

**Examining the Non-Adoption of Mobile Phone
Technologies for Agricultural Activities by
Smallholder Farmers in Zimbabwe**

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ABSTRACT

The introduction of mobile phones and their associated technologies has impacted every aspect of human existence, particularly in the developing world. This increase in mobile phone usage has given developing nations a window of opportunity to use mobile phone technologies as a means of achieving development. However, most of the research across sub-Saharan Africa (SSA), including Zimbabwe, reported minimal usage of mobile phone technologies by a few smallholder farmers. There is an underusage of mobile phone technologies for agricultural purposes by most of the smallholder farmers in Zimbabwe, while these farmers use mobile phone technologies productively in their everyday lives.

This research sought to understand why most smallholder farmers in Zimbabwe do not use their mobile phones in their agricultural activities when they successfully use them in their everyday lives. The study explores the perceptions of smallholder farmers in Zimbabwe on the role of mobile technology in the sustainable development of smallholder agriculture in the country. The researcher employed a qualitative technique to understand smallholder farmers' perspectives on mobile phone technology use in their agricultural activities. The research adopted an inductive approach to theory creation based on interpretivism, a philosophical theory that recognises the possibility of multiple realities and subjectivity during the formation of knowledge. Qualitative techniques including observations, a focus group discussion (FGD) and in-depth interviews were used to gather empirical data.

The study was conducted following the key tenets provided for conducting a progressive case study. The researcher analysed the literature on smallholder farmers and mobile phone use in agriculture and offered a detailed overview of the study's context. The factors influencing mobile phone uptake and use in agriculture and attitudes and perceptions toward technology are identified and discussed. The main contribution of this research to the body of knowledge is the constructed eclectic theoretical model with nine constructs. The empirical research results affirmed the findings from the literature analysis for six constructs Perceived Costs (PC), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Perceived Compatibility (PComp), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC). The

research also proposed three new constructs, which are Perceived Expressiveness (PE), Perceived Support of Service Provider (PSoSP), and Perceived Mobility (PM).

This research has found the proposed model to irradiate the adoption and usage patterns, and variations of mobile phone technologies by smallholder farmers in Zimbabwe. The model emphasises the significance of the role of agricultural extension service officers in the adoption and usage processes. That is why it incorporates agricultural extension services officers as a vital cog in the model because of the moderating effect on eight constructs of the proposed model. According to the research findings, agricultural extension service personnel in Zimbabwe play a crucial role in teaching smallholder farmers and assessing the utility of mobile phone technology applications as a supplemental tool in agricultural extension processes.

The study's secondary aim is to contribute to practice by creating a framework for guiding the adoption and usage of mobile phone technologies to advance smallholder agriculture in Zimbabwe. The proposed framework integrates the key agricultural stakeholders in the layers and places the agricultural extension services officers at the epicentre of the operationalisation of the framework since they are a vital part of the smallholder agriculture information dissemination and agriculture development matrix. The framework intends to support the integration of agricultural information sources into a centralised repository which should be accessible to all agricultural information dissemination platforms. All developed mobile phone technology for agriculture platforms should be integrated into the framework after evaluation. The agricultural extension services officers, who work directly with smallholder farmers, should evaluate the intrinsic conditions of the smallholder farmers under their jurisdiction and recommend the best mobile phone technology agricultural application suitable for each farmer's circumstances.

Key terms:

Mobile phone technology, smallholder farmers, agricultural extension officers, digital divide, perceptions, interpretivism, case study, eclectic model, TAM, TRA, TPB, combined model, framework

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DECLARATION

I declare that “*Examining Non-Adoption of Mobile Phone Technologies for Agricultural Activities by Smallholder Farmers in Zimbabwe*” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged through complete references.

A handwritten signature in blue ink, appearing to read 'Musungwini', is written over a horizontal dotted line. The signature is contained within a rectangular box.

SIGNATURE

25 January 2023

DATE

(Mr Samuel Musungwini)

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LIST OF ACRONYMS

Abbreviation	Description
3G	3 rd Generation Technology.
Agritex	Agricultural Extension Services.
CCA	Constant Comparison Analysis.
CFS	Committee on World Food Security.
CMB	Cotton Marketing Board
DOI	Diffusion of Innovation.
EDGE	Enhanced Data for Global Evolution.
eGov	Electronic Government.
ESAP	Economic Structural Adjustment Program.
EU	European Union.
FAO	Food and Agriculture Organisation.
FTLRP	Fast Track Land Reform Program.
FGD	Focus Group Discussion.
GDP	Gross Domestic Product.
GMB	Grain Marketing Board.
GNI	Gross National Income.
GoZ	Government of Zimbabwe.
GPRS	General Packet Radio Services.
GSM	Global System for Mobile.
GSMA	Global System for Mobile Association.
HDI	Human Development Index.
ICT	Information and Communication Technology.
ICT4Ag	Information and Communication Technology for Agriculture
ICT4D	Information and Communication Technology for Development.
IDI	ICT Development Index.
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund.
ITU	International Telecommunication Union.
IVR	Interactive Voice Response
M4D	Mobile for Development.
MDC	Movement for Democratic Change.
MDG	Millennium Development Goals.
mGov	Mobile Government.
MMT	Mobile Money Transfer.
MNO	Mobile Network Operator.
MofAMID	Ministry of Agriculture, Mechanisation and Irrigation Development
NGOs	Non-Governmental Organisations.
OECD	Organisation for Economic Co-operation and Development.
POTRAZ	Postal and Telecommunication Regulatory Authority of Zimbabwe.
SDG	Sustainable Development Goals.
SMS	Small Message Services.
SSA	Sub-Saharan Africa.
TAM	Technology Acceptance Model.
TMB	Tobacco Marketing Board
TPB	Theory of Planned Behaviour.
TRB	Theory of Reasoned Behaviour.
UN	United Nations.
UNDP	United Nations Development Program
USSD	Unstructured Supplementary Service Data
WB	World Bank.
ZANU PF	Zimbabwe African National Union Patriotic Front.
ZISCO	Zimbabwe Iron and Steel Company.
ZJC	Zimbabwe Junior Certificate

CHAPTER ONE: INTRODUCTION

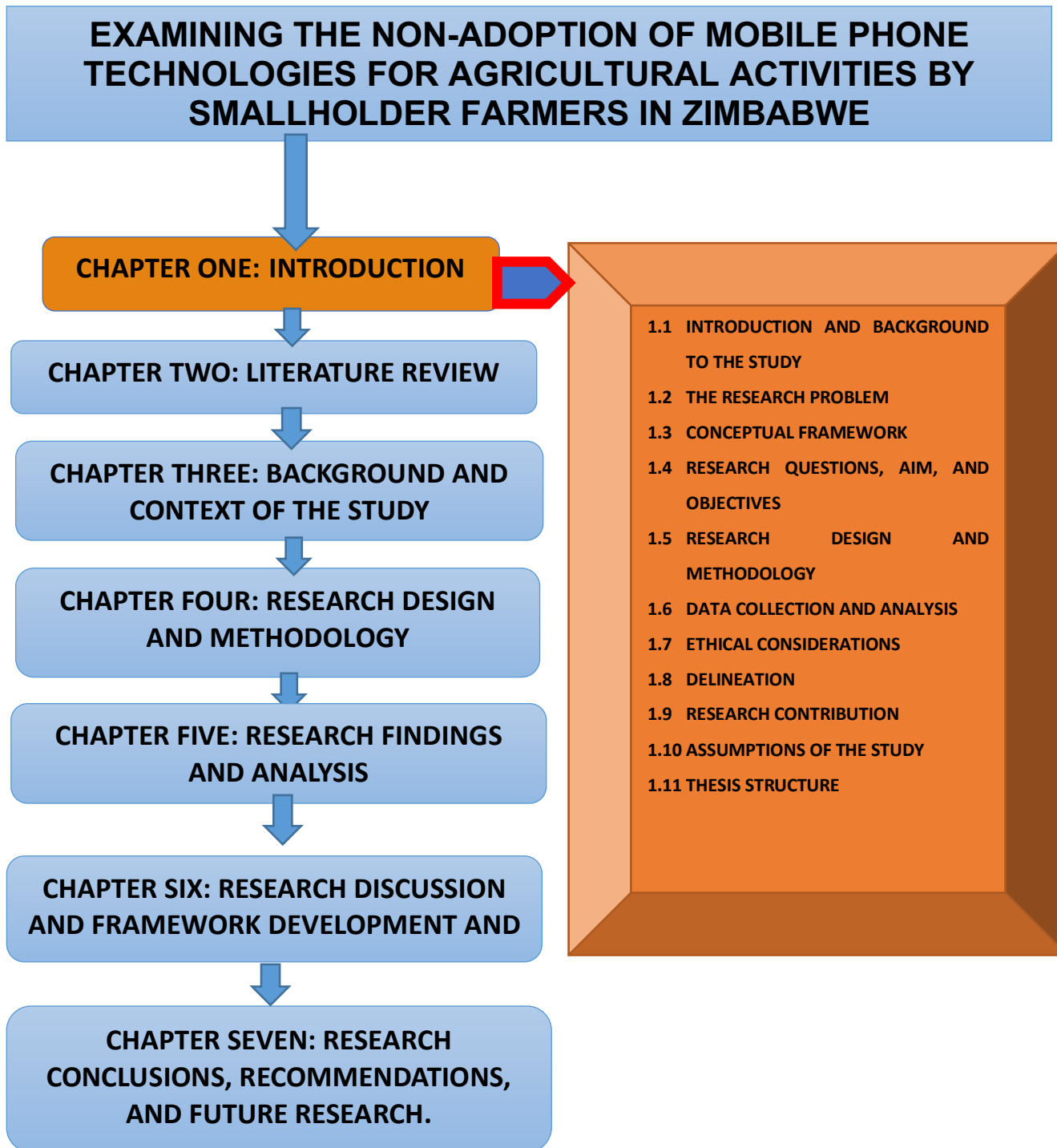


Figure 1. 1: Thesis and Chapter One navigation map (author's construction)

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

The advent of mobile phones and their associated technologies brought hope to the developing world (Walton, 2015). Mobile phones are capable of being more than just communication devices and they are now straddling every aspect of human existence, including in the developing world, as pointed out by several research papers (Porter, et al., 2020; Mushroor et al., 2019; Krell et al., 2021). The increase in the usage mobile phone technologies provided a window of opportunity for developing countries to harness them as an avenue for realising socio economic development. In most sub-Saharan Africa (SSA) countries, governments have teamed up with the private sector and made some substantial investments to establish key information and communication technology (ICT) infrastructure in their respective countries. This development and the continuously declining cost of mobile phone handsets have resulted in high mobile phone ownership (POTRAZ, 2021).

In the past 15 years, research has consistently linked mobile phone usage to development in the developing world. research that considered mobile phone usage in smallholder agriculture in developing countries (Krell et al., 2021) reported a positive connection between the usage of mobile phone technologies by smallholder farmers and their agricultural productivity. However, most research articles on SSA, including Zimbabwe, reported that only a few smallholder farmers used mobile phone technologies for agricultural information seeking. Hannibal and Kauppi (2019), submit that agriculture is an information-driven sector that requires access to real-time actionable information.

Therefore, while it is noted that mobile phone technologies have brought a possible avenue by which smallholder farmers in the developing world may gain access to up-to-date agriculture information in real time, this benefit has not been realised by many smallholder farmers in Zimbabwe. Despite the ubiquity of mobile phones in the hands of many agriculture key stakeholders like smallholder farmers, the actual use of mobile phone for agricultural purposes is lower in Zimbabwe, as found in the research by Masimba et al., (2019) and Quandt et al., (2020). While some researchers have argued for context-specific development and deployment of mobile phone technologies to realise acceptance, adoption and high usage (Takavarasha et al., 2017). The actual adoption and use of mobile phone technologies for agricultural

purposes remain low, even for those context-specific developed technologies like *Agrishare*, *Ecofarmer*, *eMkambo* and *AgriFin* (among others) in Zimbabwe. Evans (2018) posited that mobile phone technologies and their applications are powerful tools that should be channeled for broadcasting agricultural information and knowledge, but their actual use is limited. The surge in mobile phone ownership and usage has reached the length and breadth of Zimbabwe, including marginalised, rural, and informal communities.

This research was motivated by three factors which are listed below.

- a) There is A high mobile penetration rate in Zimbabwe (Kemp, 2020).
- b) Historically, agriculture has been the mainstay of the Zimbabwean economy (Mutami, 2015)
- c) The increasing number of smallholder farmers in Zimbabwe (Moyo, 2011).

These factors are discussed briefly in the proceeding sections below.

First, there is a very high mobile penetration rate in Zimbabwe as the statistics on the International Telecommunication Union (ITU) website (UIT, 2020) indicate that mobile phone technologies are almost accessible to everyone. While the average mobile phone penetration rate for Africa is reported as 91.8%, for Zimbabwe, the rate hovers around 100% (Kemp, 2020). However, possession may not always equate to efficient and beneficial use as found in research by Nyamba (2017) and UIT (2020).

Second (and historically), agriculture has been the mainstay of the economies of SSA countries (Dethier & Effenberger, 2012). In Zimbabwe, agriculture was a significant contributor to the Gross Domestic Product (GDP) in the past, as claimed by Tekere, (2001), and the nation was a net exporter of agricultural goods, hence it was eulogised as the 'breadbasket' of Africa (Maiyaki, 2010; Mkodzongi & Lawrence, 2019) until 2000 when the Fast Track Land Reform Program (FTLRP) began. The significance of the agricultural industry is that it is the vibrant economic sector in most African countries, and as a result, its development presents the best prospect for economic growth and poverty alleviation on the continent (Chisita & Malapela, 2014; Van Zyl et al., 2014).

Third, since gaining independence in 1980, there has been an increase in the number of smallholder farmers in Zimbabwe, and this significantly increased in the 1990s for various reasons (Cliffe et al., 2011). The Economic Structural Adjustment Program

(ESAP) and the FTLRP activities increased the number of people dependent on the land as a source of livelihood (Mkodzongi & Lawrence, 2019). smallholder farmers are critical to the developing world because they constitute a significant percentage of the populace (Gabagambi, 2013; Ogbeide & Ele, 2019; Olarinde & Oladunni, 2013) than in developed countries. They [Smallholder farmers] are directly involved in agricultural production, which is the engine of developing economies, as reported by Baumuller (2015) and Magesa et al., (2015), among others.

Increasing access to the novel agriculture information (through ICTs) has become vital to government departments, policymakers, researchers, and practitioners in the modern world. Researchers and practitioners have argued for policies that promote the use of ICTs in various socioeconomic activities like education, health and agriculture to promote social and economic transformation of communities like (Qureshi & Najjar, 2017). In the developed world, governments have been at the forefront of the implementation of ICTs in development, but governments in the developing world, including sub-Saharan Africa (SSA), have been lagging in terms of this development trajectory, as reported by Heeks and Ospina (2019) and UIT (2020). Research on mobile phone technologies and their usage in agriculture has focused on establishing the uses of mobile phones by smallholder farmers in information dissemination and delivery (Khan et al., 2019) and some research focused on general ICT use and agriculture (Ogbeide & Ele et al 2015). At the time of conducting this research, no other had looked at the non-adoption of mobile phone technologies by smallholder farmers for agricultural purposes while they successfully use them for general everyday activities.

Agricultural professionals advise that smallholder farmers should have real-time access to information about weather patterns, agricultural input costs and prices, agricultural produce market prices, pests and diseases, and control strategies (Quandt et al., 2020) and this information might be delivered via mobile phone technologies. The Sustainable Development Goals (SDG) Framework of the 2016 to 2030 development agenda is premised on harnessing ICTs to attain the world we want. This research is in direct alignment with SDG 1 (End Poverty in All its Forms) and SDG 2 (Zero Hunger) as well as having an indirect impact on SDG 3 (Health), SDG 4

(Education), SDG 8 (Economic Growth) and SDG 12 (Environmental Protection), (Sustainable consumption and production) (Assembly, 2015).

1.2 THE RESEARCH PROBLEM

ICT refers to any gadget that can accept information and store, retrieve, manipulate, transmit or receive it electronically in a digital form. Information and communications technologies for development (ICT4D) are based on the use of information and communication technologies (ICTs) in the fields of socioeconomic development, poverty eradication, international development and human rights (Heeks, 2015). This is explained by the claim that improved information and communication technology accelerates social progress (ibid). ICT4D research focuses on attempting to understand the instrumental role of ICTs in the development process (Marais, 2011). While ICT4D research has attracted increasing interest from scholars and policymakers, it is important that the researchers are indigenous or residents of the developing countries in which they study the effects of ICT4D. This is vital as the key questions that enable academics to contribute to their fields and subsequently, for practitioners to use these contributions to enable ICT implementations and policies that improve people's lives can be best discovered in this way.

The research is an enquiry into why most smallholder farmers in Zimbabwe do not use their mobile phones in their agricultural activities despite using them successfully in their general everyday lives. It investigates how Zimbabwean smallholder farmers perceive the contribution of mobile technology to the sustained growth of their industry. The researcher is indigenous and a resident of Zimbabwe. As far as the researcher knows, no research has been conducted that focused on understanding the reasons why Zimbabwean smallholder farmers are not fully appropriating their mobile phones in their agricultural activities yet are using them effectively in other areas of their lives.

Most smallholder farmers in Zimbabwe do not access the relevant information on time, and the absence of actionable real-time agricultural data contributes significantly to their underproductivity. Although many mobile phone technology applications for agriculture have been developed and deployed in Zimbabwe, research has found that there is limited use of these technologies for agricultural purposes. This underutilisation results in retarded development of these farmers and their

communities. While some research suggests that a practical skills gap is impacting the adoption and use of these mobile phone technologies by smallholder farmers (Emeana et al., 2020), however, other research has also shown that the same smallholder farmers successfully utilise mobile phone technologies in other areas of their everyday lives (Ugochukwu et al., 2020).

Currently, there is an absence of empirical knowledge on the adoption, usage, and impact of mobile phones on smallholder agriculture on an individual household level, from the smallholder farmer's perspective. Hence, this research investigates the perceptions of smallholder farmers in Zimbabwe about the role of mobile phones in the sustainable development of their agricultural activities to understand the different variations in the adoption and usage of mobile phone technologies. Based on the findings, the secondary aim of the research is to avail a framework for the adoption and use of mobile phones by smallholder farmers in Zimbabwe. This framework could be used to facilitate policies that promote the effective usage of mobile phones in smallholder agriculture. This research was motivated by the desire to improve the adoption and effective usage of phones in smallholder agricultural activities in Zimbabwe.

However, no research has investigated why smallholder farmers in Zimbabwe are not using mobile phones in their agricultural activities despite fully appropriating mobile phone technologies in other areas of their daily lives. The main concern that prompted this research is that smallholder agriculture will continue to be underproductive unless the root causes of the problem are identified and addressed. As a result, this study examines the perspectives of Zimbabwean smallholder farmers on the usage of mobile phones for agricultural reasons. The problem statement can be summed up as:

There is an underutilisation of mobile phone technologies for agricultural purposes by most smallholder farmers in Zimbabwe while these farmers productively use mobile phone technologies in their general, everyday lives.

1.3 CONCEPTUAL FRAMEWORK

The use of a conceptual framework is encouraged in qualitative research because it lives at the centre of an empirical study. In the words of Rogers (2016) "A conceptual

framework serves as a guide and ballast to research": it assists and guides the data collection and analysis process in interpretive inductive research for theorising purposes to allow for the concepts which are relevant to the practical situation under investigation to emerge through data analysis process (Bernardi, 2017). The conceptual framework is the lens through which research is framed and thus is used to guide the development of research questions, design the methodology, and analyse data (Thomas et al., 2011). Stainton et al., (2009) believe that A conceptual framework assists in the researcher's ability to establish early study results and evaluate those findings using the body of literature already in existence. That is why the researcher developed the conceptual framework to use it only as a general guide.

ICTs Developed and deployed cannot deliver on their anticipated objectives if they are not adopted and effectively used by the targeted potential users. Hence, information systems theories like the theory of reasoned action (TRA), theory of planned behaviour (TPB), diffusion of innovation (DOI), unified theory of acceptance and use of technology (UTAUT) and technology acceptance model (TAM) models have been proposed to provide the basis for determining consumers' behaviour (Nabavi et al., 2016). The author developed a nine-construct conceptual framework to guide the development research boundaries and formulate objectives and research questions. These constructs are Perceived Expressiveness (PE), Perceived Mobility (PM), Perceived Support of Service Provider (PSoSP), perceived compatibility (PComp), Perceived Ease of Use (PEOU), Perceived Costs (PC), Perceived Usefulness (PU), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC) and For more on this see Chapter 2 (Section 2.11).

