insight into the contextual practices of information and knowledge diffusion supported by ICTs.

4.4.1. Social and physical context of information and knowledge diffusion practices

The common way to acquire knowledge on how to farm and all its accompanied practices, such as crop cultivation and animal rearing, is from father-to-son knowledge sharing:

> *"I learned most from my father. When I was growing up I saw everything my father did to feed us. So everything I do I learned from my father"* (Gobar, male, subsistence farmer, Zanlerigu).
>
> *"It started as a thing from generation to generation. So from father to son"* (Butchers' chief, male, subsistence farmer, Galiwei)

One major lesson taught by their ancestors was how to observe nature in order to retrieve whether rainy season would start or not. When particular trees start to grow leafs, when there is morning dew underneath a stone or when the air becomes cloudy and dark are all important learned observational criteria. Another way of acquiring knowledge is consulting the elderly of one's community:

> *"We will go and ask them. An elder person in the community, we will ask if this rain that has come is the time to start farming or that we should wait for the next rain to come. But if the elder say we may not start, than we wait for the next rain to come. We respect the elderly. When they say no, then we don't. We believe that if the elder say no, and you still do, you won't get any yield."* (Nagbilo, subsistence farmer, Zanlerigu)

The village is divided into several areas. Each area consists out of a group of family compounds that are close by. Within every community area there are elderly community members whom are consulted when important decisions need to be made, such as when to start farming for example. They are therefore important knowledge sources for the community.

Another important knowledge source on farming practices comes from a more formal source: the so-called 'Agric officers' or formally 'the Agricultural Extension Officers' from the Ministry of Food and Agriculture:

> *"We have learned some from our fathers. When we were young we would go with our fathers to farm the land. They taught us how to weed for example. They would correct us if we were doing it wrong. But nowadays we also learn some new knowledge on farming techniques from the Agric officers."* (Timbe, male, subsistence farmer, Zanlerigu)

However, as mentioned before, most of the interviewed subsistence farmers did not receive direct help from the Agriculture Extension Officers. Timbe was for example one of the few farmers with access to ground water and was able to farm and experiment during dry season. The

community found a way how to communicate these new taught knowledge on farming practices equally with each other by organizing themselves formally every month in farmer community gatherings.

One example of these village's community gatherings is the formally organized ZALDA group, which is an acronym that means 'Zanlerigu comes together':

> *"We meet every month with our smaller farmer groups of the community. This is where we learn more techniques from each other. When we gather we talk on what cereals and seeds we plant and which ones will give us good yield. Or how to store manure, how to keep the manure to be plenty and how to spread it on our lands. Sometimes the agric officers also come and join us. They will teach us how to use fertilizer and other things. To keep the plants growing. All this we learn at our farmers' group ZALDA"* (Anthony, male, subsistence farmer, Zanlerigu)

The ZALDA group consists out of several subgroups, with 20 to 30 participants each, whom meet every month. The entire ZALDA group meets every two months. Via mouth-to-mouth everyone will be notified when and where these meetings will take place:

> *"When a meeting will take place, the leader or the chief will pass the message. All the people that are under him, the sub-chiefs, will spread the message on to their own community area. They will tell everybody we have the meeting than and there. Every area is not big, you can go yourself to every house and inform the people, send a small child to spread the message or just tell someone when you bump into them."* (Nagbilo, male, subsistence farmer, Zanlerigu)

When someone has gained new knowledge on farming from a NGO, another farmer or from the Agriculture Extension Officers he or she will share this new knowledge during the community meetings. Every subgroup has a chosen leader and he or she will present this new learned knowledge during the larger meetings every two months. These groups are gender mixed, noteworthy to mention that the female participants are mostly widows. After their husbands' died they became responsible for the farmlands and come to these meetings to learn more about farming. Since a couple of years the community also organizes groups specialized in animal rearing. Such as the Guinea Fowl group, wherein they exchange knowledge on how to take care of their animals and on how to improve their animal rearing skills.

The farming and animal rearing community meetings are becoming more common and frequently these days. Inhabitants only participate and organize themselves if they perceive it as beneficial for themselves. The local market vendors are not organized for example. They tried it

once, but it failed because some participants were causing too much trouble. A woman was stealing the monthly contribution saving pot for example, which caused distrust among the group members causing the group to fall apart. However, most of the informants perceived these meetings as very beneficial to them and participated almost every meeting.

4.4.2. Contextual practices of information and knowledge diffusion supported by ICTs

Nowadays most of the farmers in Zanlerigu own mobile phones or have at least access to one. This also applies to ownership and access to local and national radio. However, when it comes to situated knowledge practices personal communication via one of the above-mentioned ICTs is not preferred:

> "*You can use the phone to call someone and explain a new technique you've just learned. But we prefer to meet face to face and communicate with people during meetings."* (Butcher's chief, subsistence farmer, male, Zanlerigu).

People do use mobile phones for calling their relatives and friends who live far away. They also call fellow community members if they want to ask something or want to meet up. None of the informants used SMS, because of their illiteracy. Another major drawback for using mobile phones was the affordability of mobile credits. Most of the informants consider themselves very poor unable to afford the credits needed for using mobile telephones. Subsequently, the network was also causing problems for using mobile phones in the village. The three large Ghanaian telecom providers Airtel, Vodafone and MTN all had bad reception in the area:

> *"I have MTN but I have no reception here. At times it will work, but I have to go to the graveside in order to get some reception."* (Fousseyni, male, subsistence farmer, Zanlerigu)
>
> *"They are arguing that the network is really bad up here. So even if you want to provide them with information services on mobile phone, how will they be able to use it? When the service is so bad?"* (Fousseyni, focus group discussion, Zanlerigu)

Another perceived problem was the lack of sufficient electricity access: since five years the village has permanent electricity access, which is unfortunately also cut off frequently making the use of mobile phones sometimes impossible. However, most farmers also see the benefits of calling someone instead of meeting someone in person. If you need someone or want to tell someone something who lives in another town you just call instead of visiting that person. In the end using a mobile phone can safe you time and money.

The types of mobile phones owned by the informants were mostly low-tech 2G mobile phones, such as the older models of Nokia, Motorola or Sony Ericson. Not everybody was able

to use the mobile phones independently; this was mainly caused because of the fact that most of them still do not understand the symbolic meaning of numbers properly and the ways to use a mobile phone (i.e. what buttons to press to call someone). As a solution they would ask someone in the house to call the person for them in order to be able to communicate via mobile telephony.