The conceptual model assisted in understanding the perceptions of Zimbabwean smallholder farmers as to why they are either not or only partially using mobile phones in their agricultural activities and ultimately, why these smallholder farmers might fail to develop and become self-sustainable. The scope of this research focuses on merging mobile phone agriculture applications and services; mobile phone device elements and the applications they support; smallholder agriculture activities, characteristics, and challenges. This research could help contribute to understanding non adoption of mobile phone technologies by smallholder farmers for agricultural purposes, even in cases where these farmers are using the same gadgets in other

areas of everyday life. This understanding will result in the development of a framework for guiding the adoption and use of mobile phone technologies and sustainable development of smallholder agriculture in Zimbabwe through the delivery of context-specific real-time, actionable agriculture information that results in the empowerment of smallholder farmers.

This research also adds to the existing literature on adoption theories and models, ICT4D, specifically electronic and mobile agriculture, information systems, and ICT/mobile frameworks. The research can also assist the agricultural extension officers in their everyday work, the improvement of mobile device elements and the applications they support. Various models could also be developed from the proposed framework, such as the social media use of agricultural extension officers in a resourced-constrained environment as a low-cost model and the model on resource management on mobile devices. The next section focuses on the research aim and objectives.

1.4 RESEARCH QUESTIONS, AIM AND OBJECTIVES

This section presents the research questions, aim and objectives.

1.4.1 Research questions

The main research question is formulated as follows:

Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully use them in their general, everyday lives?

The researcher believes that providing answers to this research question assist in achievement of the aim research aim. The research developed the following sub-research questions and answering them enabled the main research question to be addressed:

- a) What are the smallholder agricultural activities, characteristics, information needs and challenges farmers face in Zimbabwe?
- b) What are the mobile agricultural applications and services available in Zimbabwe?
- c) What are the perceptions of smallholder farmers on the outcomes of their agricultural activities due to the use of mobile phones?

- d) How do smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes?
- e) What are the factors affecting the adoption and use of mobile phone technology as a source of agricultural information, its upscaling and sustainable use by smallholder farmers in Zimbabwe?
- f) How to ensure that most smallholder farmers in Zimbabwe effectively use mobile phone technologies in their agriculture activities productively?

1.4.2 Research aim and objectives

The research aims to understand the reason for the non-adoption of mobile phone technologies for agricultural purposes by smallholder farmers in Zimbabwe.

This research pursues the following objectives that enable the achievement of the research aim:

- a) To identify the smallholder agricultural activities, characteristics, information needs and challenges farmers face in Zimbabwe.
- b) To identify the mobile agricultural applications and services available in Zimbabwe.
- c) To identify the perceptions of smallholder farmers on the outcomes of their agricultural activities due to the use of mobile phones.
- d) To understand how smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes.
- e) To identify the factors affecting smallholder farmers' adoption and use of mobile phone technologies in Zimbabwe.
- f) To develop and incorporate the contextual empirical findings into a framework for harnessing mobile phone technologies for the sustainable development of smallholder farmers in Zimbabwe.

1.4.3 Mapping the research questions, objectives and methodology.

Table 1. 1: Mapping the research questions, objectives and methodology.

MAIN RESEARCH QUESTION: Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general, everyday lives?				
	Research Sub-Question	Units of Analysis	Strategies/Methods	Research Objectives
1	What are the smallholder agricultural activities, characteristics, information needs and challenges farmers face in Zimbabwe?	Smallholder farmers, agricultural extension officers	Literature review, observations, FGD and interviews	To identify the smallholder agricultural activities, characteristics, information needs and challenges farmers face in Zimbabwe.
2	What are the mobile agricultural applications and services available in Zimbabwe?	Mobile phone technologies	Literature review, FGD, and interviews	To identify the mobile agricultural applications and services available in Zimbabwe.
3	What are the perceptions of smallholder farmers on the outcomes of their agricultural activities due to the use of mobile phones?	Smallholder farmers and the researcher	FGD and interviews	To identify the perceptions of smallholder farmers on the outcomes of their agricultural activities due to the use of mobile phones.
4	How do smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes?	Smallholder farmers and the researcher	Observations, FGD and interviews	To understand how smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes.
5	What are the factors affecting the adoption and use of mobile phone technology as a source of agricultural information, their upscaling and sustainable use among smallholder farmers in Zimbabwe?	Smallholder farmers, agricultural extension officers	Literature review, observations, FGD and interviews	To identify the factors affecting smallholder farmers' adoption and use of mobile phone technologies in Zimbabwe.
6	How can we ensure that most smallholder farmers in Zimbabwe effectively use mobile phone technologies in their agriculture activities?	Smallholder farmers, agricultural extension officers, agriculture value chain players, and researchers	Literature review, observations, FGD and interviews	To develop and incorporate the empirical findings into a framework for harnessing mobile phone technologies for the sustainable development of smallholder farmers in Zimbabwe.

1.5 RESEARCH DESIGN AND METHODOLOGY

This study used a qualitative research approach to understand the perspectives of Zimbabwean smallholder farmers on mobile phone technology use in their agricultural activities to comprehend their non-adoption for agricultural purposes. The researcher further assessed these farmers' acquisition and ongoing usage of mobile phones for their agricultural operations. The research adopted an inductive approach to theory creation and is based on interpretivism, a philosophical theory that recognises the existence of multiple realities and subjectivity in the formation of knowledge. Qualitative techniques including observations, a focus group discussion (FGD) and in-depth interviews were used to gather empirical data and the study was conducted following the key tenets guiding a case study provided by Yin (2006). A case study is an empirical investigation that explores a current phenomenon in its actual setting, particularly when the distinctions between phenomenon and environment are ambiguous (Yin, 2003). The case study approach was also chosen because it allows the study of how and why questions should be asked about a currently existing set of events over which the researcher has no control (Yin, 2014). A case study was able to offer insight into smallholder farmers' activities and their general use of mobile phones as well as establish the significance of geographical context precise differences between cases.

1.6 DATA COLLECTION AND ANALYSIS

The data collection and its subsequent analysis are intrinsically reliant on which methodological approach is used in the research (Bryman, 2009; Saunders et al., 2009a). This is usually the most critical part of the research process and significantly contributes to the study's overall reliability and validity. The data were mainly collected through interviews and a focus group discussion as well as observation and participatory observations. The use of various data collection methods is generally referred to as data triangulation. Data triangulation enables research findings from one technique to be examined and substantiated by making a comparison with findings from another method. Because it provides a multiplicity of perspectives on the issue under investigation, triangulation is beneficial for the theory development, practical understanding and the development of the proposed framework.

The research required a substantial amount of time in the research field for the researcher to become familiar with the setting, collect data and understand what mobile phones meant to the people and how they were using them. This researcher spent three months visiting the research sites to familiarise with the environment and collect the requisite data. The primary data are the principal data of any research and therefore should be best understood as data that is being analysed directly instead of from the perspective of another's viewpoint. The researcher observed smallholder farmers performing their farming activities and agriculture extension officers during their fieldwork of farmer supervision.

1.7 ETHICAL CONSIDERATIONS

Ethical considerations refer to research concerns that govern the moral standing of every researcher's behaviour regarding the research subjects hence, this researcher observed the moral issues that were projected to arise during the research. In line with that the researcher obtained the clearance for conducting the research from the Ministry of Agriculture in Zimbabwe. Ethical considerations can be individual, interlinked and collective. These include but are not limited to responsibilities regarding moral, legal, role and professional conduct. The researcher ensured that the research subjects were treated equitably and fairly, and that all participants' contributions and opinions were equally valued and given due representation. The research subjects were consulted, and their consent was sought; therefore, they were not coerced into participating in the research.

This research involved the collection of personal (although not sensitive or health-related information) and from a legal perspective, the research complied with the requirement of the 2021 Data Protection Act of Zimbabwe (Poshai et al., 2023). Data about the research subjects were strictly used for this research only and for no other reason. These issues include the data collection, data analysis, the confidentiality of the participants and the data presentation.

1.8 DELINEATION

This research was mainly conducted in the Njelele area of Gokwe South in the Midlands Province where smallholder farmers are very actively farming and were more concentrated than most other areas. Pilot studies were conducted at the Mbare and Kombayi

marketplaces to which smallholder farmers bring their products to sell. Around 12–15% of smallholder farmers found at these marketplaces were from Gokwe. Theoretically, the research focused on the impact of mobile phone technology on smallholder agriculture in Zimbabwean development, mainly focusing on the Njelele area of Gokwe South. The study mainly concentrated on establishing how smallholder farmers and agricultural extension officers are using mobile phones in their farming activities and their work. This enabled the researcher to obtain practical knowledge from the smallholder farmers about their experiences and challenges with mobile phones and their perceptions about the adoption and use of mobile phones in agricultural activities. This research might assist in designing strategies that need to be employed to successfully harness mobile phone technologies for the advancement of smallholder farmers in Zimbabwe. The study was confined to smallholder farmers, agricultural extension officers and mobile phone technology in Zimbabwe.

1.9 RESEARCH CONTRIBUTION

This study is multi-disciplinary, linking information systems, smallholder agriculture and ICT4D. The research primarily aimed to understand the reasons for the non-adoption of mobile phone technologies by smallholder farmers in Zimbabwe, even though these same farmers successfully use such technologies in their general, everyday lives. The research makes a theoretical contribution to the body of knowledge. The empirical research results confirmed the literature analysis for six constructs (Perceived Costs, Perceived Ease of Use, Perceived Usefulness, Perceived Compatibility, Perceived Subjective Norms and Perceived Behavioural Control). The research further contributes significantly by proposing three new constructs, which are Perceived Expressiveness (PE), Perceived Support of Service Provider (PSoSP) and Perceived Mobility (PM). The proposed model has been named the mobile technology agriculture adoption model and has shed more light on the adoption and usage patterns and variations of mobile phone technologies by smallholder farmers in Zimbabwe.

The model emphasises the significance of the role of agricultural extension service officers in the adoption and usage processes. Consequently, the model—crucially—incorporates agricultural extension services officers because the study ascertained that their role moderated eight constructs of the proposed model. According to the research findings, agricultural extension service personnel in Zimbabwe play a crucial role in teaching

smallholder farmers and assessing the utility of mobile phone technology applications as a supplemental tool in the agricultural extension processes. Chapter Five (Section 5.10) provides details of the study's theoretical contribution.

The research secondarily aimed to make a practical contribution by proposing a guiding framework to guide the adoption and usage of mobile phone technologies by smallholder farmers in their agricultural activities and other context-specific factors of smallholder agriculture in Zimbabwe, a developing country in Southern Africa. This could assist policymakers in formulating better policies that promote the increased adoption and usage of mobile phone technologies by smallholder farmers. The study's contribution could potentially develop and benefit Zimbabwe, as no such research has been undertaken to date. The study adds a practical understanding that could be used for successfully harnessing mobile phones for the development of smallholder farmers in Zimbabwe, which, in turn, could aid in scaling up the adoption and effective usage of mobile phones and the sustainability of the process.

1.10 ASSUMPTIONS OF THE STUDY

All research inevitably encompasses assumptions and although many researchers may not prioritise or disregard these assumptions, they are critical and must be supported to be binding (Fortus, 2009). Simon (2011) suggested that the research's assumptions are factors that are partially outside the researcher's control, but if they disappear or are ignored, the research may be rendered irrelevant. As a result, this researcher believes that a set of assumptions for each study project should be established at the beginning of such a study. Assumptions are so fundamental that the research topic or problem statement cannot emerge without them (Leedy & Ormrod, 2010). The chain of assumptions in a study should fundamentally encompass basic methodological assumptions, theoretical assumptions and, to a lesser extent, subject-specific assumptions and assumptions concerning the study's measurements.

1.10.1 Methodological assumptions

In the study of smallholder farmers' impressions of the use of mobile phone technology in their routine agriculture operations in the context of a developing country, the implementation of multi-data gathering tools ensures consistency of reality. This is because the subject under investigation can be examined from a different angles. Because

data are acquired through dialogical encounters, both the researcher and the participants impact the study's conclusion. Because participation in this study is voluntary and the participants' confidentiality is protected, the researcher believes that the interview and FGD participants would answer honestly (Wiles et al., 2008). Owing to the authenticity of the questions and the semi-literacy rate among the respondents, it can be surmised that the respondents would fully comprehend the questions being asked. The researcher assumed that since participants were able to read and understand English and Shona, they would engage in the research sincerely and objectively. Furthermore, the sample's inclusion criterion is appropriate.

1.10.2 Theoretical assumptions

Conceptual models are essential elements of knowledge generation in information systems research because they serve as blueprints for designing research procedures (Meredith, 1993). The conceptual model developed by the researcher in Chapter Two might not be exhaustive for assessing smallholder farmers' perceptions of mobile phone use in agriculture within the context of a developing country because it only focuses on the literature review and empirical data from the Zimbabwean context. However, every context possesses nuances that might only be learnt after the empirical research has been conducted. The five theories applied in this study collectively provided the basis for the proposed conceptual model developed and operationalised to guide the data collection and analysis in this research.

1.10.3 Research topic assumptions

Due to slow modernisation, developing nations lag behind developed countries in terms of technology investments, human capacity development, technology readiness, ICT infrastructure and mobile technology services. Because of the diverse contextual factors in each country, the degree of technology investment differs between countries. As a result, frameworks from one context may not be appropriate for use in another due to a lack of contextual empiricism. The study anticipates that certain factors influencing the adoption and use of mobile phone technology by smallholder farmers in their agricultural activities will emerge from the collected data using observations, in-depth semi-structured interviews, focus group discussions and an expert review because the research instruments are naturally open-ended. The success of ICT4D research is influenced by the local environment. This indicates that because of contextual relevance, the factors

influencing smallholder farmers' adoption and use of mobile phone technology in their agricultural activities vary in intensity.

1.10.4 The researcher's assumptions

Any researcher's cognitive functions have natural limitations because people are born and nurtured in certain conditions that influence how they experience the world. What people know is merely a product of what they have been exposed to and learned. As a result, they seek information and the procedures through which individuals acquire knowledge vary from one to another (Walters, 2001). Therefore, the reasons, answers and explanations they may supply depend on the nature of the questioning. Consequently, what one knows may only be a partial truth and what one does not know does not imply that it does not exist (Leedy & Ormrod, 2010). Therefore, this study aimed to explore the undiscovered universal factors affecting the adoption and usage of mobile phones for agricultural purposes by smallholder farmers in Zimbabwe and learn more about the phenomena.

1.11 THESIS STRUCTURE

Chapter One introduces the background and objectives of the study, the research questions, the rationale, and the research. Chapter Two reviews the literature on ICT4D, m-government and m-agriculture research articles conducted mainly in sub-Saharan Africa and to some extent globally. The chapter then explores previous research on frameworks guiding the use of ICTs in agriculture and the information systems technology adoption models and end up with the presentation of the conceptual framework. Thereafter, Chapter Three provides a brief background about sub-Saharan Africa as well as the region's characteristics and history. The chapter further discusses agricultural technological innovations and their potential impact on agriculture productivity, focusing on Zimbabwe and its agricultural sector, Gokwe South, which is the main research site of this research, and the Mbare farmers' market in Harare and the Kombayi farmers' market in Gweru.

Chapter Four details the research design employed in this study. This covers the research philosophy and the research approach employed in the study. The chapter describes the research techniques and instruments utilised as well as their justification and the delimitation of the cases to be used in the study. Chapter Five presents and analyses the empirical data. The data are presented using codes, themes, tables and graphs. The researcher also presents quotations from the interview transcripts and focus group

discussion. Constant content analysis and classical content analysis are applied in the data analysis and presentation.

Chapter Six presents the interpreted data and the framework while in Chapter Seven, the researcher concludes the findings of the research which leads to recommendations for future research areas that could be pursued by other researchers in the future and implications for practice.

CHAPTER TWO: THE LITERATURE REVIEW

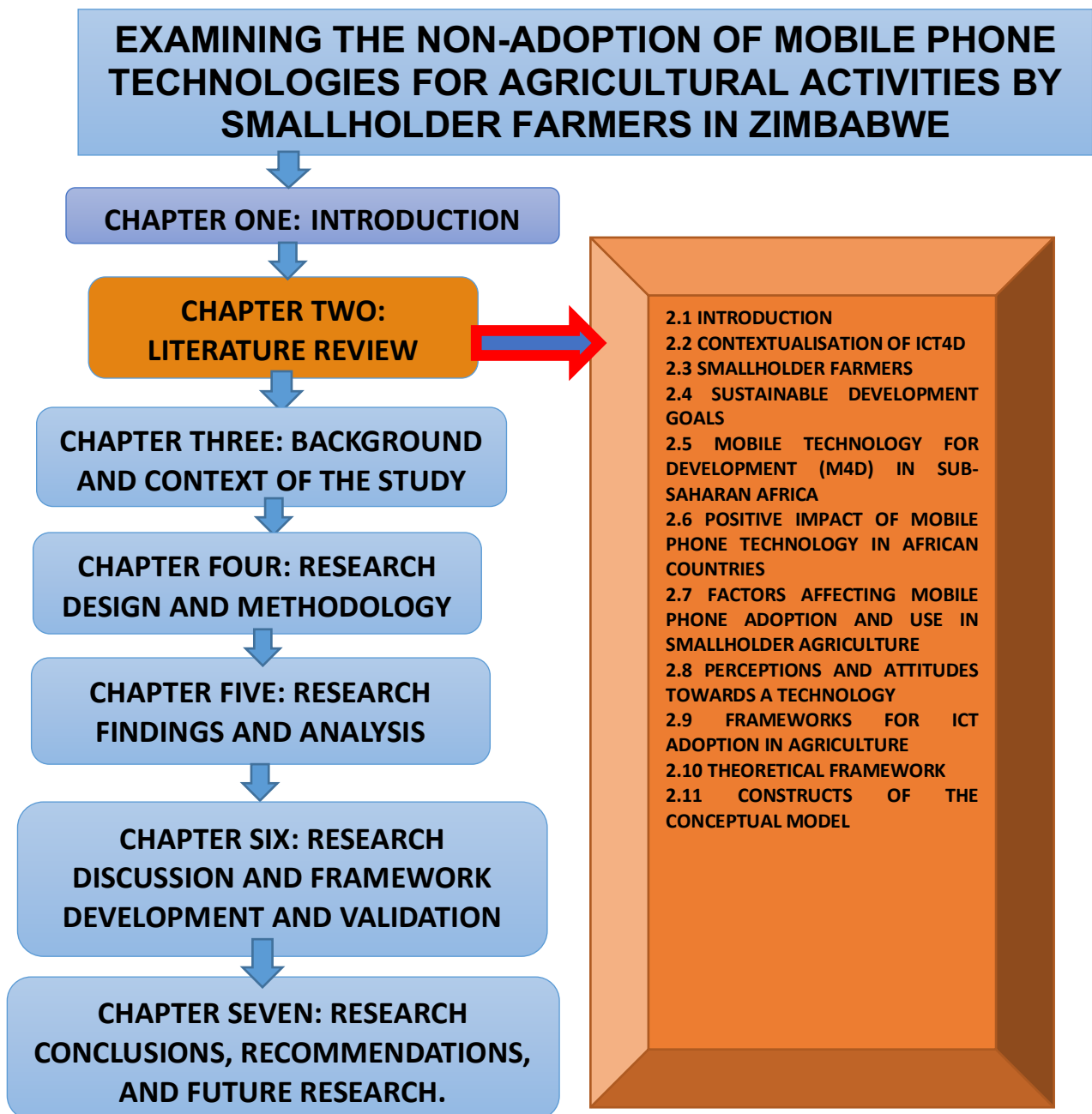


Figure 2.1: Thesis and Chapter Two navigation map (author's construction)

2.1 INTRODUCTION

The chapter provides literature on ICT4D articles, focusing on mobile technology and smallholder agriculture in sub-Saharan Africa. The purpose of this literature review is to lay the groundwork for the research by going through, summarising and assessing major topics linked to the mobile phone technology adoption and usage putting more thrust on the by smallholder farmers and agriculture. Primacy is given to studies undertaken in developing nations, with a focus on sub-Saharan Africa, which is the context of this research. Nonetheless, some material from various developing countries in other regions of the world has been included to increase universal understanding of ICT4D.

ICT4D research has changed over time and much of it has been characterised by a multiplicity of evaluation typologies and theories, with most of them concentrating on adoption, benefits, obstacles and user acceptability. However, no studies have explicitly focused on understanding the non-adoption of mobile phone technologies by smallholder farmers in their agricultural activities even though they successfully use them in their everyday lives. In addition, no studies have developed a mobile agricultural framework for harnessing mobile phone technologies for the development of smallholder agriculture in Zimbabwe, to the best of the researcher's knowledge.

The literature evaluation is divided into five bodies of knowledge with the first part introducing the concept of ICT4D with the goal of examining several essential subjects associated with the ICT4D phenomena. The second sub-section examines the smallholder farmers' characteristics, challenges and information needs. The third sub-section evaluates the SDGs and mobile phone use in developing nations' smallholder agriculture, concentrating on sub-Saharan Africa. This is followed by an examination of people's perceptions and attitudes toward technology. The chapter next discusses the theoretical framework, reviewing numerous technological adoption and acceptability models before developing a conceptual model for the study. Figure 2.1 depicts the chapter outline, which will help the reader navigate the chapter.

2.2 CONTEXTUALISATION OF ICT4D

This section contextualises ICT4D by presenting the ICT4D concept. ICT4D is an endeavour that seeks to provide equal access to modern communications technology to close the digital divide and promote economic growth (Heeks & Ospina, 2019). The researcher conducted a systematic literature review, which is a methodical approach to finding, analysing, and synthesising relevant research in a specific domain, as suggested by Xiao and Watson (2019). The researcher reviewed the literature for ICT4D articles over time and gave primacy to research articles published between 2018–2022. The research was motivated by the need to establish factors influencing the non-adoption of mobile phone technologies for agricultural activities by smallholder farmers in Zimbabwe. To successfully conduct the literature review, the researcher identified relevant databases to search for ICT4D articles on the adoption and use of mobile phones in agriculture by smallholder farmers. The databases include *Scopus*, *Web of Science*, *ACM*, *IEEE* and *Google Scholar*. The researcher developed the following search threads: [Mobile phones use in smallholder agriculture], [Mobile phone technologies and agricultural activities], [Mobile for Development (M4D)] and [ICT4D and smallholder agriculture] as they are related to the research question.

The researcher then analysed the results of the search process to determine which articles were relevant to the research question. To successfully perform the analysis process, the researcher first analysed the title and context and then assessed the abstract of each article. The researcher also determined the quality of the articles by considering the theoretical perspective underpinning the articles and the methodological approach used. This process enabled the researcher to discard any research articles that did not meet the defined criteria. The researcher then analysed the results of the search process to identify the main themes and trends related to the research aim. The main findings were then synthesised and are presented in Tables 2.1, 2.2 and 2.3 as the literature review is organised into different sections.

The literature submits that ICT4D refers to any initiative intending to eliminate the technological discrepancy between the affluent and poor, which manifests in technological disparities (geographic regions or demographic groupings), and to promote economic growth by ensuring equal access to innovative communications technologies (Bonina et

al., 2021; Chipidza & Leidner, 2019; Grunfeld, 2007; Heeks, 2014a; Heeks & Ospina, 2019). The primary goal of ICT4D research is to comprehend the underlying function of ICTs in the development process (De´et al., 2018). ICT4D is premised on the use of ICTs in domains such as poverty eradication, socioeconomic development, human rights and international development (Heeks, 2015). The theory underpinning this is simply that the accessibility to abundant and superior ICTs among many people in a given society could promote the advancements of that society. When ICT is the central point of ICT4D, the development aspect can be vast, covering many facets of society. These include but are not limited to:

ICT4D for service delivery

ICT4D for poverty alleviation

ICT4D for agriculture (***the focal point of this research***).

ICT4D for healthcare

ICT4D for education

According to Heeks (2014b), who coined the term ICT4D and, arguably, is the leading scholar in ICT4D, two occurrences in the 1990s gave rise to what is popularly called ICT4D 1.0. These were the availability of the internet to many people and the crafting of the Millennium Development Goals (MDGs). These two developments quickly became complementary as the MDGs were set as the targets to be achieved, and the ICTs, specifically the internet, became a means of achieving those goals (Gomez et al., 2012). Since then, the term ICT4D has become synonymous with any ICT-related technology developed. Thereafter, it became apparent that whenever new technologies came into being, policymakers, academia, and researchers developed a significant interest in establishing the potential of ICTs to enhance development.

Accordingly, a growing body of research on the use of Information and Communication Technologies for Development (ICT4D) has emerged in the past decade across many socioeconomic strata, including the agricultural sector, particularly in the context of smallholder farmers in developing countries. Studies have found that mobile phone technologies can improve the livelihoods of smallholder farmers by providing access to market information, agricultural advice and financial services (Masimba et al., 2019). However, despite the ubiquitous availability of these mobile phone services, most smallholder farmers in Zimbabwe have not adopted mobile phone technologies for their

agricultural activities. Research has identified several factors contributing to the non-adoption of mobile phone technologies for agricultural activities, including a lack of knowledge and understanding of the technology, lack of access to mobile phones, and limited access to electricity (Khan et al., 2019). Other factors include a lack of trust in the technology, limited literacy and numeracy skills, and the cost of mobile phone services (Poveda & Roberts, 2018). In addition, cultural and gender norms can influence the adoption of mobile phone technologies.

For this reason, the ICT4D 2.0 era should evaluate and decide on the kinds of innovations to be developed by designers and how such innovations should be developed (Heeks, 2015). Heeks identified three different modes: pro-poor, para-poor and per-poor. Pro-poor denotes developing innovations that target impoverished people without involving such people in the process. The para-poor mode signifies developing innovations for impoverished people that involve such people in the process of developing ICTs for development. The per-poor model comprises an innovation deployed within impoverished communities and by impoverished communities. The per-poor innovation model can be exemplified by things like 'beeping' when one tries to call but does not complete the process and 'call me back', a free SMS facility within GSM (Ezeomah & Duncombe, 2019). However, research has shown that most innovations are developed under the pro-poor model, which exposes a research deficit and provides an opportunity to study the context-specific issues experienced by smallholder farmers in Zimbabwe and to understand the per-poor innovations suggested by Mambo (2020).

The conception of ICT4D inspired many researchers to explore it, and as a result, many authors have published several research articles on ICT4D. Heeks (2007) explained that in the lifecycle stage of applicability, the development of ICTs ensues and is followed by the adoption of the technology by organisations or the public, depending on the technology. The adoption phase is followed by the general use of technology, and the last phase is the impact of the technology on the organisation and the public adopting and using such technology. However, to enable the impact of technology, there is a need to ensure that effective usage of the adopted technology takes place, which is fundamental in any area of technology application (Gatero, 2011; Van Reijswoud, 2009). Heeks also wrote about ICT levels of applicability and identified five levels of ICT development informatics applicability. These are meta levels, where ICT development informatics can be applied

on a global scale and could be in one specific social aspect or many (Heeks, 2008; Heeks et al., 2014). ICT development informatics can also be applied on a macro level. This encompasses the development and deployment of ICTs to a region, covering more than one country. The macro level of ICT development informatics covers the whole country and can be cross-sectoral and extensive. The meso level is sector specific ICT4D in a particular country and could be health, agriculture, mining, energy or tourism. The micro level of applicability considers a specific organisation where the ICT development informatics are applied to any organisation in each country, after which the impact is evaluated. Lastly, Heeks addresses the application of ICT development informatics to individuals. Thus, this researcher explored the individual (smallholder farmer) and the sectorial (agriculture).

Previous research has shown that the bulk of ICT4D research has been undertaken in Asia, particularly in India, by researchers residing in India as posited by Chepken et al. (2012). Since then, although considerable research on ICT4D has been conducted in other parts of Africa, like South Africa and Kenya (among others) by researchers residing in those countries, very few studies have been conducted in Zimbabwe, and none of these studies explored smallholder agriculture and non-adoption of mobile phones. Since researchers and policymakers globally prioritise health and education, ICT4D research has historically been dominated by these two fields. Agriculture has attracted very little attention until such time the research by Chepken et al. (2012), was undertaken. Since the proclamation by Chepken et al. (2012), several research articles have probed the area of smallholder agriculture and mobile phone use (Emeana et al., 2020; Etwire et al., 2017; Kacharo et al., 2019; Krell et al., 2021). While most of these researchers have investigated the level of adoption and usage of mobile phone technologies by smallholder farmers, the most notable reasons claimed for smallholder farmers' nonuse of mobile phones for agricultural purposes are a lack of infrastructure and a lack of skills in the target recipient areas. However, Chipidza and Leidner (2019) argue that if these are the true reasons for the failure of ICT4D projects, it means that donors should concentrate their efforts on supporting the development of higher education institutions and infrastructure in poorer nations, as these two factors would set the groundwork for future ICT4D success.

Chipidza and Leidner (2019) identified that a plethora of challenges affect the adoption and usage of ICTs, resulting in a failure to achieve the objectives of ICT4D aspirations in

any intended area. These challenges include cultural clashes among the key stakeholders and resource constraints, including digital skills and funding. In some cases, it transpired that the intended beneficiaries of the ICTs had been ignored during the entire design and implementation, often resulting in such prospective beneficiaries encountering difficulty using the technology. The issues of a lack of technical skills and language barriers are some of the factors affecting the diffusion of ICTs among the populace in most studies. Additionally, there are cultural barriers that hinder the adoption and usage of technology by groups, such as women and the disadvantaged groups in rural and urban areas.

However, no researcher investigated the reasons for the low adoption and usage of these mobile phone technologies by smallholder farmers for agricultural purposes, particularly in circumstances where these farmers productively use these mobile phones in their everyday lives. Therefore, research on smallholder farmers in the context of a developing country but in a different situation should be conducted to add new perspectives on the factors impacting the adoption and usage of mobile phone technologies for agricultural purposes by these farmers who successfully use them in other areas of their lives. This is because ICT4D is not a static destination to be reached; it is multifaceted with dynamic social processes that often involve tensions and contradictions and are always contested and situated within a specific time and place (Zheng et al., 2018). None of the literature published between 2012 and 2022 explored the non-adoption of mobile phone technologies for smallholder farmers' agricultural activities within the Zimbabwean context. Hence, there is a need to explore and understand the nuances arising from this context, especially given that these farmers successfully use mobile phone technologies in other general areas of their everyday lives.

2.3 SMALLHOLDER FARMERS

This section explores the literature review, specifically focusing on smallholder farmers and their characteristics, as well as the challenges they face.

2.3.1 Characteristics of smallholder farmers

The Food and Agriculture Organization (FAO) defines a smallholder farmer as someone who cultivates subsistence crops and one or two cash crops on a small plot of land and almost entirely uses family labour (Food and Agriculture Organization of the United Nations

(FAO), 2014). These characteristics include the size of the farmland, availability of financing, risk exposure level, use of input technology and market orientation (RSB, 2013). This research denotes a smallholder farmer as someone cultivating a small portion of land, using household family labour to produce crops mainly for family consumption. This farmer has limited access to capital, inputs and markets for their produce. Research by Dunjana et al. (2018) established several characteristics of smallholder farmers in Zimbabwe. These characteristics are briefly discussed below in terms of how these characteristics impede the progress of smallholder agriculture.

Smallholder farmers' sole source of income is agriculture, which suggests that their inability to be productive in agricultural ventures would herald gloom for many aspects of their lives (Mutami, 2015). The education of their children, health, the purchase of household necessities and, most significantly, buying agricultural inputs for the upcoming cropping season are other aspects of smallholder farmers' lives that are impacted by their underproductivity. Various studies have explored the conundrum of the underproductivity of smallholder agriculture in SSA and how that regularly causes cycles of poverty because more than any other factor, agriculture is directly linked to the development of rural communities. Hence, smallholder farmers are essential participants in the value chain for agricultural output and expansion (Nkomoki et al., 2021). Consequently, farmers' low productivity has a ripple effect on various facets of their lives.

Smallholder farmers have limited portions of land on which to perform their agricultural activities and furthermore, possess few other assets (Dube, 2020), some of whom produce below the subsistence level. Mashamaite (2014) defines subsistence farming as the practice of growing crops and raising livestock sufficient only for one's use, without any surplus for trade. That is the most impoverished group, which cannot survive on farming income only but rely substantially or even entirely upon off-farm work and other sources of income. This group constitutes the world's poorest and most vulnerable farmers, which includes a significant proportion of female-headed households and an increasing number of farmers who no longer own or have never owned land. Smallholder farmers rely significantly on cattle draught power for ploughing, cropping and transportation (Dunjana et al., 2018). This can be a constraint since healthy, well-fed cattle are required for draught power usage in the fields. If a farmer does not possess cattle, they must lease draught power from other farmers in the region. However, another challenge is that practically all

these farmers rely on rainfall for cultivation. As a result, every farmer prioritises their farming area over those of other farmers who hire their services and thus, crops grown by farmers who do not own farm animals are typically planted late and might not germinate. Cattle, sheep, goats and chickens serve as a supply of organic manure as well as a source of protein.

This is a significant obstacle for individuals who do not have such animals because they have to spend money on fertiliser to improve their probability of growing crops (Houensou et al., 2021). Smallholder farmers benefit from livestock during difficult times such as drought since they often sell cattle to support their families. Smallholder farmers rely extensively on home labour for agricultural activities; hence, the size of the family impacts the labour supply. Due to the above-mentioned conditions, these farmers' prospects of raising their production and escaping poverty are equally likely or unlikely and limit the possible success of smallholder farmers' agricultural activities. Table 2.1 below outlines the identified characteristics of smallholder farmers from the literature review conducted in the current section as well as the challenges faced by smallholder farmers, their information needs and the literature sources for that data.

Table 2. 1: The characteristics, challenges and information needs of smallholder farmers.

	Challenges	Sources
Characteristics of smallholder farmers	<ul style="list-style-type: none"> ❖ Mixed crop-livestock production ❖ Reliance on-farm production for livelihoods ❖ Limited access to capital inputs ❖ Food and cash crop production ❖ Dependence on household labour for farm production (family) ❖ Maize is grown to meet the household's subsistence requirements ❖ Livestock is kept as a source of draft power (cattle and donkeys) ❖ Livestock is kept as a source of organic manure as well as a protein source (cattle, sheep, goats and chickens) ❖ Communal grazing, woodlots and waterpoints 	<ul style="list-style-type: none"> ❖ Abraham and Pingali (2020) ❖ Acclassato Houensou et al. (2021) ❖ Chandio et al. (2018) ❖ Dunjana et al. (2018) ❖ Eagle and Saleh (2021) ❖ Ngoma et al. (2021) ❖ Nkomoki et al. (2019) ❖ Olomu et al., (2020) ❖ Phiri et al. (2019) ❖ Stellmacher and Kelboro (2019)
Challenges faced by smallholder farmers	<ul style="list-style-type: none"> ❖ Land ownership ❖ Small piece of land ❖ Lack of capital ❖ Lack of access to agricultural inputs ❖ Lack of access to lucrative agricultural produce markets ❖ Lack of access to real-time actionable agriculture information ❖ Limited access to extension services due to high agricultural extension officer–farmer ratio ❖ Limited access to extension services due to under-resourced agricultural extension officers (No motorbikes) ❖ Agricultural extension officers with insufficient knowledge and the digital divide 	<ul style="list-style-type: none"> ❖ Chandio et al. (2018) ❖ Donadeu et al. (2019) ❖ Eagle and Saleh (2021) ❖ Formoso (2021) ❖ Kahwili, R. M (2020) ❖ Kumar et al. (2020) ❖ Muench et al. (2021) ❖ Olomu et al. (2020) ❖ Phiri et al. (2019) ❖ Stellmacher and Kelboro (2019) ❖ Tetteh Anang et al. (2020) ❖ Wiggins (2021)
Information needs of smallholder farmers.	<ul style="list-style-type: none"> ❖ Weather forecast information ❖ Information about agricultural inputs, their prices and where to find them ❖ Information about agricultural produce markets and prices ❖ Information about pest and disease management for crops and livestock ❖ Information on the availability of agricultural loan/credit facilities. ❖ Information on agrotechnology 	<ul style="list-style-type: none"> ❖ Abraham and Pingali (2020) ❖ Awuor et al. (2016) ❖ Dunjana et al. (2018) ❖ Eagle and Saleh' (2021) ❖ Kumar et al. (2020) ❖ Kwapong et al. (2020) ❖ Lwoga et al. (2010) ❖ Dube (2020) ❖ Phiri et al. (2019) ❖ Zimstat (2019)

2.3.2 Challenges faced by smallholder farmers

Smallholder farmers are continually confronted with numerous challenges that keep them stuck in everlasting and abject poverty. Firstly, smallholder farmers 'possess' a little piece of land that they do not own; it is like the rented property that they may only utilise for as

long as they are permitted to do so. The community land ownership concept was created in such a manner that the government is the custodian of the land. Smallholder farmers, unlike commercial farmers, do not own farms and do not have title deeds. As a result, the little plot of land has become a problem rather than an advantage. Their objectives are hampered by a lack of tenure security (Olarinde & Oladunni, 2013). This has a two-pronged impact on their production potential. It prevents smallholder farmers from investing in productivity-enhancing assets, making them more vulnerable to poverty. Farmers' capacity to mobilise resources to finance their agricultural activities is further hampered since they cannot borrow against the land and other assets because these are communally held and this problem is worsened for female smallholder farmers.

Research by Dunjana et al. (2018), Ngoma et al. (2021), Rapsomanikis (2015), Umar and Nyanga (2014) and Wyche and Steinfield (2016) points out that sub-Saharan countries' economies hinge on agriculture; smallholder farmers practise much of the agriculture in this region. The authors identified the challenges faced by smallholder farmers as imperfect markets, market accessibility and associated marketing infrastructure. Such farmers produce very little, and what little they produce might end up being sold at low prices. In some circumstances, this might prevent the farmers from recouping the costs of inputs incurred, let alone the labour expended (Olomu et al., 2020). The farmers also face the challenge of a lack of access to improved farm inputs and production technology and the high cost involved with acquiring such inputs and technology (Kahwili, 2020). These circumstances often lead to farmers accessing input through informal channels, creating the problem of counterfeit seeds and agrochemicals, in turn leading to reduced productivity.

There is also a lack of access to agricultural credit facilities because smallholder farmers do not have collateral security (Chandio et al., 2018). In addition, the intention was for smallholder agriculture to obtain agricultural information and knowledge from agricultural extension services in Zimbabwe. However, according to Dunjana et al. (2018), agricultural extension services are inadequate due to a high agricultural extension officers-to-farmers ratio. These few agricultural extension officers are also not capacitated sufficiently to

perform their duties effectively, thereby rendering poor extension services to smallholder farmers, causing a decline in the agricultural sector growth, which results in increasing food prices globally (Haug et al., 2021; Stellmacher & Kelboro, 2019).

Further, smallholder farmers are also vulnerable to the effects of climate change since most of them rely on dry land farming (Diercks et al., 2019). Climate change causes an increase in the frequency and degree of the severity of natural disasters like droughts, cyclones and flooding. All of these have a devastating effect on the productivity of smallholder farmers, many of whom have been farming on their small pieces of land for a very long time; consequently, their soils are usually poor, fragile or degraded; hence, the output is heavily compromised (Nkomoki et al., 2019). The future of smallholder agriculture would primarily depend on decisions made by governments and secondarily by international organisations (Murray et al., 2016).

In smallholder agriculture, there is also the problem of asymmetric information as submitted by Aker et al. (2016). This knowledge asymmetry leads to smallholder farmers lacking access to economical, appropriate and quality inputs such as quality seeds, adequate fertiliser and effective and efficient insect and weed control strategies. As a result, smallholder farmers have relatively low yields. Farmers have a shortage of access to storage and warehousing facilities even in remarkably productive years, forcing them to commute vast distances to markets. This problem is exacerbated by the lack of infrastructure in many rural locations which results in extremely expensive transportation. Most smallholder farmers do not have adequate access to area-specific research and extension services presenting a draw back on their productive potential.

These challenges, coupled with smallholder farmers' feeble bargaining power, often result in them falling victim to time and geographical arbitrage pricing (Kahwili, 2020). Smallholder farmers are incapacitated; hence, they have little say in decisions that affect them and no scope for influencing research or policy agendas. Although there is an increasing demand in domestic and global markets for agricultural produce due to the population explosion, there is intense competition for these markets by commercial farmers, rendering such markets increasingly inaccessible to many smallholder farmers.

The increase in the world population has raised the demand for food, thereby generating interest in smallholder agricultural activities since the turn of the century. For this reason, the importance of smallholder farmers and their farms in ensuring food security has recently been discussed in international forums on many occasions (Rahmann et al., 2021).