Every informant owned a radio (working on batteries) and would listen to it frequently. Some of the informants even listened to radio on their mobile phones. The local Christian radio station Word.fm was far out the most popular. The informants listened daily to music, religious discussions, local and national news and educational topics concerning healthcare and agriculture. The latter being an important knowledge source for acquiring new information and knowledge on farming:

> *"Nowadays we also learn new knowledge on farming techniques on the radio. The Agric officers are announcing on radio for example that it is almost rain season and we should start sowing"* (Robert, male, subsistence farmer, Zanlerigu).

Most farmers benefit from these radio shows on agriculture, learning new farming skills and methods. Some farmers even record these radio shows on tape and share them during community meetings. Another important feature of radio usage is spreading a message to the local community. If one has an important announcement to make, such as a funeral announcement or filing someone missing, the radio provides itself as an excellent communication method. However, it is sometimes uneasy because one needs to travel back and forth to the local radio station in order to bring the announcement to be made in person and one also has to pay for broadcasting the announcement. This makes it sometimes a very costly enterprise and therefore not affordable for everybody.

4.5. CS4D: a new approach towards ICT4D

This section describes in detail the perceived development ideology and methods used in CS4D projects of ICT(4D) professionals, whom are attached to VU University Amsterdam and the Ghanaian University of Development Studies. It focuses on their perceived pitfalls and benefits of regular participatory ICT4D projects. Their perceptions serve as a constant point for reflection towards the previous sections concerning the topics on the social and physical context and situated knowledge practices in Upper-East Ghana. In order to gain better understanding towards what extent an in-depth understanding of the socio-economic development context of subsistence farmers living in Upper-East Ghana could be of value to the ideology and methods used by these ICT(4D) professionals. In particular attention is given to the relevance of such an understanding towards the development of the CS4D tool 'Kasadaka'. The objective of the latter is firstly aimed

at facilitating the local exchange of knowledge through the use of ICTs, which are adapted to the local context. Secondly, it is aimed at capacity building of local software developers and entrepreneurs on how to create sustainable ICT services (VOICES, 2011).

4.5.1 ICT(4D) professionals ideological and methodological perceptions of CS4D projects

All of the ICT(4D) professionals agreed on the ideology of development to be bottom-up and inclusive. This ideology means that they perceive development projects to be depending on the needs and socio-economic contexts of the development beneficiaries and that the latter should be included within the design and implementation of these development projects:

> *"It all depends on the end-user, what he or she wants or needs. Technicalities don't have to be a big problem; the main problem is the end user. If they can actually use what we are trying to create for them. Or even if they need it in the first place. From my experience most rural folks are interested in things if they immediately can see that it is useful to them"* (Francis, male, ICT4D PhD at UDS Ghana & VU University Amsterdam)

Thus, there is no reason to assume that on the other side of the world there is a need for technology to bring solutions to development problems. Therefore, it is aimed to start with exploring if there is a bottom-up articulated need for ICTs to contribute to development problems. Subsequently one should think on how to make a technical contribution to these development needs. This is in line with the assumption that development beneficiaries are best suited to articulate their development needs. An ICT(4D) professional should try to find a way connecting to these needs and think of suitable technological possibilities. The latter means finding technological innovations, which are suitable to the existing technological infrastructure. In sum, technology developed and used in CS4D projects should be suitable to the socio-economic and technical development context in order to achieve sustainable solutions.

The main aim of CS4D projects is thus thinking on technical solutions suited to contextual relevant development needs. However, a major problem that often occurs is a lack of awareness on both sides of the metaphorically ICT4D coin. On the one side you have the techies that lack awareness on how to cope with the translation of contextual relevancy of user needs to sustainable technical solutions. On the other side you have the lack of awareness of the development beneficiaries that often don't know what the technical possibilities are, which can bring solutions to their development needs. Therefore, CS4D projects are in need for:

> *"An intermediary between the techie and the end user. There should be something in between, like a communicator or translator of both worlds.*

> *Someone who will build a bridge between what the user wants and the techie can build. This process is also known as the requirement analysis. This is a very interesting, intensive and innovative process. It is a melange of knowledge pieces and this is something that was lacking in general ICT4D projects"* (Anna, female, ICT4D professional at VU University Amsterdam)

CS4D projects are thus very knowledge intensive collaboration projects. Intermediaries who can manage the development of ICTs suitable to a certain development context are for example social researchers who are able to retrieve in-depth understandings of contextual requirements or local NGOs and local software developers: professionals who are aware of the local development needs and context, but also have knowledge on what is technical possible and what isn't.

4.5.2 The 'Kasadaka': a tool aimed towards 'bridging the gap'

The 'Kasadaka' is an inexpensive voice-application server for rapid prototyping under rural conditions. This hardware tool is aimed towards supporting the technical process of developing contextual dependant applications. It is able to bridge the gap between not knowing what is contextual relevant by the techies and not knowing what is technical possible by the development beneficiaries:

> *"The main aim for us is to build contextual relevant applications. However, to build sustainable contextual relevant applications one also needs to have suitable and supporting hardware. The 'Kasadaka' is such a platform that supports the development of contextual relevant applications."* (Hans Akkersmans, ICT4D professional at VU University Amsterdam).

The development of such a hardware tool is not only depending on local technical constraining and enabling criteria, but also on the important determinant of socio-economic contextual criteria in order to become a sustainable solution.

4.5.2.1 'Kasadaka put into context: Socio-economic contextual enabling and constraining criteria

The 'Kasadaka' could become a valuable contribution to the realm of participatory and bottom-up CS4D projects. However, it has some socio-economic enabling and constraining criteria that should be taken in account during the development and implementation of such a tool in a rural development context. These criteria are put into perspective through the previous findings on subsistence farmers in Upper-East Ghana.

Within the researched rural development context of Upper-East Ghana farmers were able to articulate their most pertinent development needs. However, most of these needs could one directly link to the lack of financial capital. In order to come out of poverty almost all of the informants perceived up-scaling their farming activities, enabling them to sell more on local markets and gain more income, as a suitable solution. To gain more financial capital was perceived as the only means to this end. Obtaining more financial capital individually was for most of them not feasible, making them dependant on external help from NGOs or government officials. When the informants were specifically asked what kind of information needs or knowledge gaps there were in order to help them develop their farming activities, most of them lacked the capacity to articulate these needs and gaps independently. The researcher needed to stimulate the informants with examples such as rain and market price information, which she retrieved from in-depth research on the local farming practices and daily experienced problems of her informants. Within this process she was able to make the informants more aware of their information needs and knowledge gaps. However, most informants were afterwards still not able to articulate other information needs and knowledge gaps that could help them solve their daily experienced problems besides the given examples. An intermediary who is aware of the contextual practices and experienced problems and knows what information and/or knowledge could help develop and solve these problems is therefore of the essence in defining contextual information gaps and knowledge needs.