Smallholder farmers are some of the most vulnerable and marginalised populations in the developing world (Donadeu et al., 2019). In SSA, three-quarters of Africa's malnourished children reside in rural areas and are members of families living on smallholder farms. Nevertheless, these poverty-stricken smallholder farmers are essential not only for achieving food security but also for generating poverty-reducing agricultural growth for the region. Therefore, smallholder farmers are a vital factor in development in the SSA region. Smallholder farmers with enhanced access to knowledge, relevant technologies, ideal markets, acceptable loans, premium pricing and insurance have a higher probability of developing and becoming sustainable (Quandt et al., 2020). Accordingly, smallholder farmers who have constrained access to the aforesaid elements and are frequently confronted with adverse government policies, droughts and other challenges such as demographic pressures, are bound to be underproductive. Smallholder agriculture has a direct impact on rural Zimbabweans' lives and its viability, productivity and sustainability are crucial for Zimbabwe in its quest to achieve the UN SDGs, especially Goals 1 and 2.

2.3.3 Information needs of smallholder farmers.

Individuals and communities benefit greatly from information for their social and economic growth. Many people in SSA work in the smallholder agriculture sector, and agriculture requires precise, fast and dependable information regarding agricultural produce markets and pricing for farmers to enhance output and improve their welfare (Phiri et al., 2019). Their situation could be improved by broadcasting real-time information on new and better farming practices to farmers. Agricultural extension personnel are responsible for providing such information to smallholder farmers (Dunjana et al., 2018). This information is critical because it directs farmers on what crops to grow. For example, if a year is forecasted to have low rainfall, farmers could plant drought-resistant crops to withstand arid conditions.

Conversely, during a good rainy season, farmers need to know when to apply fertilisers to their crops because the application of ammonium nitrate results in crops wilting if rainfall occurs later. Information about agricultural inputs, their prices and where to find such inputs is vital (Kumar et al., 2020).

In the agriculture industry, relevant and prudent information goes a long way toward ensuring that farmers make the appropriate decisions in their day-to-day agricultural operations (Lwoga et al., 2010). Agricultural information is described as all official and unpublished knowledge about broad elements of agriculture, including agricultural policy advances, concepts, and technology. This knowledge is an asset essential for the adoption of innovative agricultural production concepts. The significant variance in information preferences among rural smallholder farmers can be ascribed to differences in agricultural operations as well as geographical location. This results in disparities in their information demands; however, these information needs are relatively connected in terms of category, since the essential information needs revolve around weather, animal and crop husbandry, pest and disease management, and agricultural markets for agricultural output (Abraham & Pingali, 2020). Table 2.1 lists such major information needs. Therefore, it has been determined that effectively addressing these smallholder farmers' information needs is essential to the sustainable growth of smallholder agriculture in underdeveloped countries. With the increasing global population, calls to address the impending food crises have been made and smallholder farmers have been identified as crucial to resolving such food crises.

2.4 SUSTAINABLE DEVELOPMENT GOALS (SDGS)

SDGs were born from the realisation that "... with targeted interventions, sound strategies, adequate resources, and political will, even the poorest countries can make dramatic and unprecedented progress" (The World Bank, 2010, p. 15; United Nations, 2015, p. 47). The SDG is an expanded framework with 17 specified goals and 169 targets to be achieved by 2030 (Heeks, 2014a). Each of the 17 goals has specific targets, of which none are achievable in isolation but require the contribution of all others to achieve their targets.

These were crafted in the aftermath of the Millennium Development Goals (MDGs) of the 2000 to 2015 framework, which was designed to accelerate the eradication of poverty in the world, especially in developing countries (Stalker, 2008). Approximately 70 per cent of the MDGs were targeted at people living in rural areas, particularly in Asia and Africa; for most of the rural poor, agriculture was identified as a critical component in the successful attainment of the MDGs (Heeks, 2014b; United Nations, 2015), which synchronises with the aspirations of smallholder farmers.

Although several milestones have been achieved under the MDGs, as reported by the United Nations (2015), new challenges continue to affect rural people, especially smallholder farmers (Misaki et al., 2018). Hence, by 2015, the MDGs bestowed the development authority to the Sustainable Development Goals (SDGs) 2015–2030 development framework. These frameworks have consistently identified ICT as the key catalyst for the sustainable advancement of smallholder agriculture in the developing world. The successful sustainable development of smallholder agriculture in Zimbabwe is critical for several reasons:

- a) Most inhabitants, around 70% of the population reside in rural areas and depend on smallholder farming for their livelihoods; therefore, they can provide themselves with adequate food supplies and eradicate hunger.
- b) Eradicate poverty: The sustainable development of smallholder agriculture can result in the eradication of poverty amongst smallholder farmers.
- c) Smallholder farmers might be able to send their children to school because they can sell their surplus to acquire money for education.
- d) Peace and development: When people are well-fed, they are naturally happy; happy people are at peace, and where there is peace, there is development.
- e) The Gross Domestic Product of the country will grow as the agro-processing industries will be working and consequently, the unemployment rate will fall.

While the availability of radio, television and agricultural extension officers is important and provides basic inputs and market information, it is not sufficient for smallholder farmers to gain access to tailor-made, context-specific information that serves them satisfactorily.

Because larger economic transformation processes have often followed agricultural development around the globe ever since the agricultural revolution, this is probably inevitable in Zimbabwe and other SSA nations if smallholder agriculture is to be revolutionised. Smallholder agriculture's transition from subsistence-oriented and farm-centred to becoming commercialised, productive and off-farm-centred presents a window of opportunity for SSA growth.

It is due to this realisation that smallholder agriculture is increasingly becoming a topical issue on the international scene. In 2014, the United Nations (UN) declared the year, 'International Year of Family Farming' (as the smallholder is sometimes affectionately known) as reported by Kesavan and Swaminathan (2014). This created a time and opportunity to take stock of the status of family-based agriculture in the world regarding food security, socioecological sustainability and equitable economic development. This development changed global perception due to the realisation that smallholder farmers are vital and a potential solution to the problem of food security that the world is facing. Thus, this research decided to explore smallholder farmers and understands the perceptions of smallholder farmers towards the adoption and effective usage of mobile phone technologies in their agricultural activities in Zimbabwe. It is mainly because the adoption and general usage of mobile phone technologies by smallholder farmers in their agricultural activities in Zimbabwe are not well documented, although the mobile phone diffusion rate is around 100%.

This study examines how smallholder farmers in Zimbabwe—a developing country—utilise mobile phones in their agricultural operations, as well as the problems they experience in adopting and using mobile phones during such activities. The study primarily aims to develop a theoretical understanding of the reason(s) why the bulk of smallholder farmers in Zimbabwe do not use their mobile phones in their agricultural activities, whereas the farmers use them successfully in other areas of their everyday lives. The study secondarily aims to create a context-specific mobile agriculture framework that might aid in the utilisation of mobile phones to improve smallholder agriculture operations in Zimbabwe. The latter aim can be achieved if context-specific issues in the country affecting the

intended recipients are investigated and established. To achieve the desired usage levels that would have a substantial impact in any area of ICT4D application the systems must be user-centric, as suggested by Aker et al. (2016).

2.5 MOBILE TECHNOLOGY FOR DEVELOPMENT (M4D) IN SUB-SAHARAN AFRICA

The whole world is undergoing an overwhelming technological revolution in information, electronics, computers, and communication. This revolution will widen the gap between developed and underdeveloped countries. Those who master science and technology and manage information will survive while those who do not will perish, at least economically.

The Egyptian Ministry of Education's Technology Development Center (1997) as cited by (Warschauer, 2003 p.299).

The quotation above illustrates that it is presently necessary for every aspect of society to embrace technology; further, as regards ICTs, it is equally vital to consider the local environment within which the technology is deployed. Most third-world nations have more remote rural settlements with basic and unorganised amenities, and mobile technology is a viable tool for such instances. Because mobile phones are sometimes the only accessible communication avenue in sub-Saharan Africa, their influence is more significant in SSA than in the developed world. The mobile phone has made considerable strides in enabling disadvantaged individuals like smallholder farmers to access critical resources, as posited by Kabbiri et al. (2018). However, the remaining problem is a lack of widespread use by smallholder farmers, even though they successfully use mobile phone technologies in other areas of life. The World Bank (2011) claimed that an additional 10 mobile phones per 100 people in a typical developing country can boost gross domestic product (GDP) by 0,8 percentage points. That is a bold claim, but since it is from an international body, this researcher respects the claim as it is; this study does not evaluate it but merely refers to it.

Mobile phone technologies can aid in the improvement of the education system, healthcare, disaster risk management, agriculture and other fields; hence, such technologies assist in eliminating poverty. In catastrophic circumstances, mobile phones

allow citizens and governments to communicate in real time. This has the effect of boosting the general well-being of a country's population. Governments, commercial organisations, and other entities in Africa are recognising the potential of mobile technology to enhance their operations and generate money. Mobile phone technology has become a boon to all developing countries worldwide owing to its ability to disseminate information while also improving personal lives and corporate operations through bidirectional communication. Due to this aptitude, mobile phone technology has quickly evolved into one of the key building elements of contemporary civilization.

The extensive scope of communications networks worldwide, particularly in developing countries, has improved significantly with the invention of mobile phone technology. Due to its pervasiveness as a communication tool, the mobile phone enables the essence of all human activity, satiating the need to remain in contact and communicate with others. This connection validates the idea of mobile technology sustaining the 'm' of information for people in all aspects of life. According to Pronyk et al. (2012), mobile phones are a gift to developing countries which could be utilised towards development and, in the process, reduce human seclusion while offering the citizens of those countries better access to medical care and other facilities. Thus, the mobile phone benefits traditionally marginalised people, especially in SSA (Duncombe, 2012).

2.6 IMPACT OF MOBILE PHONE TECHNOLOGIES IN AFRICAN COUNTRIES

Except for South Africa, many African nations are still developing; regarding ICT uptake and usage, developing nations often lag behind developed countries. The successful use of mobile phone technology by African countries has the potential to significantly reduce and potentially bridge the economic gap between African and first-world countries. During the first decade of the MDGs, emerging nations displayed a readiness to stake their claim on the technology landscape, particularly regarding mobile phone technologies. Developing nations, notably in sub-Saharan Africa, have demonstrated the fastest growth in mobile phone deployment, mobile services and user base (Ondiege, 2016). As a result,

the researcher focuses on the influence of mobile phone technology on SSA nations in the upcoming sections of this thesis.

Mobile phone technology has transformed various aspects of Kenyans' lives, ranging from the simple use of voice conversations and SMS to mobile commerce and mobile money transfer (Mbiti & Weil, 2016). The technology could assist with interactions and the coordination of activities within an organisation or between organisations in a supply chain, for example, through e-collaboration between an organisation and government or between an organisation and its stakeholders. Mobile phone technology benefits Kenyans from all walks of life and is rapidly becoming multipurpose, capable of capturing images, typing, editing documents and serving as a portable wallet (Nyaga, 2014). Mobile phone technology allows users to maintain contact and access numerous and continually expanding goods and services (Moyi, 2019), promising changes in the way business is established and undertaken. Of all the areas impacted by mobile telephones in Kenya, none has been influenced as much as Mobile Money Transfer (MMT) (Altamirano & Beers, 2017). Kenya conceivably has one of the most active MMT markets in Africa, if not the world.

Four Mobile Network Operators (MNO) provide mobile communication services in Kenya, all offering MMT services (Kilimo, 2014), i.e., Airtel, YU, Orange and Safaricom. The latter was the first company to offer mobile and MMT services in Kenya. Among these MNOs, Safaricom is the most successful to date, with over 64.5% of the total 30.4 million subscribers in Kenya in 2014 and its entire subscriber base subscribing to its MMT services (Oteri et al., 2015). The rural farming areas of Kenya are highly dispersed; there is a virtual absence of financial intermediation (Livingston et al., 2011). Moreover, financial intermediation is expensive for traditional banks in rural areas, mainly due to geographically dispersed clients. These circumstances have led to the closure of non-performing branches (mostly rural), which has been advantageous to mobile telecommunication companies.

With 178.5 million inhabitants, Nigeria is the seventh most populous nation in the world and the most populous nation in Africa. The country is home to the fastest-growing population and is regularly beset by third-world challenges like lack of infrastructure (Anadozie et al., 2021).

The country is home to different tribes who have different opinions and approaches to life. Resources are scarce, considering the population they are supposed to sustain. Consequently, development has been limited, with certain areas of the country being favoured. In January 2001, the Nigerian government fully liberalised the telecommunications sector by awarding MTN and Econet licenses to operate mobile networks. Since then, mobile networks became highly 'contagious', spreading from place to place. The ubiquitous introduction of mobile phones that provide for chatting and text messaging proved to be the most important tool in this revolution. This had the effect of bridging the digital divide in Nigeria with mobile phones spreading to almost all villages and providing a vital communication medium to the rural populace (Jennings et al., 2015).

The adoption and usage of mobile phone technology in healthcare delivery enables healthcare practitioners and institutions to address the essential medical requirements of the Nigerian population in general (Alam et al., 2017), especially those of people in rural areas and regions without qualified medical staff and services (Okunade et al., 2020). The introduction of the Global System for Mobile Communication (GSM) has substantially improved information exchange in Nigerian society in general, particularly in teaching hospitals (Dasuki & Zamani, 2019).

A research project conducted by Krell et al. (2021) on the influence of mobile phone technologies on rural farmers' marketing decisions established that agricultural produce markets are not sufficiently competitive. As a result, grain market prices are endogenous, whereby farmers are obliged to make calculated decisions on where, when, how much and to whom to sell produce to obtain the highest price. Imperfect market information has also resulted in spatial and temporal arbitrage. This research suggests that mobile phone technology use could bridge this gap. Smallholder farmers in Africa benefit from using mobile phone technologies by receiving pricing information via text messages, which saves

time and travel expenses and helps them ascertain where to sell their goods, thereby increasing their revenues (Quandt et al., 2020).

The increased usage of mobile phone technologies results in smallholder farmers increasing their incomes, enlarging their markets and improving their general livelihoods. As a result, farmers have a better chance of achieving those goals thanks to the mobile phone, notably in collecting marketing and meteorological information (Chhachhar et al., 2016). Smallholder farmers can connect with numerous customers in a variety of markets and offer their goods at affordable costs because of mobile phone technology (Krell et al., 2021). Further, such farmers can access real-time weather forecasts and up-to-date details on agricultural supplies like pesticides and fertilisers.

Table 2.2: Mobile phone technology capabilities and possible impact.

Mobile phone technology capabilities and impacts	Sources
Mobile phone: <ul style="list-style-type: none"> ❖ A tool for education ❖ Can reduce communication and information costs ❖ Can reduce information asymmetry ❖ Capable of providing information for climatic conditions, weather, input prices, the market price for products, diseases and other disasters in real-time ❖ Capable of enlarging markets ❖ Capable of reducing losses of perishable agricultural produce ❖ Capable of facilitating knowledge-sharing among farmers ❖ Capable of facilitating money transfer, banking, and transaction services between buyers and sellers 	<ul style="list-style-type: none"> ❖ Altamirano and Beers (2017) ❖ Baumüller (2012, 2018) ❖ Jani et al. (2020) ❖ Jennings et al. (2015) ❖ Komunte et al. (2012) ❖ Leon et al. (2012) ❖ Misaki et al. (2018) ❖ Mittal and Hariharan (2018) ❖ Mittal and Mehar (2016) ❖ Morrill (2009) ❖ Ogunniyi and Ojebuyi (2016) ❖ Musungwini (2018) ❖ Siraj (2010) ❖ Walton (2015) ❖ World Bank Report (2019)

2.6.1 Impact of mobile phone technologies in Zimbabwe.

The mobile phone has left an indelible mark on the Zimbabwean landscape in different aspects of life, ranging from health, education and mobile money transfer services. MMT has been successful in Zimbabwe primarily because it is premised on individuals who do not have formal bank accounts in traditional financial institutions (Gukurume & Mahiya, 2020). As a result, MMT is used in Zimbabwe for several purposes, including transferring

and receiving money. These include, but are not limited to, wage and salary payments, commercial transactions, remittances and school fee payments, which, together with other activities, are common elements of enterprises' and people's everyday lives. The favourable conditions in Zimbabwe aided the growth of *EcoCash*, Zimbabwe's cornerstone MMT (Akinyemi & Mushunje, 2020). MMT necessitates the availability of an effective, trustworthy and economical money transfer service that allows money to be deposited and withdrawn in discrete locations in both urban and rural areas (Zhou et al., 2015).

The ubiquity of MMT is further aided by the structural restrictions of Zimbabwe's formal banking system. Because banks are concentrated in metropolitan areas and their operating circumstances are restrictive, there are hurdles to using their services (Gukurume & Mahiya, 2020). MMT, particularly *EcoCash*, is no longer just used for transactions; it can now be used for savings accounts. This arose from the realisation that people did not always need to cash out or transmit balances as soon as they received or uploaded money to their mobile phone wallets (Levin, 2013). Because someone might deposit money into their MMT account and receive money from other MMT account holders, money might build into the mobile phone and sit dormant for a while. As a result, MMT has evolved into a tool for conserving money, in addition to its purpose of distributing money.

When *EcoCash* entered the financial intermediation space, the rural areas and informal traders gave them an unrivalled market segment (Gukurume & Mahiya, 2020). MMT has tentatively lowered transaction costs directly related to access to financial services and alleviated the barriers that smallholder farmers have faced in obtaining access to finance. Smallholder farmers could and are increasingly turning to MMT as their only option. Farmers don't have to spend a lot of time or money on transportation to get to banking facilities when they use MMT (Okello et al., 2018). MMT services are less expensive and more reasonable since they do not demand ledger fees or minimum balances. Zimbabweans from all walks of life are now able to access MMT services from almost every corner of the country, especially in urban settings and growth points at a lower cost and this has seen the living standards of ordinary people improving. Therefore, like Kenya's

M-PESA, *EcoCash* Zimbabwe is one success story of mobile phone technologies having a lasting impact on the financial services sector and consequently, uplifting the lives of people.

However, despite its success, Econet has not realised this success in its *Ecofarmer* service, which supports the farming activities of ordinary people even though agriculture is supposed to be the mainstay of most sub-Saharan African countries including Zimbabwe. There is a need for more research on mobile phone use by smallholder farmers in their agriculture activities and their perceptions of the technology. All these studies concur that technology adoption occurs rapidly and extensively where there is a reasonable level of knowledge of the underlying local contextual factors. Education was found to be a key catalyst in the adoption and effective use of technology. If mobile phones are conceived, developed, deployed, and accommodated in locally meaningful ways, they can provide a platform for furthering development agendas in scalable, sustainable, and long-term ways. The next section focuses on mobile phone adoption and usage in smallholder agriculture.

2.7 FACTORS AFFECTING MOBILE PHONE ADOPTION AND USE IN SMALLHOLDER AGRICULTURE

Several studies have demonstrated that the reduction in communication costs and real-time context-specific information linked with mobile phones has resulted in demonstrable economic benefits that have considerably improved smallholder agricultural activities under various conditions and nations. Due to a lack of knowledge, rural farmers in Africa have traditionally been subject to a many challenges throughout the agricultural lifecycle. ICTs in general, and mobile phone technology are generally credited with being the main force behind levelling the playing field in the smallholder agriculture of developing nations. However, while research has consistently identified that mobile phone technologies can change the general welfare of smallholder farmers if adopted and used appropriately, their actual adoption and usage by smallholder farmers for agricultural purposes have been very elusive. In this section, the researcher identifies the factors affecting the adoption and effective usage of mobile phone technologies in smallholder agriculture with an emphasis on SSA in general and Zimbabwe in particular.

According to research by Masimba et al. (2019), mobile phone technology adoption by smallholder farmers offers a basis for improving agricultural performance because it plays a critical role in strengthening farming operations and activities through information dissemination (Kassem et al., 2021). However, the research also determined that perceptual issues like the perceived utility and perceived ease of use of an innovation or technology significantly impact smallholder farmers' adoption of mobile phone technology. Masimba et al. (2019) recommend addressing perception issues if smallholder farmers are to accept and comprehensively appropriate mobile phone technologies.

Research by Khan et al. (2019) establishes that factors affecting the farmers, such as the period of their mobile phone ownership and their adeptness with mobile phone technology, play a significant role in the comprehension and acceptance of mobile phone use in agriculture. Thus, the research suggests that farmers who have had a mobile phone device for a substantial amount of time are better equipped to operate it using cellphone activities, such as making voice calls, SMS messaging, navigating the internet and other related mobile applications. Such usage enhances mobile phone technology adoption and its application for agricultural purposes. Thus, aspects such as the period of mobile phone ownership and level of aptitude are crucial to any research investigating the qualities related to farmers' mobile phone technology usage (Mwantimwa, 2019). Other researchers like Krell et al. (2021), Misaki et al. (2018) and Quandt et al. (2020) reveal some challenges to the possibility of using mobile phone technologies for agriculture. The smallholder farmers' views about the role of mobile phone technology usage in agriculture and the possible benefits that might be derived from using it from the smallholder's perspectives should be investigated.