Some of the farmers did have access to important knowledge intermediaries such as NGOs or the Agricultural Extension Officers. These farmers belonged to the small group of ‘lucky farmers’ who owned plots of land with access to ground water. They were able to farm small-scale during dry season and sell their produce on local markets. These farmers received help from external parties in the form of workshops and/or subsidies to experiment on new farming techniques and crop cultivation. The larger part of the village was excluded from this external help, which leads to their further marginalization. Fortunately most farmers are participating more and more in community meetings and small farmer organizations in order to share new obtained knowledge, which they have learned elsewhere. Frequently the farmers will sit together in farmer organizations such as the ZALDA group and discuss new learned farming skills and techniques, making it a valuable knowledge sharing practice among farmers. However, most farmers stick to the farming skills and techniques taught by their ancestors. New skills and techniques are only adopted when they are proven to be more beneficial to them. Another important factor for adoption is the approval of these new skills and techniques by the elderly or the village’s chief.

They need to be persuaded first on the benefits of adopting new skills and techniques in order for the rest of the farmers to adopt these as well.

4.5.2.2 'Kasadaka' put into context: Technical contextual enabling and constraining criteria

Within the development and implementation of CS4D technologies, targeted towards supporting situated knowledge processes, getting to know the existing technical infrastructure is of the essence. The main argument for this assumption is that this will secure the sustainability of technical development interventions (Schlobach et al., 2015). The technical enabling and constraining criteria in a rural development context will be elaborated in this section with the help of the case study among subsistence farmers living in Upper-East Ghana.

All of the informants had access to low-tech mobile telephones and most of them also owned one. However, not everyone was able to use these phones without help from others. This was mainly caused due to the fact most of them were not educated and therefore illiterate. In addition, most people also did not know the symbolic meaning of the numbers 0-9. The SMS service was therefore never used and most of the informants needed help with dialing a number. The main purpose of using a mobile phone was for calling a relative, a friend or a community member to catch up or when someone wanted to ask something. This was perceived as beneficial to them considering the fact that it saved a lot of time and also money. Some of the informants struggled with the affordability of credits in order to use a mobile phone. Another major problem was the 2G-connection provided by the three large Ghanaian providers MTN, Airtel and Vodafone. None of these providers foresee the area with a reliable network. This makes the regular usage of mobile telephony problematic. The electricity network has improved the last years, however the village still often struggles with regular power cut offs, making the charging of mobile phones also a problematic enterprise.

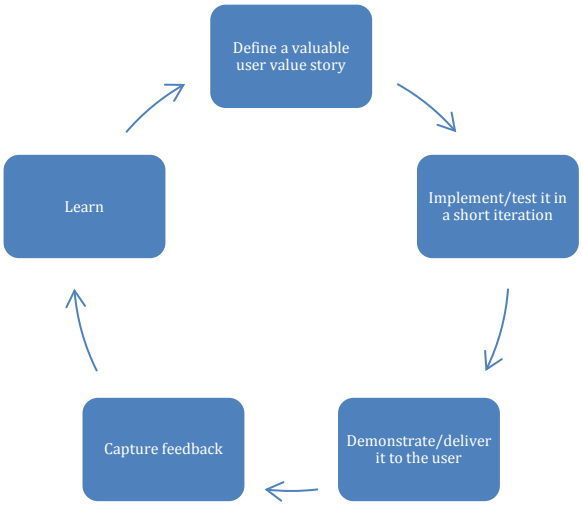
A more reliable ICT device was the radio, which most informants would listen to on a daily basis. Because most of the used radio's worked on batteries power cut-offs were not considered as a problem towards radio usage. Informants would listen to national and local radio stations, but the most popular ones were the local radio stations that broadcasted in the local dialect called Frafra. In Ghana people speak over 50 different dialects and one often only speaks and understands the dialect of their particular region. The informants used the radio for several purposes: from entertainment to information and knowledge acquisition. One could listen to radio for music, religious discussions, local and national news, and also for educational topics on healthcare and agriculture. Another important feature of radio was that it enabled the farmers to spread messages to their community on a large scale by broadcasting their message through local

radio. However, this process is considered as time consuming and costly, because one needs to travel back and forth to the radio station that is situated far away. Furthermore, the researcher also experienced the effects of very hot temperatures and a dusty environment on technologies in a rural development context. During research the surface of her laptop melted apart, which could not be mended anymore. Also all of the used technologies were covered with a thick layer of red dust within the blink of an eye. These rural conditions ask therefore for robust and simple technology design.

4.5.3 Conclusion: user stories and generic requirement analysis

A rapid prototyping tool such as the 'Kasadaka' can become a valuable contribution to the realm of rural development. It enables the local development of context specific applications aimed at supporting situated knowledge processes. The best possible outcome would be that professional intermediary parties, such as social and computer science researchers, NGOs, policymakers and local software developers, take part in community meetings. Where they sit together with community members and talk about their perceived daily problems and find suitable solutions together, and brainstorm on how these can be supported by contextual dependent ICT applications. Together they can discover what types of information could give valuable content to the situated knowledge processes and what role ICTs can play in terms of facilitating this process. This approach is comparable to agile software engineering: an iterative and cyclic process wherein the user story partakes a central place (Leffingwell, 2011). This process is thus contextual dependent and is schematically represented as follows:

Figure 1. User stories: incremental-value-deliveray approach (Leffingwell, 2011)



The ‘Kasadaka’ can function in this knowledge sharing process as a flexible tool for creating local awareness on what information or knowledge could help these farmers with their development needs and what particular role ICTs can play herein. In this sense the ‘Kasadaka’ enables the metaphorically ‘the proof of the pudding is actually the eating’ process within a specific development context. Through determining what applications are best suitable to the development needs and solutions perceived by the development beneficiaries.

Furthermore, a rapid prototype tool such as the ‘Kasadaka’ also enhances the inclusion of local software developers in the development and implementation process of contextual dependent and sustainable ICT solutions. It provides suitable hardware for the local development of ICT services targeted towards rural development. This will enable ICTs enabling rural development to have sustainable impact in the long run (VOICES, 2011). However, for hardware to function under rural development conditions it should measure up to the following generic technical requirements: hot weather, dusty environments, no or low (2G) network connections, regular power cut-offs, local languages, illiteracy and lack of knowing symbolic meaning of numbers 0-9. In addition, the popularity of mobile phones gives opportunity to the successful implementation of voice-based ICT applications targeted towards rural development. Due to the illiteracy of most subsistence farmers it is required to incorporate audio-visual interfaces such as Voice-based ICT applications. Also the popularity of local radio as an important channel for community input and facilitating new knowledge on farming skills and techniques can enhance the situated knowledge sharing of subsistence farmers targeted towards improving their livelihoods. The tool should therefore also support the development of applications based on the existing technical infrastructure of local radio and low-tech mobile phones.

5. Discussion

5.1 Revisiting the problem

The aim of this research is to gain in-depth understanding of a specific socio-economic rural development context and its existing technical infrastructure. In order to retrieve the societal and technical constraining and enabling criteria for developing and implementing a low-cost, replicable and easy to use ICT tool (such as the Kasadaka) that enables the flexible development of contextualized ICT applications. Therefore, this research contributes to the debate on the issue of scalability within ICT4D: the quest to find a pragmatic balance between sensitiveness to local contexts and the need to standardize between contexts (Rolland & Monteiro, 2002; Walsham, Robey & Sahay, 2007). This research introduces CS4D as a new innovative approach towards developing and implementing generic ICTs that enable the flexible development of contextualized

ICT applications. Furthermore, CS4D also focuses on how these knowledge technologies can become more sustainable: by designing hardware suitable to rural conditions that enables the inclusion of local software developers throughout the design and implementation process of contextualized applications.

The qualitative research conducted in Upper-East Ghana shows that solely a bottom-up articulation of information needs and knowledge gaps caused quite the struggle among most informants. Most of them were not capable to articulate these independently and needed examples given by the researcher. The researcher was able to articulate these examples after an in-depth analysis of the daily practices and perceived problems of the subsistence farmers living in poor, remote and rural areas. Eventually, some information needs and knowledge gaps were discovered, such as; accurate rain data, information on market prices, animal disease information, emergency notifications and knowledge on improved farming techniques and skills. In addition the research also showed that the majority of the informants were excluded from knowledge acquisition and sharing practices given by external parties, such as NGOs and governmental organizations, which further marginalized the poorest of the poor. However, the situated knowledge practices of small community organizations partly solved this problem. Within these small community organizations every community member can participate and learn the new acquired knowledge on farming and animal rearing from fellow participants who receive help from NGOs and government organizations.

These findings seem to confirm the development pitfalls of participatory methodologies as articulated by Hickey & Mohan (2005), wherein participants are selected based on their added value towards the planned development objectives of donor agencies. While participatory methodologies should include ‘an authentic and autonomous discourse by which groups of people may come to see where they share ideas and priorities and where they do not’ (Powell, 2006: 529). In addition, attempts to give voice to the marginalized by consulting them on their needs, priorities and local environmental or technical knowledge (Briggs & Sharp, 2006) through in-depth research methods was more difficult than expected. Most development beneficiaries were not able to articulate their local environmental and technical knowledge independently. Subsequently, the question remains how ICTs could be targeted best towards supporting these situated knowledge processes in a rural development context. The following sections will discuss the findings in more detail and relate them to wider theoretical debates.

5.2. Discussing the findings

5.2.1. Whose knowledge?

This research investigates how local, situated knowledge processes can be supported and facilitated through flexible, low-tech and easy to use ICTs towards the development of subsistence farmers. An underlying assumption to this question is that local, situated knowledge sharing calls for the inclusion of voices and priorities of the marginalized, which will provide them with ownership in their own development process (Briggs & Sharp, 2006). This assumption is central to the rhetoric of post-development, which claims that the knowledge of the development beneficiaries should be included in order to provide sustainable solutions (Agrawal, 1995). As opposed to the top-down approach wherein solely scientific knowledge and developmentalism are perceived as superior and universal applicable (Escobar, 2012). However, this research showed that giving the marginalized a voice by asking them to articulate their own information needs and knowledge gaps failed every time.

An important question is whether this failure was caused because the informants were incapable of articulating their knowledge gaps and information needs or whether the researcher was incapable of understanding their articulation due to the fact she is captured in her own Western or scientific perception of what knowledge and information should be (Powell, 2006). The latter being a major pitfall in many development projects: despite the interest in others, the West is only interested in hearing its own voice. For local knowledge to be taken seriously, hence to become accepted as constructive knowledge and not as an opinion or folklore, the life world of the marginalized has to be translated into the language of development and science. Making it impossible for the marginalized to truly express oneself (Spivak, 1988).

However, the voices of the marginalized are heard if the methods of the researcher or development advisor are appropriately tuned into them. These voices might be expressed through embodied practices rather than a coherent articulation; the latter often sought after by academics. This involves fieldwork, in order to gain in-depth understanding of the environmental and technical knowledge, and in particular a sense towards the embedded knowledge that is part of the everyday practices and experiences of the people involved (Briggs & Sharp, 2006.).

5.2.2. Situated Knowledge & Mutual Learning

As mentioned in the previous section enabling the voices of the marginalized to be heard is not only to be found within the coherent articulation of local knowledge, but particularly within the expression of embodied practices (Briggs & Sharp, 2006). Therefore, local knowledge can be perceived as situated and practice-based: knowledge is socially constructed in specific contexts

and embedded within a specific social and physical environment (Lave & Wenger, 1991; McFarlane, 2006). Knowledge sharing is therefore 'a process of knowledge creation, in which participants make sense of certain events and construct meaning' (Hooff & Huysman, 2009: 2). The findings show that shared and created knowledge among subsistence farmers is indeed socially constructed during community meetings on farming or animal rearing. The farmers gather together during these meetings under a large Mango tree and learn from each other's knowledge on various farming and animal rearing practices, such as manure methods, terracing methods and mixed-cropping techniques. Most of the newly shared knowledge on farming and animal rearing practices were taught to a specific group of farmers by external aid agencies.

In fact, most of the present governmental and non-governmental agencies in the area seemed to commit the same mistake as many other development agencies. They selected farmers for their aid programs, who were perceived to be suitable enough for their development agendas, which often leads to the further marginalization of the majority (Hickey & Mohan, 2005). Furthermore, this transfer of knowledge from aid agencies to selected development constituents also contributes to development to become counterproductive, by marginalizing alternative local knowledge and silencing local discourses (Ferguson et al., 2010). Instead, aid agencies and researchers should aim to make a contribution to development solutions by drawing on the situated knowledge of the development beneficiaries. In order to gain better understanding of situated knowledge research should be done on how knowledge is socially produced and on how knowledge is embedded in the daily practices and experiences of the poor themselves (McFarlane, 2006).