According to Mwalukasa et al. (2018), the sociodemographic variables of smallholder farmers influence their adoption and usage of mobile phone technology for accessing agricultural information on climate and weather conditions, as well as adaptation measures. This means that the smallholder farmers' sociodemographic variables like their gender, age, marital status, size of land owned, farming experience and mobile phone ownership are key precursors to the adoption and usage of mobile phones in agriculture.

The research concluded that young, male farmers who are married, own a large piece of land coupled with huge farming experience and own a mobile phone are more likely to adopt and use their mobile phone technologies for agricultural purposes than the opposite.

Misaki et al. (2018) posit that the lack of trust and transparency when obtaining farming information on mobile agriculture applications is another obstacle to smallholder farmers' adoption and usage of mobile phone technology. Smallholder farmers with good education and a high income are highly likely to use mobile phone technology to acquire agricultural information (Wyche & Steinfield, 2016). Many studies have revealed that higher levels of education influence mobile phone technology uptake and use (Mansingh & Erena, 2016; Richard & Mandari, 2017). Using a foreign language, notably English, for communication in this setting damages the cultural background influencing smallholder farmers' use of mobile phone technology in acquiring farming information (Misaki et al., 2018; Mwalukasa et al., 2018).

Some researchers argue that smallholder agriculture is one economic sector where the application and usage of mobile phone technology have grown significantly in the last decade (Etwire et al., 2017; Kacharo et al., 2019). However, mobile agriculture applications are still emerging, and their usage by smallholder farmers is still low (Barakabitze et al., 2017; Baumüller, 2018; Emeana et al., 2020). As a result, their influence on improving smallholder farmers' livelihoods is yet to be understood. According to the literature review conducted in this study, mobile phone technologies have brought tremendous hopes for economic progress and human development. However, unless technological solutions are well developed to fit their intended purpose, they do not inevitably lead to progress in any sector of life. In the context of sub-Saharan Africa, there are high expectations of mobile phone technologies; their potential and widespread availability to even the poorest citizens provide an opportunity for improving living circumstances through technology.

With novel directions and strategies for rural farmers, mobile devices are leaving a permanent footprint on the socioeconomic processes of rural communities in sub-Saharan Africa. According to studies, mobile phone technologies are helping farmers save time and travel, which eventually boosts their incomes. With a 100% mobile penetration rate (Kemp,

2021) and a literacy rate of over 90% (Chiparausha & Chigwada, 2021), Zimbabwe seems well-positioned for its rural smallholder farmers to use mobile phone technologies to overcome some of their challenges. The elements identified in the literature referred to above impact the adoption and efficient use of mobile phones in smallholder agriculture and can be divided into two groups, as shown in Table 2.3 below.

Table 2.3: Positive and negative factors affecting the adoption and use of mobile phone technologies for agriculture by smallholder farmers.

	Factors	Sources
Factors affecting the adoption and use of mobile phone technologies in agriculture	<ul style="list-style-type: none"> ❖ Mobile phone ownership by the farmer ❖ Education level attained by the farmer ❖ The duration of the period of a farmer's mobile phone ownership ❖ The gender of the farmer (male) ❖ The prime age of the farmer (30–49) ❖ The farming experience of the farmer ❖ The affluent and/or high-income-earning farmers ❖ The size of the farmland owned by the farmer. ❖ The availability of infrastructures like telecommunication boosters and electricity ❖ The accessibility of mobile phone facilities and services ❖ The level of digital knowledge of the farmer ❖ User-centric designed technology ❖ User ability of the farmer ❖ Positive perceptions about technology 	<ul style="list-style-type: none"> ❖ Radi and Shokouhyar (2021) ❖ Asif et al. (2017) ❖ Duncombe (2012) ❖ Emeana et al. (2020) ❖ Hailu et al. (2017) ❖ Jadhav and Weis (2020) ❖ Kabbiri et al. (2018) ❖ Kacharo et al. (2019) ❖ Khan et al. (2019) ❖ Krell et al. (2021) ❖ Masuka et al. (2016) ❖ Misaki et al. (2018) ❖ Mwantimwa (2019) ❖ Porter et al. (2020) ❖ Quandt et al. (2020) ❖ Wyche and Steinfield (2016)
Factors inhibiting the adoption and effective use of mobile phone technologies	<ul style="list-style-type: none"> ❖ Negative perceptions about technology ❖ Lack of necessary knowledge and information to use mobile phones ❖ Illiteracy of the farmers ❖ The advanced age of the farmer ❖ A lack of infrastructure ❖ The complexity of technology ❖ Technophobia of the user ❖ Foreign language content provides technology ❖ The gender dynamics (female farmers) ❖ Socioeconomic status ❖ High cost of mobile phones and mobile services 	<ul style="list-style-type: none"> ❖ Alam et al. (2017) ❖ Radi and Shokouhyar (2021) ❖ Batchelor et al. (2014) ❖ Baumüller (2018) ❖ Chhachhar et al. (2016) ❖ Emeana et al. (2020b) ❖ Etwire et al. (2017) ❖ Kabbiri et al. (2018) ❖ Krell et al. (2021) ❖ Odoyo et al. (2019) ❖ Van Baardewijk (2017) ❖ Wyche and Steinfield. (2016)

However, these statistics do not reflect the situation on the ground. Potnis (2014) finds that high levels of mobile phone users do not mean development is guaranteed if other elements like their living environments, structures and the transformation of institutions are not correctly aligned. The literacy rate does not automatically translate to digital literacy.

Marginalised communities also suffer from digital exclusion (Rashid, 2016), usually influenced by educational level and the ability to use technology.

2.8 PERCEPTIONS AND ATTITUDES TOWARDS A TECHNOLOGY

According to Allport (1935), an attitude is a mental or neural state of readiness formed by lived experience that directs or influences how an individual responds to all things and circumstances that are relevant to it. It is further regarded as an individual's tendency to act for or against something in the environment that becomes either a positive or negative value (Allport, 1935; Pickens, 2005). Therefore, attitudes are a combination of complexities, which include one's personality, beliefs, values, behaviours and motivations. People are complex; understanding them is imperative for any meaningful engagement. Hence, in many situations involving people from different cultural backgrounds, they must use community gatekeepers like traditional leaders to succeed in their ventures (Krauss & Turpin, 2010). Attitudes are psychologically orientated and based on sociocultural environments and geographical backgrounds. Their background has a bearing on exposure to the world and the accumulated knowledge a person has about the world. That directly affects attitudes towards ICT since research studies on the effectiveness of ICTs in any social facet revealed that attitude influences the use of ICT tools (Lokeswari, 2016). Therefore, a positive attitude is a prerequisite for adopting and using ICTs.

2.8.1 Farmers' Attitudes towards ICTs and Information Systems Theories

The diffusion of innovation or technology in agriculture is affected by variations in attitudes due to each smallholder farmer's perception (Martin & Abbott, 2011). Regardless of the level of the technology's sophistication or how valuable the technology's effective adoption and usage would be, the latter depends on the positivity of the intended users' attitudes towards that technology. Research has shown that smallholder farmers have distinct attitudes towards ICTs; these attitudes are two-dimensional: some are positive, and some are negative. According to Lokeswari (2016), factors affecting farmers' attitudes towards ICTs include education, landholding, scientific orientation (Mokaya & Njuguna, 2010), risk orientation (Mittal, 2012), economic motivation, annual income, material possession, farming experience, social participation, age (Aldosari et al., 2017; Vishwatej et al., 2016)

and exposure (Intelligence, 2015). Like all humans, smallholder farmers are social beings; hence, their behaviour is influenced both psychologically and economically by their circumstances (Redmond, 2015). The combined model by Nysveen et al. (2005) might provide a comprehensive and cohesive analysis of human behaviour, informed by subjective norms and behavioural control; as such, smallholder farmers use mobile phones in an everyday life context (Nysveen et al., 2005).

Consequently, the information systems theories, TRA, TPB, DOI, UTAUT and TAM, were collectively used and incorporated to devise the conceptual framework in this study (Nysveen et al., 2005; Sendekka, 2006). Because mobile phone service users are typically charged for utilising them, smallholder farmers' use of mobile phone services depends on the availability of financial resources to fund the usage. Therefore, the key to utilising mobile phones for the sustainable growth of smallholder agriculture in Zimbabwe may be knowing the mindsets and decision-making procedures of smallholder farmers when using mobile phones in their agricultural activities. Most of the research contributions on how ICT shapes the social context emphasise the user-centric position, where the role of technology is not adequately espoused.

2.8.2 Agricultural extension Officers

Smallholder farmers collaborate with agricultural extension officers in their agricultural activities; therefore, agricultural extension officers are vital to smallholder farmers' agricultural activities. Smallholder farmers trust agricultural extension officers to a great extent and take whatever agricultural extension officers say very seriously. The dynamic between agricultural extension officers and the smallholder farmers is like that of traditional leaders and their subjects (Krauss & Turpin, 2010). Thus, agricultural extension officers' attitudes toward technology are vitally important (Mugwisi et al., 2015). Therefore, it is imperative to understand the attitudes of agricultural extension officers since they directly influence the success or failure of smallholder farmers' acceptance, adoption and effective use of mobile phone technologies in their everyday agricultural activities.

Various factors affect attitudes towards ICTs, and such factors must be established (Kiforo, 2013; Mutula, 2015). These factors include perceived benefits (Hussain, 2016; Mansingh

& Erena, 2016), perceived challenges (Patel & Shukla, 2014), costs, peer influence, experience (Aker et al., 2016), evaluations of ICT applications, gender (Rashid, 2016) and individual age (Aldosari et al., 2017). It follows that such factors might affect smallholder farmers and agricultural extension officers in Zimbabwe. Hence, this research mainly analysed smallholder farmers and, to some extent, agricultural extension officers based on the stated factors in the preceding paragraph. The study evaluated these factors' implications on the decision-making processes involved in the acceptance, adoption and continued usage of mobile phones for agricultural purposes in Zimbabwe. In the next section, the research pivots towards the theoretical framework of this research.

2.9 FRAMEWORKS FOR ICT ADOPTION IN AGRICULTURE

Research has shown that ICTs play a major role in every aspect of contemporary society in a globalised world. This is because ICT has transformed how we 'operate', i.e., the way we communicate with each other, how people work in the modern world and find much-needed information, and how people manage their social and economic lives. However, as earlier stated, mobile phone technologies are the ICT variant in the hands of many people in the developing world as stated by Ponce et al., 2016). As these mobile phone technologies affect the general everyday lives, they also affect the macroeconomic growth of developing countries, which subsequently affects society indirectly as this enables the development of infrastructure, as well as the improvement of the standard of living of the general populace. Smallholder agriculture has been identified as one area in which mobile phones can leave an indelible mark. However, unless it is fully embraced, adopted and effectively used by the targeted recipients; no technology can have an impact on any given socioeconomic activity. Yet this has always proved to be difficult without implementing a strategy, model or framework developed from contextual data, to guide adoption and usage issues. In the following section, previous frameworks that have been developed and deployed in different countries and contexts are reviewed.

Madon (2000) presented an abstract framework to explain how the Internet interacts with socioeconomic growth in a developing context. The framework was established using research, circumstantial information, and hypothesis. It shows that the internet has a

primarily beneficial effect on four (4) main factors: economic growth, social well-being, political well-being, and the physical environment. In his framework, Madon (2000) highlights the significance of intermediate institutions, such as government activities, in facilitating the impact of the internet on socioeconomic growth. While this is a very useful framework, it is particular to the internet rather than ICT in general. Although the framework is also exclusive to developing contexts, it does not precisely indicate some essential variables, such as human development, even though the author discusses some of them in the framework exposition. The framework focuses on the general impact of the internet but does not address how adoption takes place among people, especially the marginalised communities.

2.9.1 eSagu project

The *eSagu* agricultural information dissemination framework is a hybrid technology intervention system that was conceptualised by integrating agriculture into a pilot academic research project. The project intended to enhance existing agricultural strategies in India. The framework was designed for providing an ICT-based agricultural extension system to facilitate individualised, query-free, prompt, cost-effective and simple construction services to farmers. Its single prototype research was intended to determine whether ICT-enabled expansion is practical, which it was indeed discovered to be, as well as that one visit with advice per week would meet the needs of farmers.

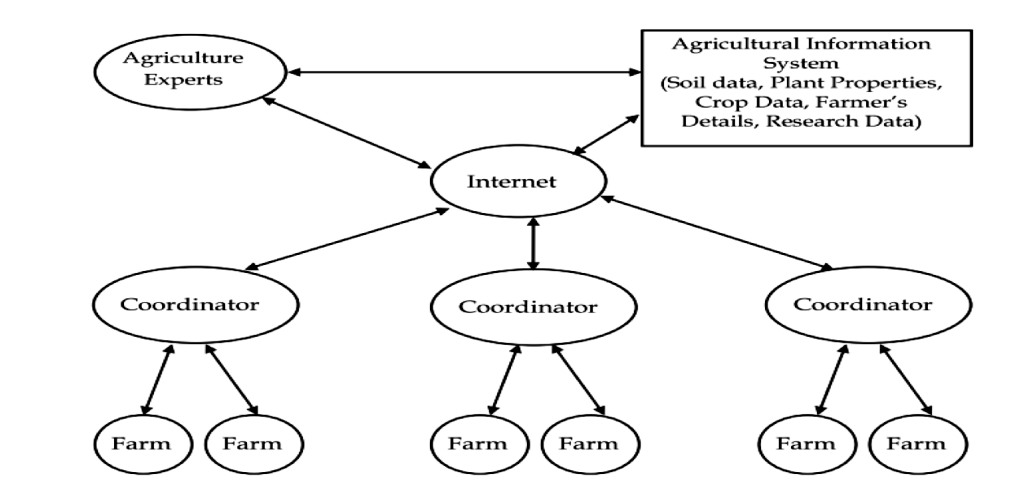


Figure 2.2: The *eSagu* agricultural information dissemination framework

The framework is premised on the agricultural coordinator using the internet facility to access agriculture-related information and provide support to farmers. Following the framework, a coordinator could visit 125 farms in one week and an expert could cover up to 500 farms. However, the framework did not address the farmers' lack of knowledge, poor literacy levels and lack of confidence, which provided drawbacks in understanding the information provided by specialists. The framework did not address the need for farmers to directly acquire information themselves but instead would have to depend on the coordinator to gain access to information. Moreover, the framework was only focused on cotton and chilli crop farming.

2.9.2 Technological framework for the SOUNONG search engine

The framework was launched in the Chinese province of Anhui, and its thrust was to offer specialised farmer cooperatives with information gathered from the internet productively. An information assistant, information distribution models and an internet site are the three key components of this ICT-based system. The *SOUNONG* is an internet-powered search engine developed by the Institute of Intelligent Machines to support gathering and disseminating vital agricultural information to stakeholders. It collects and coordinates data from all the agriculture websites run by the Chinese government. The search engine scans nearly all of China's agriculture data from over 7,000 websites. These websites offer knowledge on over 20,000 varying categories of agricultural commodities, including those on climate, weather, agrochemicals, crop species, pest and disease diagnostics, pricing commodities in more than 9,000 categories, and wholesale farm product prices.

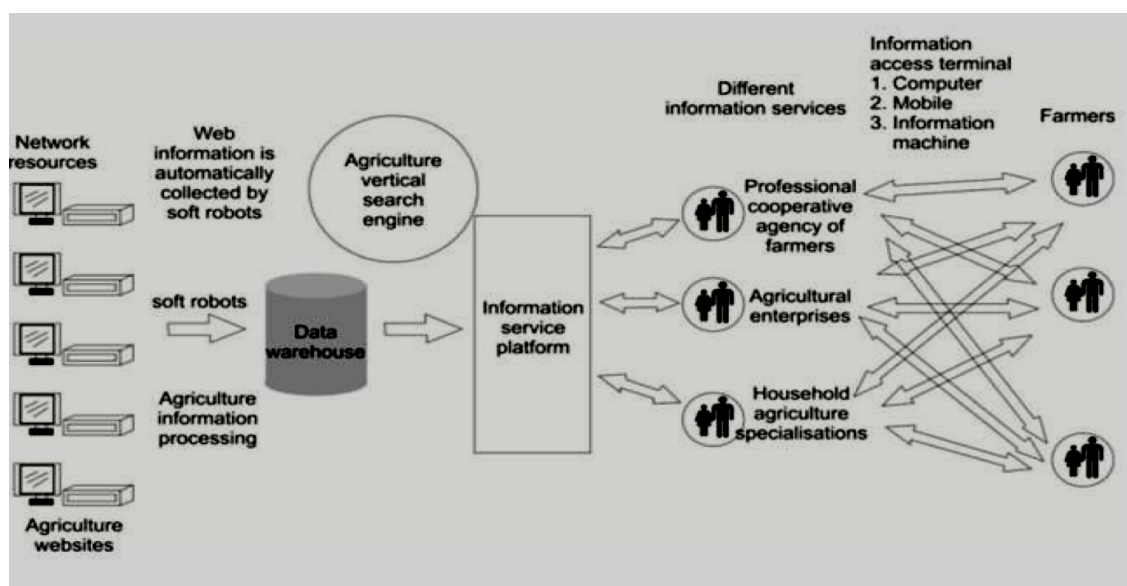


Figure 2.3: Technological framework for the SOUNONG search engine

2.9.3 A framework for agriculture information dissemination system

This framework was designed for the Management of the Extension and Farming System of the province of Khuzestan (per extension agents), as explained by Ommani and Chizari (2005). The framework was created for fostering communication among agricultural stakeholders in the value chain. These included farmers, agricultural professionals, agricultural extension agents, research facilities and the community at large. The framework was designed to facilitate the flow of information, centred on farmers' needs and ensure that communication between all the components is reciprocal. The farming community received access to sophisticated agricultural knowledge via the internet, but because some farmers could not read or write and only spoke their native languages, they could only utilise the system through an extension agent. This framework is internet-based and, therefore, would only work for farmers who own computers, smartphones and other devices that can access the internet and reside in areas covered by the internet.

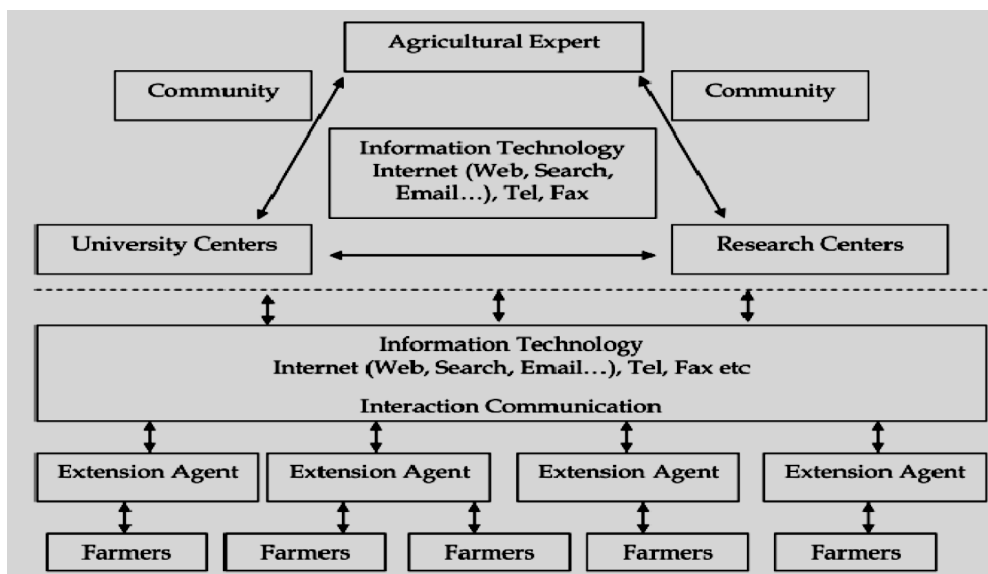


Figure 2.4: A framework for an agriculture information dissemination system

The framework centres around disseminating agricultural information to farmers through agricultural extension agents. Information is extracted from various sources like research institutes, universities and agricultural experts for storage in an electronic repository. The framework places the agricultural extension agents at the epicentre of its operations since they are responsible for accessing information from the internet repository and passing it on to farmers. The reviewed literature on frameworks indicates that many have been implemented, although the scope and specifications of these frameworks vary. Each framework has shortcomings, and some only cover a few factors of socioeconomic growth. Furthermore, these frameworks were developed in specific contexts and seemingly formulated for specific purposes; therefore, in line with the need to make a secondary contribution, this research will consider the information gathered from the reviewed frameworks, borrow some elements, and together with the empirical findings of this research, formulate an integrated framework for harnessing mobile phones for the advancement of smallholder agriculture in Zimbabwe.