In addition, one also needs to keep in mind that perhaps not all these local practices and experiences are beneficial to sustainable development (i.e. slash and burn agriculture). Ferguson et al. (2010) argue therefore for a process of situated mutual learning and knowledge, which is "characterized by a willingness to explore complementary views, looking at the consequences of each and what makes a difference, and testing against experience in context' (Ferguson et al., 2010: 1806). This embraces the idea of 'multiple knowledges' wherein individuals aim to overcome their epistemic differences (Ferguson et al., 2010). By negotiating on a variety of knowledges in order to produce a hybrid and mediated knowledge (Briggs, 2005). Within this process the development beneficiaries can determine for themselves if they wish to adopt and adapt these hybrid and mediated knowledges and determine therefore what is best suitable to their situation. This process is also suitable towards designing and developing contextual relevant ICT applications that are targeted towards improving the livelihoods of development beneficiaries. An agile software engineering approach suits best: collecting valued user stories and carrying out an

iterative cyclic process of ICT development wherein the user stories and feedback from the end users partake a central place. This approach enables the process of exploring complementary views towards information needs and knowledge gaps and how ICTs could be targeted towards supporting these and also enables testing against experiencing in context.

5.2.3. CS4D: Role of ICTs in supporting situated knowledge processes

It has been widely acknowledged that ICTs are particularly useful in facilitating knowledge sharing and gaining access to knowledge (Alavi & Leidner, 2001). In addition, it is also argued by scholars that ICTs are therefore important enablers for social transformation and development (Avgerou, 2008; Walsham et al., 2007). ICTs can have an added value in terms of development-related information needs. However, another development pitfall looms when ICTs are aimed at transferring knowledge as some sort of commodity (Puri, 2007). Which will cause ineffective knowledge sharing by reducing the ability to share situated knowledge that is embedded in social and physical contextually practices (Ferguson et al., 2010). Therefore, technology design and implementation should be highly sensitive towards the local practices and values of the development beneficiaries in order to become sustainable (Schlobach et al., 2015).

Computer Science for Development (CS4D), which is a new approach towards ICT4D, is geared towards generating and exchanging knowledge supported by knowledge technology. CS4D recognizes knowledge as situated and therefore its contextual and social-practice specificities (Schlobach et al., 2015). This means that knowledge sharing enabled by ICTs should not be packaged, generalized or 'scientized'. Such an approach 'misses the point of the special character of local needs, as well as ignoring the reality of the socio-economic and historical situation of the local community in which the technology is applied' (Briggs, 2005: 110). ICTs that enable situated knowledge sharing should thus be particular, context specific and locally embedded (Avgerou, 2008; Walsham et al., 2007). This 'situated approach' emphasizes the need to design independent and local situations (Sahay & Avgerou, 2002). Furthermore, in line with what Heeks & Robinson (2013) argue, there is a need for grass-roots innovation in which local software developers create sustainable applications that are more suitable towards local contexts. However, for various reasons, especially cost considerations, such a perspective is not feasible to work out in practice when involving multiple interconnected sites. Therefore, there is an increasing need for a balance between sensitivity towards local contexts and a need to standardize between contexts (Rolland & Monteiro, 2002).

CS4D provides a more suitable approach towards the aforementioned problems within regular ICT4D projects. In general through thinking on what the societal and technical

implications are towards a generic, flexible and innovative ICT design aimed to support the development of contextually-tailored ICT applications. And more specifically through the pragmatic design of a rapid prototyping platform such as the Kasadaka. The Kasadaka, developed and implemented by CS4D professionals of the VU University Amsterdam and UDS Tamale, is a rapid-prototype platform for the grass-roots development of ICT applications under rural conditions. It will provide a technical contribution towards situated mutual learning and knowledge sharing among researchers and development beneficiaries. It enables agile software engineering through supporting the process of excessive needs assessment on which a 'set of innovative, suitable and highly contextualized ICT solutions will be co-designed and deployed, according to local goals and jointly defined requirements' (Bon, 2015). Through the development of a rapid prototyping platform (i.e. the Kasadaka) CS4D makes a valuable and pragmatic contribution to the debate on how to innovate generic and scalable ICTs that are still capable to be harnessed towards locally relevant problems (Sahay & Avgerou, 2002; Foster & Heeks, 2013).

5.3 Practical implications

There are several practical implications inherent to the findings: First of all, aid agencies and development research projects, that perceive knowledge and information as important catalysts for development, need to reconsider whose knowledge they include within development projects. If the aim is to give the marginalized a voice towards their own development realities one should carefully reconsider if these voices are truly included and implemented in development projects. Secondly, aid agencies and development research projects should embrace the idea of multiple knowledges and the assumption that knowledge is socially constructed and rooted in social and physical contextually practices. Via situated mutual learning and knowledge sharing during local communities gatherings these development agencies and research projects can contribute to hybrid and mediated knowledges, which are suitable to the development of beneficiaries' daily practices. Thirdly, agencies and research projects can make use of ICTs in order to support the above-mentioned development goals. However, the ICTs developed and implemented should not consist out of tools that enable knowledge transfer but should be targeted towards supporting situated knowledge sharing and creation. The latter asks for highly contextualized ICT solutions wherein a rapid prototyping platform such as the Kasadaka can function as a valuable means to an end.

5.4 Limitations and further research

This study is limited in terms of time and capacity available to collect and analyse empirical data needed for in-depth research on the technical and societal enabling and constraining criteria for building a rapid prototyping tool such as the Kasadaka. In addition my associate Awa Gossa Lo and me were also not able to test the Kasadaka in the field, something that is an important criteria for agile software development projects suitable to the CS4D approach. In order to improve this type of research a few recommendations follow.

First of all, the scope of the research was very limited because of the time and capacity limits for conducting fieldwork. There was just enough time to do in-depth research in one rural, remote and poor context. In order to retrieve generic implications, restrictions and limitations for building a rapid prototype tool such as the Kasadaka more in-depth research is of the essence across several contexts. The latter means that research in other African remote, rural and poor contexts is needed, which differ from Zanlerigu village in Upper-East Ghana. Due to the time consuming characteristic of doing in-depth research this will take a lot of time and patience.

Second of all, it is of the essence to continue conducting multidisciplinary research on how ICTs can benefit the poor best and what role a rapid prototype platform could play in such a process. The expertise of computer scientists is essential in innovating ICTs that are targeted towards improving the livelihoods of the rural poor. However, where computer science stands alone, problems arise due to too techno-centric approaches. Therefore broader worldviews are essential in guiding CS4D projects. These broader worldviews could come from developments studies on the nature of development, and from Social Sciences for a better understanding of human actors and local contexts (Heeks, 2008; Walsham, 2012).

Last but not least, more and better incorporation of local software developers during research is of the essence. Due to facility and organizational issues during this fieldwork, my associate from Computer Science and myself, were unfortunately not able to work together with such local specialists. A rapid prototype tool such as the Kasadaka has the potential to enable grassroots innovation of sustainable contextual relevant applications. This will foresee in better matching ICT solutions towards local needs and contexts (Heeks & Robinson, 2013). However, this also asks for close incorporation of local developers during the design and development of such a tool. In the end, they will become end users and their feedback is therefore of the essence.

6. Conclusion

This study introduces Computer Science for Development (CS4D) as a new approach towards the prevailing debate in ICT4D on the quest to find a balance between sensitivity towards local contexts and a need to standardize between contexts in ICT enabling development design and implementation. The CS4D approach acknowledges the situatedness of knowledge in local contexts and practices, and seeks how knowledge technologies can support these situated knowledge processes. The pragmatic aim is to do research on how technology suitable to rural conditions (i.e. the Kasadaka) enables the flexible development of contextualized ICT applications. This maintains a more generic understanding of the technological and societal restrictions, requirements and impacts of innovating and implementing ICTs in a development context. Therefore this study was set out to gain in-depth understanding of the societal and technical constraining and enabling criteria for developing a low-cost, replicable and easy to use ICT hardware that enables the flexible development of contextualized ICT applications.

The in-depth study on subsistence farmers in Upper-East Ghana showed that the bottom-up articulation of information needs and knowledge gaps caused quite a struggle among most informants. Situated knowledge was expressed through embodied practices rather than coherent articulation. Therefore fieldwork is of the essence in order to discover what these situated knowledge processes are. During excessive needs assessments between development practitioners and development beneficiaries information needs can be abstracted that will give bottom-up valued content to the situated knowledge of the development beneficiaries. Development beneficiaries and development practitioners should therefore sit together underneath the local Mango tree and co-design together, through iterative cycles of excessive needs assessments, contextualized ICT solutions that are best suitable to supporting and facilitating their situated knowledge processes. A rapid prototype platform such as the Kasadaka can function as a valuable means to an end in this process enabling the grassroots innovation of contextualized ICT applications.

7. Literature

Agrawal. A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and change.* 26: 413-439

Agterberg. M., Van den Hooff. B., Huysman. M. & Soekijad. M. (2010). Keeping the wheels turning: the dynamics of managing networks of practice. *Journal of management studies.* 47(1): 85-108

Alavi. M., Leidner. D. E. (2001). Review: Knowledge management and knowledge management systems: conceptual foundations and research issues. *MIS Querterly.* 25(1): 107-136

Antwi Boasiako. G. (2012). How to live and cope with climate change. Coping strategies of small-scale farmers in Upper East region, Ghana. *Master Thesis Department of urban and rural development.* Uppsala: Swedish University of Agricultural Science

Arthur, S. & Nazroo, J. (2003). Designing Fieldwork Strategies and Materials. In Ritchie, J. & Lewis, J. (Eds.) *Qualitative Research Practice. A Guide for Social Science Students and Researchers* (pp. 109-137). London: Sage.

Ashley. C. & Maxwell. S. (2001). Rethinking rural development. *Development policy review.* 19(4): 395-425

Avgerou. C. (2008). Information systems in developing countries: a critical research review. *Journal of Information Technology.* 23: 133-146

Avgerou. C. (2010). Discourses in ICT and Development. *Information Technologies & International Development.* 6(3): 1-18

Boland. R. & Tenkasi. R. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science.* 6(4): 350-372

Bon. A. (2015). ICT for food and water in Ghana. Collaborative research by VUA and UDS. 6 May 2015. *Anna Bon: Blog.* Available from: < http://w4ra.org/2015/05/06/ict-for-food-and-water-in-ghana-collaborative-research-by-vua-and-uds/ >. [10 may 2015]

Bouchard. T. J. (1976). Field research methods: interviewing, questionnaires, participant observation, systematic observation, unobtrusive methods. In M. D. Dunette (Ed.) *Handbook of industrial and organizational psychology:* 363-413. Chicago: Rand McNally

Briggs. J. (2005). The use of indigenous knowledge in development: problems and challenges. *Progress in development studies.* 5(2): 99-114

Briggs. J. & Sharp. J. (2006). Indigenous knowledges and development: a postcolonial caution. *Third world quarterly. 25(4): 661-676*

Chambers. R. (1994). The origins and practice of participatory rural appraisal. *World development.* 22(7): 953-969

Corsaro. W. A. (1985). *Friendship and peer culture in the early years.* Norwood NJ: Ablex publishing corporation

Creswell. J. W. *Research design: qualitative, quantitative and mixed methods approach.* London: Sage Publications

Edmondson. A. C. & McManus. S. E. (2007). Methodological fit in management field research. *Acadamy of management review.* 32(4): 1155-1179

Eisenhardt. K. M. (1989). Building theories from case study research. *Acadamy of management review.* 14(4): 532-550

Escobar. A. (2012). *Encountering development. The making and unmaking of the Third world.* New preface by the author added. Princeton, NJ: Princeton University Press

Ferguson. J., Huysman. M. & Soekijad. M. (2010). Knowledge management in practice: pitfalls and potentials for development. *World Development.* 38(12): 797-1810

Ferguson. J., Huysman. M., Soekijad. M. & Vaast. E. (2013). Blogging for ICT4D: reflecting and engaging with peers to build development discourse. *Info systems.* 23: 307-328

Finch. H. & Lewis. J. (2003). Focus Groups. In Ritchie, J. & Lewis, J. (Eds.) *Qualitative Research Practice. A Guide for Social Science Students and Researchers* (pp. 109-137). London: Sage.