2.10 THEORETICAL FRAMEWORK

In recent years, the conundrum of attaining smallholder farmers' successful adoption and effective usage of mobile technology in agricultural settings has attracted interest from

academics, researchers, non-governmental organisations, policymakers and government agencies. Many ICT4D policies have been crafted and implemented in several parts of the world with mixed outcomes. What has been successfully implemented in one setting has not necessarily been successfully adapted to a different environment. The theoretical approaches are central to the problem of understanding local contextual settings. The adoption of nascent technologies and their effective usage for sustainable development have become a conundrum.

Many information systems theories exist, like the technology acceptance model (TAM), the theory of reasoned action (TRA), the unified theory of acceptance use of technology UTAUT and the diffusion of innovation theory (DOI), etc. These theories have been applied and adapted for describing phenomena in different contexts (Mokaya & Njuguna, 2010; Vosough et al., 2015), for explaining a phenomenon (Twinomurinzi et al., 2017) and predicting the adoption and diffusion of technology by groups in specific contexts (Chitungo & Munongo, 2013; Tobbin & Kuwornu, 2011). While some scholars consider ICT adoption and usage a mature area in information systems research, this researcher contends that ICT adoption and effective usage are not predictable, straightforward or static; therefore, they are not a once-off event free of uncertainties.

2.10.1 The combined model

This study's conceptual framework primarily comprises constructs extracted from the information systems adoption models. The researcher borrowed the idea from Pedersen and Nysveen (2003) but did not use their developed model. This author's proposed model emphasises six adoption drivers, including perceived expressiveness, perceived mobility, perceived usefulness, perceived ease of use, subjective norms and behavioural control, in addition to behavioural considerations. A conceptual framework lays the foundation for data collection and analysis processes in interpretive inductive research for theorising to allow for the concepts relevant to the practical situation under investigation to emerge through the data analysis process (Bernardi, 2017). It is the lens through which research is framed and thus is used to guide the development of research questions, design the methodology, and analyse data. Stainton et al. (2009) opine that a conceptual framework

aids the researcher in identifying early study results and critically evaluating those findings considering the body of literature. Such evaluation provides a general overview of diffusion and adoption variables for information systems and information technology (IS/IT). This study adopted the constructs to integrate the opportunities of multi-attribute information system models, namely the theory of reasoned action (TRA), TPB, TAM, DOI and UTAUT.

Information and communication technology developed and deployed cannot deliver on the desired objectives if it is not adopted and effectively used by the targeted potential users. While information systems theories form the basis for the elements of consumers' behaviour (Ahmed & Ali, 2017; Khayyat & Heshmati, 2012; Nabavi et al., 2016); however, a part of these theories are derived from the organisational settings concerning the acceptance of technology and information systems, yet smallholder farmers' use of mobile phone agriculture services is a personal everyday life context. The theoretical model assisted in understanding why Zimbabwean smallholder farmers either do not or only partially use mobile phones in their agricultural activities and ultimately, why these smallholder farmers might fail to develop and become self-sustainable.

Previous studies (Bass et al., 2013; Nysveen et al., 2005; Hill et al., 1977; Sendeck, 2006) using the combined theory model have confirmed that ICT adoption variables like perceived usefulness (Amunkete et al., 2019), perceived ease of use (Wahid, 2007) and attitude towards use (Dhaka & Chayal, 2010) could either be direct or indirect factors determining mobile phone technology services usage. Variables, like subjective norms (Bentler & Speckart, 1979; Davis et al., 1989) and perceived control (Nysveen et al., 2005), are vital precursors of consumers' intent to use mobile phone services. Because mobile service users are usually charged for utilising these services, smallholder farmers' use of mobile phone services depends on the availability of resources.

2.10.2 The technology acceptance model

The technology acceptance model (TAM) is a theory of information systems that simulates how users embrace and use a particular system or technology (Lai, 2017). The TAM theoretical model was developed by Davis et al. (1989), who focused on the relationship between the system and technological features and user acceptance of computer-based

information systems. The TAM theoretical paradigm relies extensively on the spread of technological and informational advances. This idea explains why users embrace innovative information and communication tools including computers, the internet, e-mail and mobile phone technologies (Nysveen et al., 2005). According to Davis et al. (1989), the goal of developing TAM was to describe the factors that influence computer acceptance, and these factors are generally capable of explaining user behaviour across a wide range of end-user computing technology and the user population. TAM is theoretically supported and utilised to offer the basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions to use technology. It has been cited over 7,000 times to date and is continually growing. The idea contends that perceived usefulness (PU) and perceived ease of use (PEOU) are critical elements in system use. Attitude (A) is the general opinion of the technology and impacts the behavioural intention (BI).

Computer systems cannot improve organisational performance if they aren't used. To better predict, explain and increase user acceptance, we need to better understand why people accept or reject computers. (Davis et al., 1989, p.982)

Therefore, external variables like social influence are important factors for determining attitude. People's perceptions may vary due to demographic factors like age and gender. However, because they are typically charged for utilising such services, smallholder farmers' usage of mobile phones for regular agricultural tasks depends on the availability of resources. As a result, it's essential to consider circumstances out of the user's control. Hence, TAM falls short in its attempts to account for such things because the model comes from an organisational context. The next sub-section scrutinises the theory of reasoned action.

2.10.3 Theory of reasoned action

The theory of reasoned action (TRA) is an information systems theory promulgated by Ajzen (1991). The model aims to explain the relationship between attitudes and behaviours within human action (Nguyen et al., 2019). Because the model considers people's current opinions and behavioural intentions, it could be used to forecast how people would behave (Ajzen, 1991). TRA was developed to gauge the difference between attitude and

behaviour. The current research needs to investigate social psychologists' explanations of how and why attitude influences behaviour because social psychology is the foundation for the principles of TRA. Social psychologists assert that attitudes involve behaviour and cognition, and a positive relationship exists between attitudes and behaviours. That means TRA is appropriate for research on technological innovation and adoption. TRA furnishes three general constructs: (1) behavioural intention, (2) attitude and (3) subjective norm (Abu-Shanab, 2015).

According to Hill et al. (1977), a person's behaviour is characterised by their desire to engage in that behaviour, and intent is a result of their attitude towards that behaviour. As a result, their intention significantly impacts the potential outcomes of the person's behaviour (Xiao, 2019). According to Zhang (2018), intention is a person's cognitive representation of their preparedness to engage in a desired behaviour. The relative strength of a person's propensity to execute a planned behaviour is measured by behavioural intention. This research examines the adoption and sustained usage of mobile phones for agricultural purposes in Zimbabwe and considers this concept to be of utmost importance for smallholder farmers.

Although TRA has not been used extensively in evaluating studies such as technology adoption and diffusion in IS literature. The model has been used for categorising users' behaviours and opinions on matters like using the internet, making purchases online, using computers at home and other topics. In this research, TRA is envisioned to forecast behaviour in situations where the smallholder farmer controls their behaviour and is thinking about it (Nysveen et al., 2005). TRA submits that a consumer's true behaviour is primarily influenced by their desire to engage in each behaviour. The subjective norm (SN) is an individual's belief that the important people in their life would either endorse or disapprove of the behaviour in question, counterbalanced by the individual's desire to conform with the behaviour. Attitude towards behaviour and SN have an impact on behavioural intention. This concept is crucial to the current study. The next section details the theory of planned behaviour.

2.10.4 Theory of planned behaviour

The theory of planned behaviour (TPB) is an information systems theory devised by Ajzen (1985). TBP was founded on the theory of reasoned action (Smetana & Adler, 1980) and contends that the best behavioural prediction could be made by asking people if they intend to behave in a certain manner (Ajzen, 1985, 2010). Ajzen (1985) elucidates three determinants that explain behavioural intention:

- a) Attitude (in this case, opinions of the smallholder farmer about mobile phone use for agricultural purposes);
- b) Subjective norms (opinions of other smallholder farmers, agricultural extension officers and other stakeholders in the value chain about mobile phone use in agriculture activities);
- c) Perceived behavioural control (the ability of the smallholder farmer to use a mobile phone successfully in agricultural activities).

TPB is an extension of TRA (Ajzen & Fishbein, 1980). TRA was designed as a model to explain human behaviour and depends on the significance of the individual's beliefs about their behaviour (Ajzen & Fishbein, 1977; Songer-Nocks, 1976). Under TRA, the behavioural intention to reveal a specific behaviour is formed based on the attitudes of individuals towards such behaviour and on perceived subjective standards (Ajzen, 1991). Scholars from various fields of research have applied TPB in research, including ICT adoption; most of these researchers report that the theory is good and very significant for illuminating the intent to use or adopt ICTs (Mohamad et al., 2018; Zhang, 2018). Therefore, TPB can predict the behaviour of smallholder farmers towards using mobile phone technologies for their agricultural purposes.

2.10.5 The diffusion of innovation (DOI) theory

The diffusion of innovation (DOI) is a theoretical framework rooted in communication. The theory aims to illuminate how a new idea or item spreads over time among a particular group or social system. Under this theory of behaviour, how people perceive the characteristics of technology, the social context within which it is used, and the communication channels used to spread knowledge about it all influence how quickly

people embrace it (Sahin, 2006). The advantage of DOI is that it offers an in-depth structure for comprehending the adoption process and the variables affecting adoption decisions. However, it has been criticised for not considering the emotional and psychological aspects of adoption. Scholars have found that behaviour adoption functions better with the model than behaviour cessation or behaviour inhibition (MacVaugh & Schiavone, 2010). As a result, it disregards a person's ability to embrace the new behaviour (or technology) or their social support system.

2.10.6 The unified theory of acceptance and use of technology (UTAUT)

The unified theory of acceptance and use of technology is a behavioural framework which posits that factors such as performance expectations, effort expectations, social influence, facilitating conditions, and behavioural intention determine how individuals embrace new technologies. The theory was developed contemporaneously with a thorough review and consolidation of several theoretical concepts (Venkatesh et al., 2003). Since the creation of UTAUT, academics have used the framework substantially in attempts to understand why and how IS/IT adoption and use occur. Although the original UTAUT model successfully and significantly clarified the variation in behavioural intentions and usage behaviour, it didn't include some constructs that may be essential for understanding IS/IT acceptance and theorised certain connections that may not apply in all various settings (Venkatesh et al., 2016). The advantage of UTAUT is that it offers a thorough framework for comprehending the adoption processes and the variables affecting adoption decisions. The model was reviewed and extended to UTAUT2, which integrates the elements of hedonic inspiration, price value and habit (Kupfer et al., 2016). Another advantage of UTAUT2 is that it offers a thorough framework for comprehending the adoption process and the variables affecting adoption decisions. However, the theory has been criticised for not considering the emotional and psychological aspects of adoption (Leong et al., 2021, 2021).

The review of these technology adoption models above generally demonstrates that each has shortcomings. These models provide an understanding of the procedures involved in adoption and the variables that affect an individual's choice to adopt an innovation or

technology but have come under fire for failing to allow for the emotional and psychological variables that might play a role in adoption. To support this research for a PhD thesis premised on examining the non-adoption of mobile phone technologies by smallholder farmers in agriculture, there is a need for a conceptual framework to be developed and used as a guide for data collection and analysis. This necessity exists because a researcher's capacity to discover novel context-specific factors can often be restricted when using existing theories, as posited by Mishra et al. (2022). For this reason, in their quest to unearth new knowledge, researchers might be required to transcend conventional adoption theories and the broad theoretical frameworks frequently used in IS research by using an exploratory, inductive method. In the following sub-section, the research introduces and justifies the proposed conceptual framework and its key constructs.

2.11 CONSTRUCTS OF THE CONCEPTUAL FRAMEWORK OF THIS RESEARCH.

Nine constructs constitute the eclectic framework constructed and operationalised in this research to guide data collection and analysis. These constructs are stated as Perceived Expressiveness (PE), Perceived Support of Service Provider (PSoSP), Perceived Costs (PC), Perceived Compatibility (PComp), Perceived Usefulness (PU), Perceived Mobility (PM), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC). The sub-sections below examine each construct in detail, as presented in Figure 2.5.

Perceived Expressiveness

Perceived expressiveness is the individual's ability to express emotions or identity by allowing themselves to express his/her personality through various designs, tones, and other customisable features. Empirical data from previous research attest to a connection between perceived expressiveness and technology usage intentions (Kiiza & Pederson, 2012). Thus, a mobile phone and related services might contribute to a farmer's identity, status and public image. Nysveen and Pedersen (2003) proposed the perceived expressiveness dimension for mobile banking, which Anthony and Mutalemwa (2014) and Sendekka (2006) expanded in different mobile acceptance models. These research

articles establish that some technological applications allow users to express themselves about who they are. This category was considered vital in the understanding and analysis of mobile phone adoption and use in agriculture owing to the nature of mobile phones. Mobile phones could allow farmers to express their personalities and their farming activities through various applications, designs, tones, and other customisable features.

Perceived Costs

Perceived cost is the extent to which consumers believe that using a particular technology will cost money (Grunert, 1992; Siraj, 2010). According to Moore and Benbasat (1991), an individual's perception of cost is different from the actual cost of a product or service since cost price is a primary attribute and the perception of cost is a secondary attribute. In the case of perceived cost, the adopter considers price relative to disposable income and thus, perceived cost becomes variable depending on the individual's disposable income (Wahid, 2007). Perceived costs encompass monetary costs (acquisition and usage costs) and transparency (tariff models and cost per minute). As a result, scholars determined perceived costs as a significant predictor of customers' inclination to use mobile phone services. Because mobile service users are typically charged for utilising such services, smallholder farmers' use of mobile phone services depends on the availability of resources.

Perceived Mobility

Perceived mobility is the extent of mobile user awareness of the mobility value of mobile phone services and associated systems (Coff et al., 2015; Nikou & Economides, 2015). Thus, mobile phone users, who perceive the value of mobility, appreciate the ubiquity of mobile phones and their associated services and ultimately, have a strong perception of mobile phone usefulness in their everyday activities.

Perceived mobility encompasses issues such as network coverage, accessibility and technological infrastructure availability and, as a result, is deemed an important antecedent of consumers' intention to use mobile phone services. This research considered this factor important since smallholder farmers usually encounter real-time agricultural issues while

in their fields; thus, the failure or success of their agricultural outcomes depends on the real-time provision of actionable information.

Perceived Ease-of-Use

The Perceived Ease-of-Use (PEOU) construct is a very critical factor in the acceptance, adoption and use of a technology or system (Tahar et al., 2020). This is mainly because the more the targeted users of the system are certain that the system is easy to use, the higher the chances that they will use the system (Davis, 1992). Thus, if smallholder farmers perceive that mobile phone technologies are user-friendly and easy to use, it implies that they are likely to use them for their agricultural activities. Therefore, it is an important construct to elicit the factors which shape the smallholder farmers' perceptions of mobile phone technologies in their agricultural activities.

Perceived Support of the Service Provider

The warranty and guarantee provided by manufacturers have always provided some form of insurance to customers of such products. As such, this author believes the perceived support from the service provider is crucial to the decision-making process, which influences a consumer of telecommunication services. Thus, when adopting mobile phones for agricultural purposes, farmers might regard it as imperative to consider the support from the service provider, which includes user support, access support, user training and services support. Previous studies have demonstrated that service provider support and training positively influence technology (Mbele-Sibotshiwe, 2014). This driver was incorporated in the current study as it may explain why farmers are not adopting mobile phones in agriculture while adopting mobile phones for their everyday life activities.

Perceived Compatibility

This is the degree to which an invention is deemed to be consistent with the current values, goals, and experiences of potential adopters. It refers to how well a new technology fits into the customs, values and requirements of potential users (Ardana, 2014; Ismail, 2016). As a result, consumers' perceptions of technology compatibility are considered a crucial factor in determining their intent to utilise mobile phone services. The adoption and usage of technology by an individual may be negatively impacted if it is incompatible with their

unique demands. This research considered this factor to be important as smallholder farmers would prefer technology that fits into their everyday operations.

Perceived Usefulness

The degree to which a person believes that using a particular technology would boost their capacity to complete their work is known as Perceived Usefulness. It means that someone perceives technology to be useful for what they want to achieve. According to Davies et al. (1992), Perceived Usefulness refers to consumers' perceptions regarding the outcome of their experiences. Thus, PU is one of the independent constructs in the TAM (Amunkete et al., 2019; Wei et al., 2019). PU was incorporated in this research since it might explain why farmers are not adopting mobile phones in agriculture while adopting mobile phones in their everyday life activities.

Perceived Subjective Norms.

Subjective Norms (SN) are the perceived social pressures that compel individuals to either engage or not engage in each behaviour. They are the rules and regulations designed by society by which one should function. Thus, for any specific behaviour, society has created a set of norms for who is expected to perform the behaviour and how that behaviour should be performed. These norms are prescriptive in nature, and therefore, individuals follow these norms due to social pressure. Furthermore, norms are embedded in a cultural system. People are restricted by the belief that an important person or group of people within their social configuration would approve of and support a particular behaviour and disapprove of another, due to subjective norms. Empirical research by Bentler and Speckart (1979), Davis et al. (1989), Ham et al. (2015) and Kim and Kim (2013) discovered that there is a positive connection between social influences on SN with BI by using technology. Thus, SN is considered an important factor affecting mobile phone acceptance, adoption, and usage for agricultural purposes.

Perceived Behavioural Control

Behavioural Control is someone's ability to exercise influence and authority over their behaviour. It is a person's perception of how simple or complex they believe executing the

behaviour would be (Ham et al., 2015; Kerlinger, 1973). Investigating mobile phone adoption in smallholder agriculture PBC was aimed at reflecting the perception of smallholder farmers and agricultural extension officers who are the key players in agricultural activities. The behavioural control factors fall into the categories of the types of instructions that were given (Altawallbeh et al., 2015; Yean et al., 2015). Therefore, Perceived Behavioural Control suggests that the adoption and usage of mobile phones to perform agricultural-related activities is a central condition to be fulfilled. Thus, if a smallholder farmer or agricultural extension officer is unable to exercise control over mobile phones in performing their given agricultural-related tasks, it could prevent them from using the mobile phone.

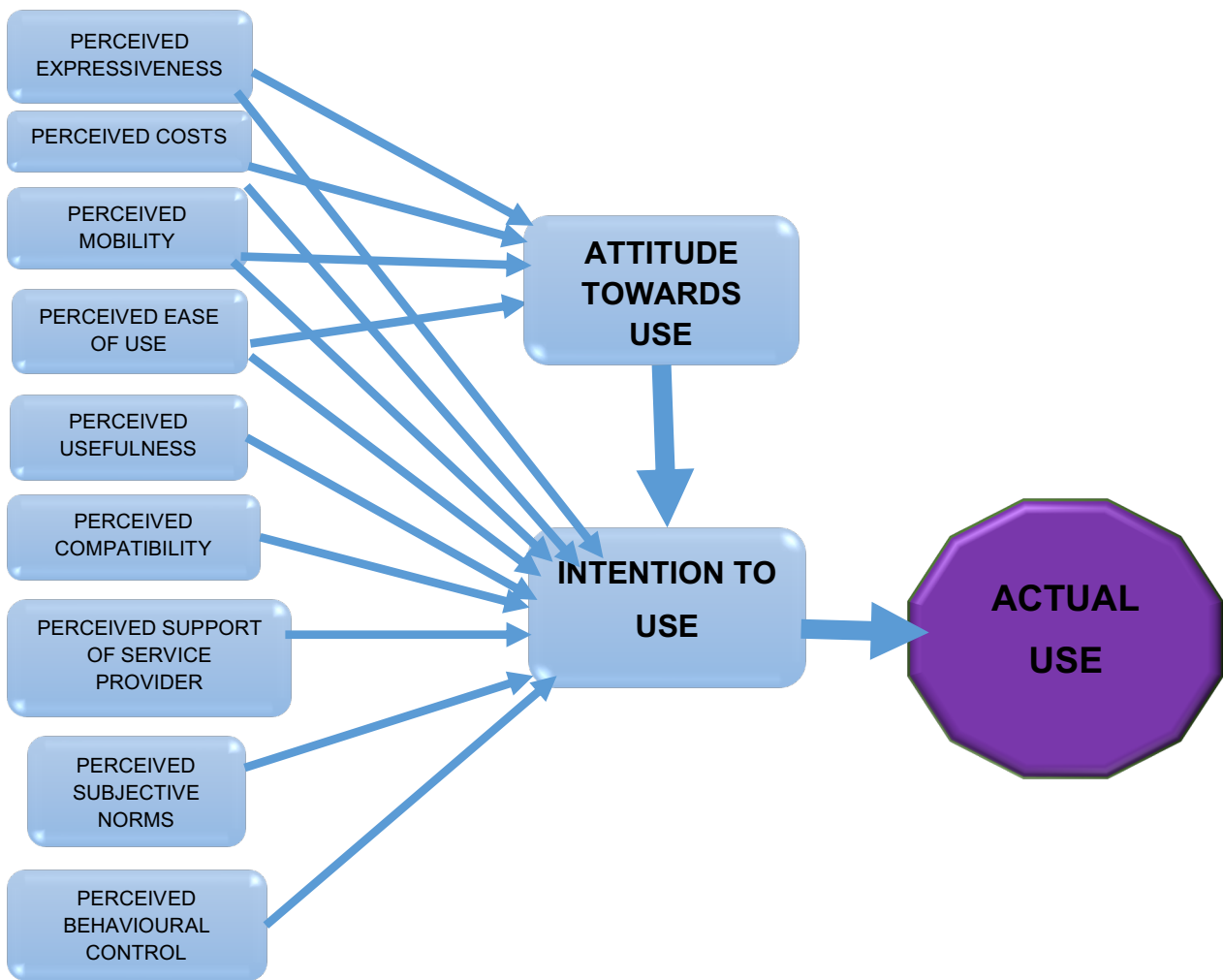


Figure 2.5: The conceptual framework (author's construction)

The use of a conceptual framework is encouraged with interpretive inductive theorising as a guide for the data collection process and to allow for the emergence of the concepts relevant to the practical situation under investigation through the data analysis process, as suggested by Bernardi (2017).