Foster. C. & Heeks. R. (2013). Innovation and scaling of ICT for the bottom-of-the-pyramid. *Journal of Information Technology.* 28: 296-315

Gardner. K., Lewis. D. (1996). *Anthropology, development and the Post-modern challenge.* London: Pluto Press

Gherardi. S. (2000). Practice-based theorizing on learning and knowing in organizations. *Organization.* 7(2): 211-233

Gioia. D. A., Corley. K. G. & Hamilton. A. L. (2012). Seeking qualitative rigor in inductive research: notes on the Gioia methodology. *Organizational research methods.* 16(1): 15-31

Gobo. G. (2008). *Doing Ethnography.* London: Sage Publications

Heeks. R. (2008). ICT4D 2.0: the next phase of applying ICT for international development. *Computer.* 41(6): 26-33

Heeks. R. & Robinson. A. (2013). Emerging markets Ultra-low-cost computing and developing countries: raspberry pi and its potential in the “global South”. *Communications of the ACM.* 56(8): 22-24

Hickey. S., Mohan. G. (2005). Relocating participation within a radical politics of development. *Development and change.* 36(2): 237-262

Hislop. D. (2009). *Knowledge management in organizations.* Oxford: Oxford University Press

Hollander. J. A. (2004). The social context of focus groups. *Journal of contemporary ethnography.* 33(5): 602-637

Indexmundi (2015) Ghana rural population. Available: <http://www.indexmundi.com/facts/ghana/rural-population [accessed: 28 january 2015]>

Kleine. D. & Unwin. T. (2009). Technological revolution, evolution and new dependencies: what's new about ICT4D? *Third world quarterly.* 30(5): 1045-1067

Lave. J., Wenger. E. (1991). *Situated learning: legitimate peripheral participation.* Cambridge: Cambridge University Press

Leffingwell. D. (2011). *Agile software requirements: lean requirements practices for teams, programs, and the enterprise.* Boston: Pearson Education Inc.

Legard. R. Keegan. J. & Ward. K. (2003). In-depth Interviews. In Ritchie, J. & Lewis, J. (Eds.) *Qualitative Research Practice. A Guide for Social Science Students and Researchers* (pp.138-169). London: Sage

Macome. E. (2008). On implementation of an information system in the Mozambican context: the EDM case viewed through ANT lenses. *Information technology for development.* 14(2): 154-170

Madon. S. (2000). The Internet and socio-economic development: exploring the interaction. *Information technology and people* 13:(2): 85-101

McFarlane. C. (2006). Knowledge, learning and development: a post-rationalist approach. *Progress in development studies.* 6(4): 287-305

Millward. L. (2012). Focus groups. In: Breakwell. G. M., Smith. J. A. & Wright. D. B. (Eds.). *Research methods in psychology.* Thousand Oaks CA: Sage publications ltd

Mohan. G., Stokke. K. (2000). Participatory development and empowerment: the dangers of localism. *Third world quarterly.* 21(2): 247-268

Mosse. D. (2001). 'People's knowledge', participation and patronage: operations and representations in rural development. In: *Participation: the new tyranny?*

Nederveen-Pieterse. J. (1998). My paradigm or yours? Alternative development, Post-development, Reflexive development. *Development and change.* 29: 343-373

ODI (2002). *ICTs and rural development: Review of the literature, current interventions and opportunities for action*. Robert Chapman and Tom Slaymaker. ODI: London

Orlikowski. W. (2002). Knowing in practice: enacting a collective capability in distributed organizing. *Organization science.* 13(3): 249-273

Potter. R. B., Binns. T., Elliott. J. A., Smith. D. (2008). *Geographies of development: an introduction to development studies*. 3rd revised edition. Abingdon, UK: Taylor & Francis Group

Powell. M. (2006). Which knowledge? Whose reality? An overview of knowledge used in the development sector. 16(6): 518-532

Pratt. M. G. (2009). For the lack of a boilerplate: tips on writing up (and reviewing) qualitative research. *Acadamy of management journal.* 52(5): 856-862

Puri. S. K. (2007). Integrating scientific with indigenous knowledge: constructing knowledge alliances for land management in India. *MIS Quarterly.* 31(2): 355-379

Rahnema. M., Bawtree. V. (1997). *The post development reader.* London: Zed Books

Richie. J. Lewis. J. & El am. G. (2003). Designing and selecting samples. In Ritchie, J. & Lewis, J. (Eds.) *Qualitative Research Practice. A Guide for Social Science Students and Researchers* (pp. 77-108). London: Sage.

Rolland. K. H., Monteiro. E. (2002). Balancing the local and the global in infrastructural information systems. *The information society.* 18: 87-100

Sahay. S. & Avgerou. C. (2002). Introducing the special issue on information and communication technologies in developing countries. *The Information Society.* 18: 73-76

Schatzman. L. & Strauss. A. L. (1973) *Field Research.* Englewood Cliffs NJ: Prentice-Hall

Schech., S. Haggis. J. (2000). *Culture and development: a critical introduction.* Oxford, UK: Blackwell publishing

Schlobach. S., de Boer.V., Gueret. C., Boyera. S. & Cudre-Mauroux. C. (2015). From knowledge engineering for development to development informatics. In: *EKAW 2014 Satellite events.* P. Lambrix et al. (Eds.). Switzerland: Springer International Publishing

Sen. A. (1999). *Development as freedom.* Oxford: Oxford University Press

Sole. D., Edmondson. A. (2002). Situated knowledge and learning in dispersed teams. *British journal of management.* 13: 17-34

Spencer. L., Ritchie. J. & O'Connor. W. (2003). Analysis: practices, principles and processes. In Ritchie, J. & Lewis, J. (Eds.) *Qualitative Research Practice. A Guide for Social Science Students and Researchers* (pp. 199-218). London: Sage.

Spivak. G. (1988). Can the subaltern speak? In Nelson. C. & Grossberg. L. (Eds.) *Marxism and the interpretation of culture.* (pp. 271-313). Basingstoke: Macmillan

Thompson. M. P. A. (2002). Cultivating meaning: interpretative fine-tuning of a South African health information system. *Information and Organization.* 12(3): 183-211

Thompson. M. P. A. (2004). Discourse, development, the digital divide: ICT and the World Bank. *Review of African political economy.* 31:103-123

UNESCO Chair in ICT4D, Professor Tim Unwin. Available from <http://www.21stcenturychallenges.org/focus/unesco-chair-in-ict4d-professor-tim-unwin/> [10 April 2015]

UNDP (2001) *Making technologies work for human development.* Human Development report, Washington DC

UNDP (2012) *The importance of ICTs in the provision of information for improving agricultural productivity and rural incomes in Africa*. Working Paper, United Nations

UNDP (2015) UNDP in Ghana: about Ghana Available: www.gh.undp.org/content/Ghana/en/home/countryinfo/ [accessed: 5 May 2015]

Unwin. T. (2009). *ICT4D-Information and communication technology for development.* Cambridge: Cambridge University Press

Van der Velden. M. (2002). Knowledge facts, knowledge fiction: the role of ICTs in knowledge management for development. *Journal of international development.* 14: 25-37

VOICES (2011). *VOIce-based Community-cEntric mobile Services for social development. Deliverable No D1.1. VOICES Use Cases and Requirements.* Project deliverable report: Bon. A. & Akkermans. H. (Eds.)

Walsham. G. & Sahay. S. (2005). Research on information systems in developing countries: current landscape and future prospects. *Information Technology for Development.* 12(1): 7-24

Walsham. G., Robey. & D., Sahay. S. (2007). Foreword: special issue on information systems in developing countries. *MIS Quarterly* 31(2): 317-326

Walsham. G. (2012). Are we making a better world with ICTs? Reflections on a future agenda for the IS field. *Journal of information technology.* 27: 87-93

Wayo Seini. A. & Nyanteng. V. K. (2003). African food crisis; the relevance of Asian models. Report on village diagnosis and household survey. University of Ghana: Legon

W4RA (2015). About W4RA. Available from: <www.w4ra.org/w4ra/ > [accessed: 17 June 2015]

8. Appendix

8.1. Appendix A: Topic Guide subsistence farmers

Objectives:
- To explore daily practices of farmers living in remote and poor areas in the North of Ghana
- To explore what the daily problems are they are cooping with
- To explore what ICTs they use in their daily life
- To explore what information services could improve their livelihoods
- To explore how ICTs could support these information services

Introduction: Introduce our project and why we are here; confidentiality; timing

1. Demographic information: personal information about the informants to gain better overall insight in participating informants
- Name
- Age
- Place of residence
- Profession

2. Life history Getting deeper into background information.
A. Geography
- Place of birth
- Situation back then
- Migration

B. Family
- Family composition
- Role division in family
- Inheritance structure

C. School
- Attended school(s)
- Skills learned

3. Community Participation: Getting to know what organizational forms there are inside the community and what specific roles the informants play within these community organizations. Discovering hierarchy and/or power structures.
A. Forms of Organization
- Community organizations
- Farmer organizations
- Other forms of organizations

B. Role within organization/community
- Hierarchy structure in organization/community
- Own role in organization/community

4. Daily activity Exploring daily practices of subsistence farmers in different periods. Discovering Gender Diversity within everyday life. Exploring the problems the informants are struggling with.
A. Difference between seasons
- Describe day in dry season (morning-evening activities)
- Describe day in rain season (morning-evening activities)
B. Struggles
- Mention different struggles in daily activity
- Comparison between past and present
C. Gender diversity
- Role division household men/women, boys/girls

5. Farming Exploring what the daily farming practices are of farmers. What crops they yield and for what reason. Where and how they learn farming techniques from and what are the main improvements to be made concerning farming knowledge and skills. Exploring different gender roles in farming activity.
A. Crops
- Different crops
- Information on crops (process of farming crops throughout a year)
B. Cultivation techniques
- Where/whom taught
- Difference past/present
C. Irrigation techniques
- Where/Whom taught
- Difference past/present
D. Main struggles
E. Gender diversity
- Role division farming men/women, boys/girls

6. Sources of Income/economic activity Exploring what the purpose is of gaining an income. How they gain any income and how the roles are divided between men and women concerning providing the family with money.
A. Ways of earning income
- What products are sold
- Best time on the market (best period for selling crops/live stock)
- Labour activities
B. Purpose of economic activity
- Savings
- Spending patterns
C. Gender diversity
- Role division earning income men/women, boys/girls

7. Information: Suggestions for prompts and directions for probing. Exploring the information needs of subsistence farmers
A. Information to share → i.e.

- Rain data
- Market data
- Farming techniques
- Healthcare
- Organization of meetings
- Sharing of news

B. Preparedness
- Usage information services
- To pay

8. ICTs Exploring ownership, access and usage of ICTs in order to discover what is already available and workable in a remote and rural context.

A. Ownership
- Mobile
- Radio
- History of ownership

B. Access
- Mobile
- Radio
- History

C. Main purpose
- Mobile
- Radio

9. Questions for the researcher/ additions from the Interviewee

8.2 Appendix B: Topic Guide ICT(D) professionals

Objectives:
- To explore career and background of Ghanaian ICT professionals/researchers
- To explore ideology towards development issues
- To explore their opinions on how ICT can enable development in a rural context
- To gather reflections on their experience of working on ICT4D projects in Ghana
- To gather reflections on our research project from Ghanaian ICT professionals/researchers

Introduction
- Introduce our project and why we are here; confidentiality; timing

1. Demographic information: personal information about the informants to gain better overall insight in participating informants
- Name
- Age
- Place of residence
- Profession

2. Life history: Getting deeper into background information.
A. Family background
- Place of birth
- Family composition
- Extended family
B. Education/Career
- Graduated in which study
- Story on winding up at UDS/ VU University
- Perspective on future career path

3. Development ideology and ICT: Getting to know how informants think about development theory and practice and what role ICT could play within development issues concerning rural remote and poor areas.
A. Development ideology
- Reflection on socio-economic circumstances rural Northern Ghana and development projects
- Opinion on good/bad development practice
- Opinion on who is responsible when it comes to development issues
- Opinion on who or what should determine main objectives on development issues
B. ICT4D
- Opinion on key development ideology ICT4D
- Opinion on ICT's contribution to development issues
- Reflection on obstacles in ICTD
- Own field experience on ICT4D projects

4. Project design evaluation: Exploring opinion of professionals concerning our research design and objectives. Abstracting pitfalls and aiming at eliminating them.
- Start explanation detailed research objectives
- Main pitfalls
- Contribution possibilities for improving rural livelihood circumstances

8.3 Appendix C: Topic Guide focus group discussion subsistence farmers

Date:	Facilitator:
Time:	Translator:
Location:	Note Taker/Discussion Leader:
Participant:	
Male:	
Female:	

1. Introduction:

- My role as a researcher

- Explain purpose of visit

- Explain urge for participants to feel free participating in discussion

→ No interview with me as a researcher, but a discussion among participants

2. Ice breaker

- Start exploring issues among participants considering agriculture and development

3. General crops (own consumption)

- Different types

- Purpose

4. General Cash Crops

- Different types

- Why chosen these types?

5. Constraints/limitations/issues of crop cultivation

6. Fertilizer use

- organic vs artificial

- benefits vs constraints

→ awareness of the disadvantages?

→ Main reasons for choosing one or the other

7. Live Stock

- What animals

- Purpose of animals

- Market value

8. Information services/sources

- Specific on sharing knowledge/info on agriculture

- What are the main sources?

- Community learning

9. Ownership mobile phones

- ownership

- access to

- History; since when first usage of mobile phones

- What changed?

10. Purpose of mobile phone

- Purpose

- Usefulness: benefits/constraints

11. What is the information need?

12. Willingness to pay

- percentage of participants

13. Use of other ICTs

A. Radio

- ownership/access

- purpose

- information abstracted

B. TV

- Ownership/access

- Purpose

- Information abstracted