2.12 CHAPTER SUMMARY

This chapter reviewed the literature on ICT and smallholder agriculture and adoption models and summarised and evaluated vital concepts related to the research question. In this chapter, the researcher described and analysed what previous researchers had established. The literature review was organised around the following main topics: ICT4D, smallholder farmers, sustainable development goals, mobile for development in sub-Saharan Africa, the impact of mobile phone technologies in African countries and factors affecting mobile phone adoption and use in smallholder agriculture. Chapter Two described the perceptions and attitudes about technology and farmers' attitudes towards ICTs and the development of the conceptual framework with constructs identified in several adoption theories. The chapter further discussed the vital concepts of each impact to provide context to the study. According to the literature, the available mobile phone technologies have been applied in different areas for development purposes, succeeding in some areas and failing in others. Substantial information exists on the potential for leveraging mobile phones to successfully develop the agricultural activities of smallholder farmers in sub-Saharan Africa in general and in Zimbabwe, in particular. However, for such adoption to occur, there is a need for context-specific information to ensure success.

CHAPTER THREE: THE STUDY CONTEXT

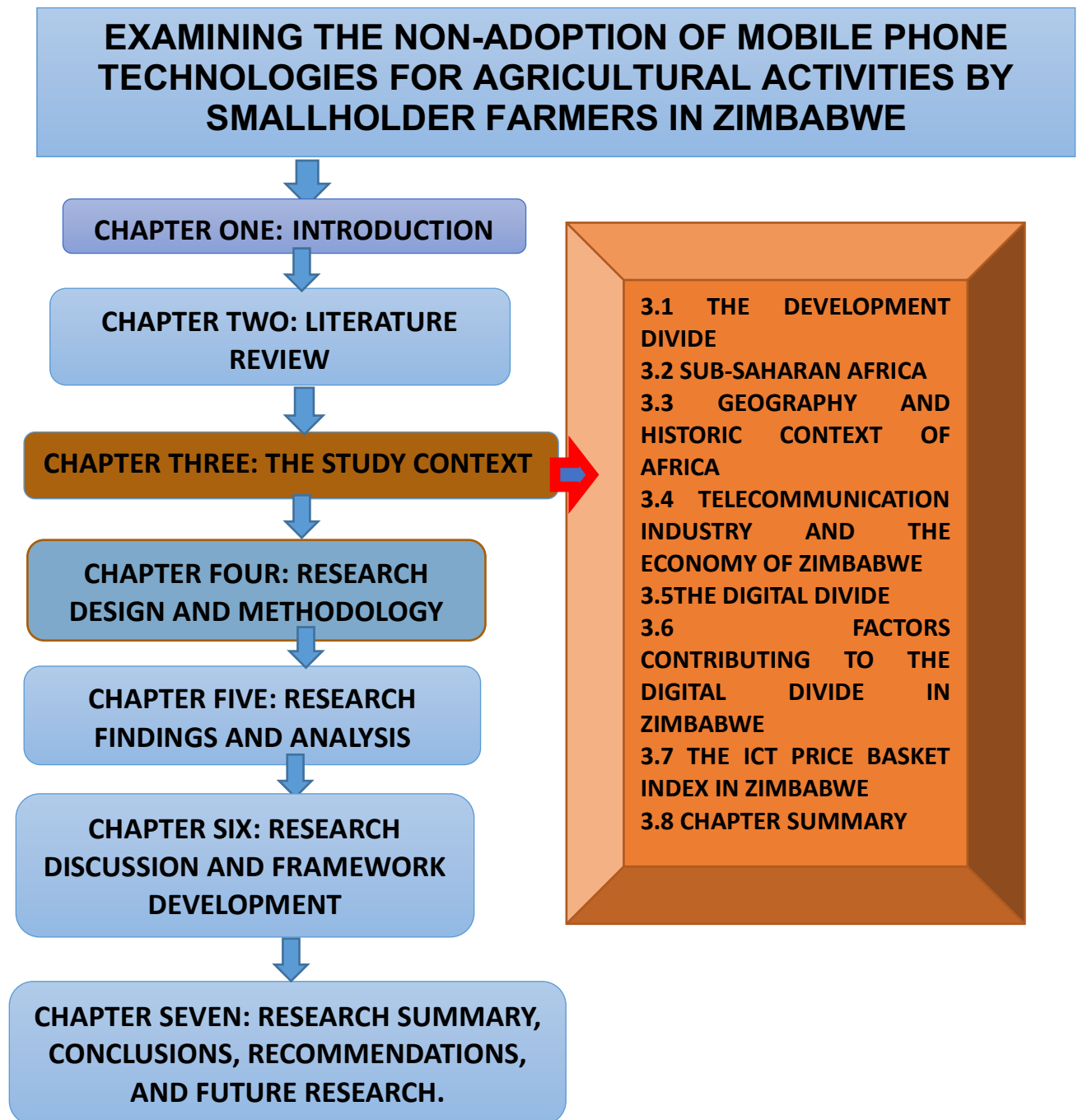


Figure 3.1: Thesis and Chapter Three navigation map (author's construction)

3.1 INTRODUCTION

Chapter Three provides background information about sub-Saharan Africa, of which Zimbabwe is a part and then concentrates on the Gokwe South district, where the study was conducted. The section describes the setting of the study in Zimbabwe, as well as the study sites of Gokwe South, Mbare Farmers' Market and Kombayi Farmers' Market. The section is organised around eight major categories: Overview of Developed and Developing Contexts, sub-Saharan Africa, Geographic and Historic Context of Zimbabwe, The Zimbabwean Economy and the mobile telecommunications industry, the digital divide, Factors Contributing to the Digital Divide in Zimbabwe, and the ICT Price Basket. The chapter concludes with a recap of what had been addressed and a preview of the following chapter.

3.2 THE DEVELOPMENT DIVIDE.

The development divide is defined as the division, difference, demarcation or gap in overall levels of human development between the world's richest and poorest people, families, groups, regions, nations or continents, as assessed using economic, socio-anthropological, cultural and political variables (Mwim & Kritzinger, 2016). The world is divided between 'haves' and 'have-nots' on an individual or household level. This applies to all emerging countries, and as a result, there is a global chasm between developed and developing countries. The developed countries are usually called first-world countries (Escobar, 1994; Naz, 2006). HDI is a universal metric used by the United Nations for measuring the level of human development in a given country (United Nations Development Programme, 2016). It is a summary estimate of a certain country's accomplishments in the three areas of human development that are seen as critical to human life. A healthier and longer life, the accessibility of information and a fair standard of living are the three main aspects. This HDI is the statistical measure of the above-mentioned three variables' normalised indices. This will result in a certain country's HDI being categorised as high or low, and eventually, as developed or developing. A nation

with a low HDI is considered developing, whereas one with a high HDI is considered developed (United Nations Development Programme, 2016).

The dimensions are provided in the sub-sections below.

3.2.1 Long life

This dimension is evaluated by the indicator of life expectancy at birth. This is mainly concerned with the expected number of years one is expected to live when they are born. This dimension is usually high for the developed world and low for the developing world. According to statistics published by the United Nations Development Programme (2016), Hong Kong had the highest life expectancy index of 84.2 for 2015 among other developed countries hovering around 80+ years. Most of the developing world, particularly sub-Saharan African countries, are above 50 years and Zimbabwe is above 59.2 years.

3.2.2 Knowledge

This indicator represents the expected number of years of schooling and mean years of schooling evaluates this dimension. This is mainly concerned with the expected number of years one is expected to spend in education, acquiring knowledge. This dimension is characteristically high for the developed world and low for the developing world. According to United Nations Development Programme (UNDP) (2016), Australia had the highest expected years of schooling with an index of 20.4 and an equally higher mean years of schooling index of 13.2, only outpaced by Switzerland, with 13.4 for 2015 among other developed countries. For the developing world, particularly sub-Saharan African countries, the expected years of schooling index is around 10 with the mean years of schooling index as low as 1.4 for Burkina Faso and 8.5 for Zimbabwe, which is surprisingly higher than South Africa (UNDP, 2020).

This is because the Zimbabwean education system is said to be the best in Africa, and it is structured as follows: Pupils undergo seven years of primary education from Grade 1 up to Grade 7. This process presently culminates in nationally set Grade 7 examinations in four subjects, namely mathematics, English, content (which is a combination of sciences

and social sciences) and one indigenous language subject, Shona or Ndebele. After completion of primary school, learners proceed to secondary school.

There are three levels in secondary school: ZJC (Zimbabwe Junior Certificate) which comprises Forms 1 and 2; however, this level is no longer examined at the national level. Thereafter, learners progress to the Ordinary Level, which constitutes Forms 3 and 4. The third and final level is Advanced Level, which includes Forms 5 and 6; this is the normal university entrance level to be passed. The ZJC Core Curriculum is comparable and equivalent to Grades 8–9 offered in other countries like South Africa. It is made up of eight subjects, namely English: one indigenous language subject (either Shona or Ndebele), mathematics, science, history, geography, Bible knowledge and one practical subject such as food and nutrition, fashion and fabrics, woodwork, agriculture, metalwork, technical drawing, etc. The choices available depend on the school's available capacity and facilities. Some schools offer an array of these practical subjects to different classes. ZJC national examinations were terminated in 2001 but the curriculum has been maintained for general Forms 1 and 2 level education.

3.2.3 A decent standard of living

This dimension is evaluated by the indicator of gross national income (GNI) per capita. The GNI per capita indicator is the dollar value of a country's final income each year, divided by the country's population in that year. This reflects the average income of the citizens of a country. Knowing the GNI per capita of a country enables one to understand the country's economic strengths and needs and this enables the crafting of policies to assist the average citizen. This dimension is usually high for the developed world and low for the developing world. According to (UNDP, 2020), Qatar had progressed significantly from 1990 to 2019 and had the highest GNI per capita index among other developed countries. Most of the developing world, particularly sub-Saharan African countries, is characterised by low GNI per capita indexes with an average index of around three digits. Somalia has the lowest GNI per capita of 294 with Zimbabwe at 1,588.

A country might score high on one index and low on another. Accordingly, a country like Qatar with the highest GNI per capita index in the world was ranked number 45 on the HDI index in the world. Norway was ranked number one in the world on the HDI index in 2020 (for some time) while Zimbabwe was ranked number 154 with an index of 0.516. Africa is the continent most struck by poverty and the continent bears the highest disease burden in the world (Alkire, 2010), resulting in a low HDI index for the region. Developing countries experience the phases of development for the first time and are frequently characterised by a low HDI index, indicating that the citizens of these countries have limited freedoms (Crul, 2014). The essence of human development is expanding freedoms such that all human beings can pursue the choices that they value; therefore, any limitation to these freedoms presents a limitation to the development of the citizens.

Development encompasses freedom of choice, symmetric information and very low disparities, if any, in the level of development among citizens. In developing countries, human development has been and continues to be uneven among regions, communities, groups and individuals (UNDP, 2016). However, in developing countries inclusive development where no one is left behind is very elusive for marginalised people, of which smallholder farmers are one such group excluded from developmental progress. This understanding provided the substratum for the crafting of the Millennium Declaration and the Millennium Development Goals (MDGs) in 2000 (Heeks, 2014). These goals were time-bound development objectives and targets agreed on in September 2000 by 189 Heads of State and Governments to reduce basic human poverty by 2015. The eight (8) Millennium development goals (MDGs) were targeted to be realised by the end of 2015.

In accordance with the aforementioned, modern discourses on development continuously acknowledge ICT as a significant engine for development, economic growth and the evolution of human society (Geldof et al., 2011; Perkins, 2010; Twinomurinzi et al., 2017). The MDGs helped about one billion people escape from the worst forms of poverty (Heeks, 2014). These goals were responsible for the achievement of several milestones like enabling more girls to attend school in the post-millennium era than before (especially in developing nations) and focusing on environmental issues to safeguard our planet, which

are examples of advancements in the fight against hunger (United Nations, 2015). New relationships were fashioned between nations because of the MDGs and inculcated the desire to end poverty in all of its extreme manifestations and consequently, altered public opinion and decision-making in both developed and developing nations. These achievements inspired the formulation of the 2030 SDG framework, which is premised on harnessing ICTs to attain the world we want.

3.3 SUB-SAHARAN AFRICA

Sub-Saharan Africa comprises at least 44 African countries south of the Sahara; this region is home to 800 million people (Zuberi & Thomas, 2012). This region is characterised by diverse people belonging to 21 main ethnic groups with sub-ethnic groupings in each ethnic group. The level of this diversity is reflected in the number of languages spoken by the inhabitants of this region; Nigeria alone accounts for 500 indigenous languages spoken by its inhabitants. Over 50 % of this region is rural and the bulk of the inhabitants reside in these rural areas (Sullivan, 2006). Agriculture is the economic system that characterises this region. Currently, the population of the region slightly exceeds one billion (<http://data.worldbank.org/region/sub-saharan-africa>). Most of the inhabitants of this region reside in the countryside and over 60% of this population directly depend on agriculture for their livelihoods (Scoones, 2009). So critical is the agriculture sector to this region that between the years 1998–2000, agriculture accounted for an average of around 29% of the Gross Domestic Product (GDP) of sub-Saharan African economies (Scoones, 2009; OECD/FAO, 2016). The majority of the farmers in many of these sub-Saharan African countries are smallholder farmers (Dethier & Effenberger, 2012). Zimbabwe is a sub-Saharan country and most of its population resides in rural areas like most countries in the region. In addition, most of the people are smallholder farmers whose livelihoods depend on agriculture.

Zimbabwe is one of the countries with the lowest m-government readiness index. In the group of lower- to middle-income nations, the country is placed 25th (Portulans Institute, 2019). To make matters worse, it has a lower pillar performance score than the lower income average in every one of the four pillars. It lags behind lower- to middle-income

nations in each of the categories at the sub-pillar level. The country was ranked low in mobile tariffs, company investment in emerging technologies, use of virtual networks, social safety net protection, government procurement of advanced technology products, handset prices and regulatory quality, among other indicators. However, the same report divulged that Zimbabwe was top-ranked on computer software spending, ICT skills, adult literacy rate, the socioeconomic gap in the usage of digital transacting platforms, the medium- and high-tech industry and the gender gap in the internet usage, to name a few.

3.4 GEOGRAPHIC AND HISTORIC CONTEXT OF ZIMBABWE

This section addresses the contextual basis of this research. The researcher discusses Zimbabwe as a part of sub-Saharan Africa, the research sites and the participants and provides a background to the research sites and participants. The researcher justifies the chosen research sites and participants. Zimbabwe is a small, landlocked country located in Southern Africa, sandwiched between two large rivers: the Zambezi to the north and Limpopo to the south.

Table 3.1: Policies pursued by the government of Zimbabwe post independence. Source (Anseeuw, Kapuya & Saruchera, 2012)

Period	Sector	Policy	Description
1980–1990	Land Agriculture	Willing buyer, willing seller resettlement program. High regulation & control policies.	Government bound by the Lancaster House Agreement. Distributed 2.46 million ha in first five years to model. Twelve-acre schemes were deemed very successful. Maintained the dual agricultural system. Continued with the pre-independence government controls, but heavily skewed towards black small-scale and communal farmers who received subsidised inputs and protected marketing. National food security was a priority.
1991–1998	Land Agriculture Food Security	Compulsory land acquisition Liberalised policies No official policy	Legislation to acquire land compulsorily was passed and was hoped to receive donor support which did not materialise. Hence, the resettlement program was very slow and far off-target. Trade liberalisation began, founded on macroeconomic reforms, which proposed a market-based economy. Cancellation of controls and subsidies ensued, but the grain sector remained partially controlled. The start of efforts to write national agricultural policies. The government prioritised food security by controlling trade in grains and funding relief aid (with help of NGOs) in years of drought.
2000–2008	Land Agriculture Food Security	FTLRP Return of regularisation No official policy	Politically motivated land invasions took place which resulted in 7.3 million ha taken by blacks in two years alone. Up to this day, the program continues to attract negative media attention the world over for its criminal elements. Production nosedived after the FTLRP. All efforts to craft national policy fail and the government again becomes highly involved in trade regulation. The central bank bankrolled national agricultural projects and the marketing of most products, especially grain, was tightly controlled. Severely reduced agricultural production and a lack of funds dampened the national food security programs. The government relied on the World Food Programme (WFP) for household food security.
2009–2013	Agriculture	Mixed approach	The unity government partly liberalised agricultural trade again. Grain trade is uncontrolled for the first time. Government and NGOs fund input projects to communal and resettled farmers.
2013+	Land Agriculture	Land audit exercise Command Agriculture	This is an exercise meant to try and establish underutilised land and multiple farm ownership. The program lacks political will, most of the multiple farm owners are top officials, hence there are challenges. This is a government policy, which is targeted at boosting food security in Zimbabwe. The government determined the need to produce enough maize for consumption. The policy was aimed at mobilising input resources for agriculture from well-wishers and getting farmers who are interested in the project to participate. At the time of writing this work, many people were very sceptical about the scheme.

Zimbabwe attained independence from Britain in 1980 and began the process of resettling people on previously white-owned farms. The first phase of the resettlement process, guided by the Lancaster Constitution, was market-oriented with the government compensating the farmers whose land had been acquired. It was premised on the willing buyer willing seller method where the whites owning the land would voluntarily avail their farms for acquisition and the government would pay a market-related price. However, the process was deemed too slow and less fruitful by the general population, particularly the landless rural people and war veterans (Anseeuw et al., 2012; Moyo, 2000).

Accordingly, more than 50,000 families were resettled in the first decade of independence (Kinsey, 1999; Moyo, 2011b; Thomas, 2003). The government regarded this phase as not having been very successful. At the expiration of the Lancaster House Agreement, the Government of Zimbabwe (GoZ) amended the constitution towards the compulsory acquisition of land for resettlement. This spanned from 1992 to 1997 during which 20,000 families were resettled (Cliffe et al., 2011; Kinsey, 1999; Moyo, 2011b). The first and second phases of land reform did not yield the desired results according to the government and the general populace. Consequently, the Fast Track Land Reform Programme became imminent in 2000, soon after the referendum. White commercial farmers were forcibly removed from their farms during the FTLRP (Cliffe et al., 2011; Cliffe et al., 2017; Moyo, 2004). This had adverse effects on the agricultural production in the country, which was ironically the anchor of the economy and subsequently, led to the closure of industries.

Table 3.1 explains the different policies and their periods over time in post-independence Zimbabwe. Over the years, these policies have had a bearing on agricultural activities in terms of land use and productivity in the country. Some policies have resulted in a new land ownership structure in Zimbabwe. The smallholder farmers' numbers have swelled to the point that at the time of conducting this research, there were +1.1 million smallholder farmers (see Table 3.1). These are the farmers upon whose livelihoods around seven million Zimbabweans directly depend. The improvement in the productivity of the agricultural activities of these farmers implies the possibility of uplifting more than

half of the population of the country. The FTLRP led to the downfall of the agro-processing industry, leading to the demise of formal markets at the start of a new era (Moyo, 2000, 2004; Thomas, 2003).

Table 3.2: The new land ownership structure in Zimbabwe in 2009. Source (Anseeuw, Kapuya & Saruchera, 2012)

Farm-class tenure	Land tenure	Farms/households		Area		
		Numbers	% of total	Hectares (million)	% of total	Farm size (a)
Smallholder	Communal	1 100 000	—	16.400	—	15
	Old resettlement	72 000	—	3.700	—	51
	A1	141 656	—	5.700	—	40
	Subtotal	1 313 656	98.0	25.800	75.6	20
Small to medium-scale commercial	Old small-scale commercial farms	8 000	—	1.400	—	175
	Small A2	14 072	—	1.000	—	71
	Subtotal	22 072	1.6	2.400	7.0	109
Large-scale commercial	Medium-large A2	1 500	—	0.900	—	600
	Black large-scale commercial farms	1 440	—	0.900	—	625
	White large-scale commercial farms	1 377	—	1.200	—	871
	Subtotal	4 317	0.3	3.000	9.0	695
Large-scale Corporate estates	Company	657	—	1.000	—	1 522
	Church	64	—	0.041	—	641
	Parastatal	153	—	0.600	—	3 922
	Subtotal	874	0.1	1.641	4.8	1 878
Transitional	Unallocated	—	—	1.300	3.8	—
Total	—	1 340 919	—	34 141	100	—

Many issues exist around discourses on land ownership, agriculture productivity and development in Zimbabwe. To better understand context-specific challenges surrounding smallholder farmers' adoption and efficient use of mobile phone technologies to increase their agricultural operations and productivity, the researcher in this study only examines concerns from an ICT4D perspective.

3.4.1 Ministry of Agriculture, Mechanisation and Irrigation Development.

The Ministry of Agriculture, Mechanisation and Irrigation Development (MofAMID) preside over all agricultural issues in Zimbabwe. It is guided by the vision “to be the breadbasket of the SADC and COMESA regions by 2015”. Unfortunately, this has not come to pass as the country is reeling under perennial food shortages. The Ministry's mission is to:

Promote and sustain a viable agricultural sector through the provision of appropriate agricultural infrastructure, mechanisation, technical, administrative and advisory services to optimize agricultural productivity to ensure food security. (The Ministry of Agriculture, n.d.)

The Ministry's mandate is to “provide technical, extension, advisory, regulatory and administrative services to the agricultural sector to achieve food security and economic development” (Ref). Its core values are professionalism, teamwork, transparency, accountability, commitment, responsiveness, honesty, integrity and productivity. The ministry is underfinanced as it receives little financial support from the central government through Treasury hence it is failing to realise its vision and mission perennially (Ministry of Agriculture, 2018). The department of agricultural and extension services under the ministry is responsible for the smallholder farmers in Zimbabwe. Agricultural extension officers are deployed across the countryside. The next section discusses the agricultural extension department in detail.

3.4.2 Agriculture and extension services (AGRITEX)

The Ministry of Agriculture, Mechanisation and Irrigation Development have 11 departments of which agricultural extension is one of the major departments under the Ministry. The department is mandated to provide technical and agricultural advisory services to smallholder farmers (Tekere, 2001; Madzivhandila et al., 2016). It extends to providing regulatory services, farmer training programs for smallholder farmers, food technology, dissemination of new technologies as well as providing market-oriented extension for sustainable farming. The department consists of five branches explored below.

a) Agronomy (Crops)

This branch specifically concentrates on crops and aims to effectively provide crop-related knowledge to different clientele, with the focus on smallholder farmers. The branch also trains agricultural extension field officers on all obligatory and other courses as and when the need arises (Tamoutsidou, 2013). The branch further supports knowledge and skills dissemination to smallholder farmers and agricultural extension officers by attending and participating in field days and shows and addressing queries related to crops by agricultural extension officers and farmers.

b) Agribusiness and farm management.

This branch of agricultural extension is principally a service division which is tailor-made for the provision of professional agricultural knowledge which includes agribusiness information and project management information to the agricultural extension department, the government, the farming community, and the universal agricultural industry and trade. The branch ensures that there is an information connection between all the agricultural stakeholders, including research institutions, industry and trade.

c) Land-use planning

This section oversees educating farmers on land use and planning concerns. The primary goal of this subdivision is to move the goal of developing a sustainable and realistic agricultural production system forward. This is accomplished by matching the potential of accessible natural resources to the current condition, as well as the available human and financial resources. The branch's mandate is to create practicable land use plans for smallholder farmers, subdivision viability evaluations for individual smallholder farmers and village land use plans for cooperatives and village communities; as well as unusual development programs such as catchment land use, grazing schemes and computer-based mapping.

d) Training and information

This branch was established to provide valuable agricultural extension services by ensuring the provision of competent and credible staff through in-service training of

agricultural extension officers. The branch also distributes vital agricultural information to the farming community through mass media. It facilitates the development of the curriculum for farmers and performs smallholder farmers' training needs, evaluation and analysis. The subdivision is also responsible for editing and harmonising the Master Farmer Training program and providing printing and documentation services to the rest of the department.

e) Horticulture

The branch educates smallholder farmers about demand, promotes horticulture output and provides training on how to manage surplus products, as well as processing and providing value-added information. This section oversees promoting and facilitating sustainable horticulture production for smallholder farmers to achieve optimal levels of food production. The officer should be aware that farmers require specific information on products and services and the information is with the agricultural extension officers (Mugwisi et al., 2015). Additionally, good economic growth and social change are provided to all segments of the agricultural community through the provision of technical, extension and consulting services. Each agricultural extension officer is allocated a ward within which to operate and service all the farmers in the defined area.

The section also monitors and evaluates horticultural-related initiatives undertaken by the government, parastatals, and other organisations.

On average, each ward has 1800–2200 households. The distance covered by a ward is variable from 15 km across the smallest ward and 30 km across the largest. This distance is required to be covered by one agricultural extension officer. In the 1980s through to the 1990s, every agricultural extension officer used to have a motorbike and was provided fuel by the ministry for moving around the ward to educate farmers, but at the moment, it has become a thing of the past (Cobbett, 1984; Stoneman, 1992; Mlambo, 2000; Hazell et al., 2006; Tata & Mnamara, 2016). Currently, most agricultural extension officers do not have a motorbike at all with the few lucky ones who do, having the responsibility of servicing and fuelling the motorbikes themselves (Food and Agriculture Organisation, n.d.; Mlambo, 2000).

The collapse of the economy in the 2000s resulted in the incapacitation of the government to function and offer support to various sectors, including agriculture. The following were direct effects on agriculture.

- ❖ Failure to establish infrastructure in new resettlement areas.
- ❖ Failure to provide adequate farming inputs timeously to farmers.
- ❖ Failure by the grain marketing board (GMB) to pay farmers on time for maize delivery.
- ❖ The exodus of human capital from the agriculture sector.
- ❖ Failure by the government to equip and support agriculture extension officers (Agritex). Absence of direct formal markets for agricultural produce.

Currently, Zimbabwe is characterised by perennial poor yields which perpetuate food insecurity, thereby rendering the country entirely dependent on international aid, particularly food aid (Anseeuw et al., 2012; Government of Zimbabwe, 2014). This provides a challenge that requires redress, for which technology provides a window of opportunity to arrest the problem.

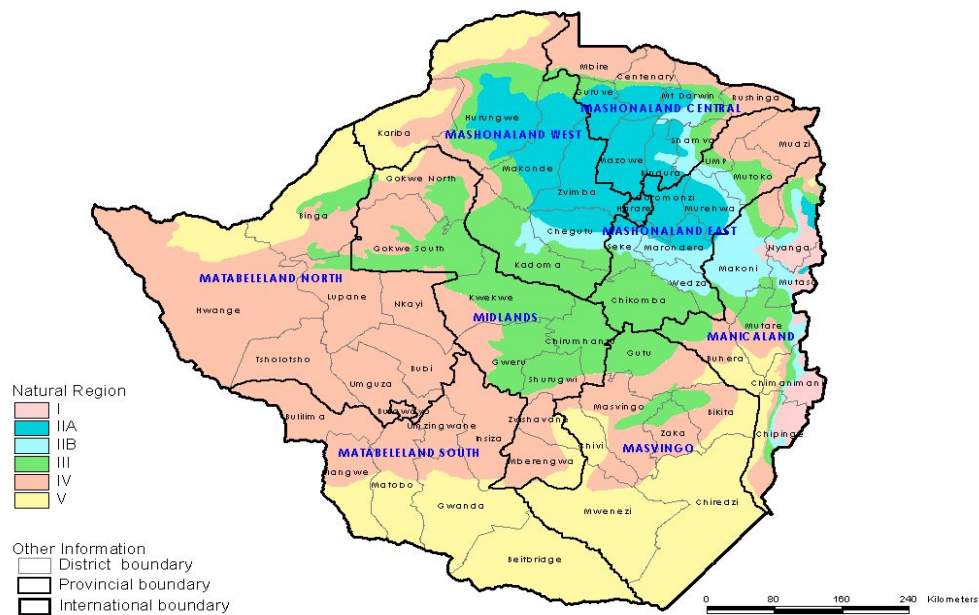


Figure 3.2: Map of Zimbabwe. Source: <http://www.fao.org/docrep/012/ak352e/ak352e00.htm>

3.4.3 Gokwe

Gokwe is a district that used to be sparsely inhabited by the Shangwe people and until 1900, was more of a forest area with wild animals (Nyambara, 2002). The tsetse fly and the arid conditions of the region inhibited the settlement of a large population in the area. The retrenchments that occurred in many Zimbabwean companies like Zisco steel, Lancashire steel and the mining and textile industry during the 1990s fuelled the influx of many inhabitants of different ethnic backgrounds into Gokwe. The problem was further fuelled by the growth of the elephant population, which began to invade people's fields, destroying crops and predators, especially lions, which threatened people's safety. Nevertheless, the area was so attractive that the influx of people continued with the economical structural adjustment programme (ESAP) in the 1990s.

The temperature of the area hovers around 40°C. Despite these negative factors, Gokwe (Gogwe mudhara) has experienced numerous migrations from almost all corners of Zimbabwe over the years. This occurred in phases in the early migration years due to its favourable vast areas of unutilised agricultural land and arid agricultural conditions, which favoured cotton production in the later migration years. Gokwe falls within ecological region IV which experiences semi-arid to arid conditions; the region receives an average

annual rainfall of between 250–500 mm per year (Mugandani et al., 2012). The second phase during the 1960s witnessed a massive influx into the area by people from all lifestyles and different regions from as far away as Gutu, Filabusi, Chirumhanzu, Shurugwi, Chibi and other areas.

3.4.4 Gokwe South

Gokwe South District is the largest district in Zimbabwe and is part of the two Gokwe districts in the Midlands province of Zimbabwe. The district shares borders with Gokwe North, Zhombe District and Sanyati. There are several chiefs in Gokwe South and among these, Chief Njelele is the supreme chief of this Gokwe. In the Njelele area lies the Njelele shrine, which is sacrosanct for the whole of Gokwe. Gokwe South is one of the most active agricultural communal areas characterised by smallholder farmers in Zimbabwe. The district comprises 33 wards and each ward has approximately 1800–2100 housing units (family units). All these families are smallholder farmers who depend on agriculture for their livelihoods.

Gokwe centre, located in Gokwe South, started as a growth point and in 2007, acquired city status as the economic centre of the district. Bomba is located around 20 km south of Gokwe centre along the Kwekwe-Gokwe highway and is a hive of economic activities. Around this area, farmers are very active, practising market gardening throughout the year. Fresh farm produce is grown in this area and sold at Bomba throughout the year to travellers who pass through the highway. Farmers from this area are very active, and as such, the area was chosen as the main research site for this research. Figure 3.3 displays a map of Gokwe South.

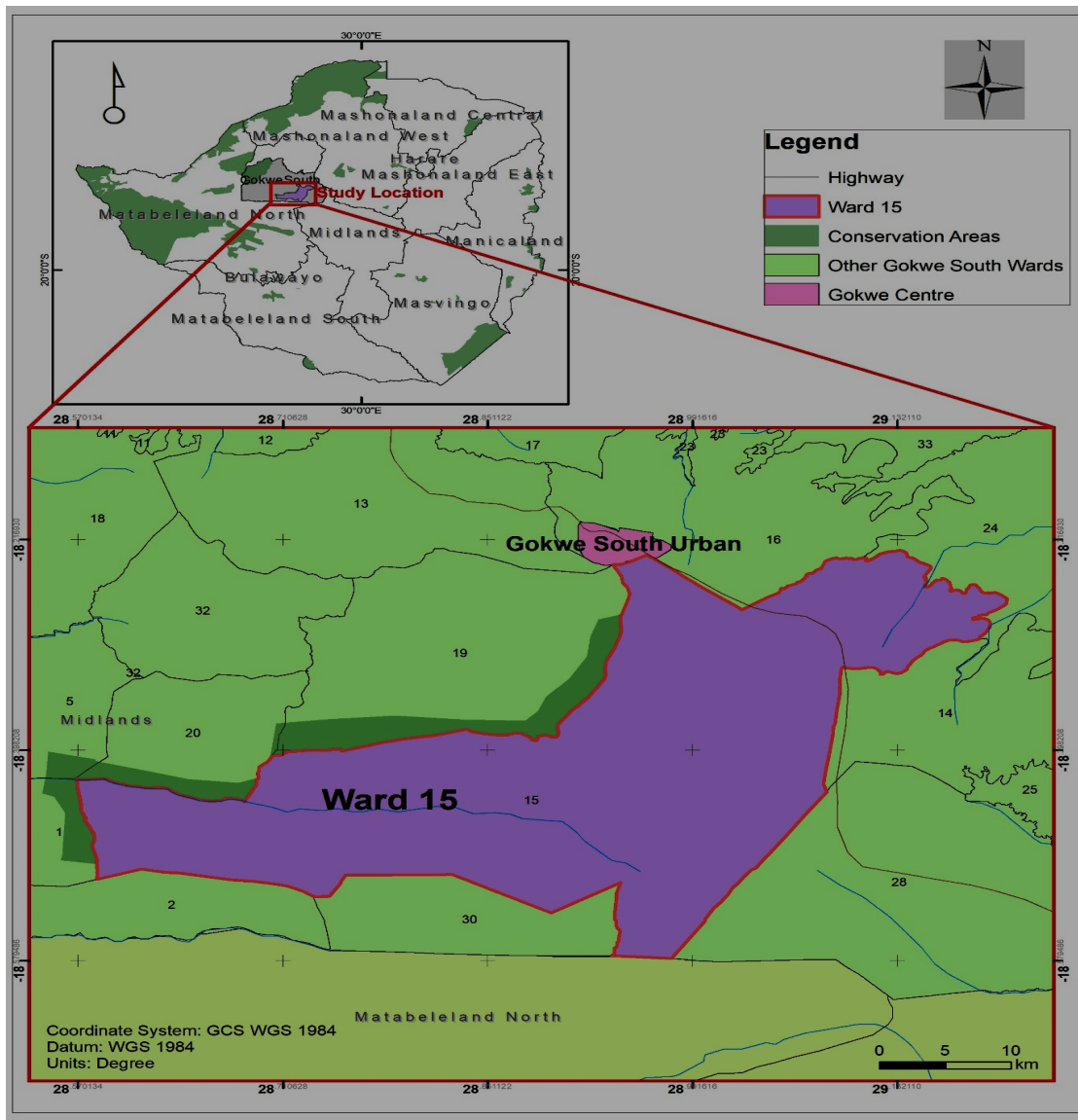


Figure 3.3: Gokwe South district map. Source: Agritex

3.4.5 Farmers vending markets

A farmers vending market (also called a farmers' market) is a place where all farmers go to sell their agricultural products directly to consumers or to vendors, who then resell the products to consumers. Farmers' markets do not only serve as a place for farmers to get the best price and consumers to buy the best products, but also serve as venues for producers and consumers of food to come together, forge relationships and exchange information. In sub-Saharan African cities and towns like Accra, Addis Ababa, Cairo, Harare, Johannesburg, Lagos, Lusaka, Maputo, Nairobi and Yaounde, farmers' markets

are increasingly becoming the 'go-to' market for smallholder farmers with the increasingly dwindling formal markets (Munasirei et al., 2007). Farmers' markets in large cities like Harare, Bulawayo, Gweru, Masvingo, Mutare and Kwekwe are perennially busy because farmers from very distant areas usually come to these big markets in search of lucrative prices.

In Zimbabwe, there are many farmers' markets all over the country, with every city, town and in some cases, a growth point having at least a market of its own. There are general customers and agriculture or food vendors at these markets who later play a critical role in the current agriculture value chain in sub-Saharan Africa as they dictate the terms regarding what is brought there to be sold (Nani, 2016). Farmers' markets are a common feature in local towns and cities the world over, where they are often called local markets. These vendors buy fruit, vegetable and crop produce from farmers in bulk and then sell the products to customers (Oberschall, 1972). The bigger the city or town, the bigger the farmer's market in terms of capacity and the volume of transactions that are conducted there. However, the vendors are a vital component in this system as they gather market information intelligence and knowledge about the products that customers want (Mitullah, 2003). Among these flourishing farmers' markets are Mbare in Harare and Kombayi in Gweru. The market forces, demand and supply are like a pair of scissors, one cannot cut on its own but requires the other (Marshall & Walras, 1924).

Mbare farmers' market

Mbare Musika has three marketplaces: the farmers' market, the vendors wholesale market, and the vendors retail market. Like real wholesaling, these vendors buy, for instance, a lorry of cabbages or more from one farmer, a lorry of tomatoes or more from another farmer, a lorry of fresh maize cobs or more from a different farmer, a lorry of fruits or more from one farmer, tonnes of groundnuts from one farmer, and so on. Well-established vendors are usually into wholesaling because they can usually afford to buy in bulk, directly from farmers and then sell the products to other vendors (Mramba, 2015). This place epitomises the most active and diverse market in Zimbabwe as large volumes of diverse fruit and vegetable produce are pushed through this market daily, as many

farmers from the areas surrounding Harare go there to sell their produce. The increased number of vendors in Mbare has meant increased demand for the farmers' produce and as a result, more and more farmers are being attracted and selling their products in Mbare (Mutize, 2014). Most of the vendors are in the retail vending business who buy from the vending wholesalers and sell directly to consumers on the retail market.

Vending wholesalers sell an array of products in small units like 20-litre tins; 50 kg packs dozens and crates of products to other vendors. This farmers' market was established in 1907 when Mbare's high-density suburb was established (Mazhambe, 2017). Some of these wholesale vendors have stalls in the retail vending market as well. Mbare Musika, which derives its name from the surrounding suburb Mbare's high-density suburb, is the oldest farmer's market in Zimbabwe (Musungwini & Van Zyl, 2017). As alluded to earlier, vendors have swelled in numbers that there is no space to accommodate all of them at the market. Figure 3.4 shows some of these vendors.



Figure 3.4: A picture of retail vendors and their vending wares at Mbare marketplace.

The Standard (2014) reported that in May 2014, the Mbare farmers' market generated approximately US\$3 015 168. 25 worth of transactions revenue. This money is exchanged between farmers, agric-produce and consumers (<https://www.thestandard.co.zw/2014/08/10/mbare-veg-market-generates-us36m/>). The report also projected that based on those statistics, US\$36 million worth of transactions between farmers and vendors could be realised per year. This is good news for

Zimbabwe, where the country is suffering from an economic meltdown, with industries closing down at an alarming rate (Samukange & Mutomba, 2014; Mugova, 2017).

Kombayi farmers' market

Gweru city is in the Midlands province of Zimbabwe; it is also the central city of the country and there are many vendors in the city. The province is home to diverse people from different tribes. These include the Shona, Ndebele, Tswana, Shangani, Shangwe, Sotho and Chewa, to name a few. Kombayi farmers' market (named after former mayor Patrick Kombayi) is a very vibrant and lively market. At this market, one finds seasoned and well-groomed vendors. Figure 3.5 shows some of the vendors.



Figure 3.5: A picture of retail vendors and their wares at the Kombayi farmers' market.

Farmers from different parts of the country take their produce to this marketplace. The researcher felt that there is a high likelihood of meeting a cross-section of farmers selling their produce at these two markets, Mbare and Kombayi. However, at the time of finalising the research, there were new changes in the vending markets in the world due to the Covid-19 pandemic and Zimbabwe was not spared (Kiaka et al., 2021). However, it was not within the ambit of this study to delve into those changes.

3.5 THE MOBILE TELECOMMUNICATION INDUSTRY AND THE ZIMBABWEAN ECONOMY

ICTs have been acknowledged as a mechanism that plays an essential role in transforming all aspects of human activities and livelihoods. Mobile technology has

become an integral part of modern economies. GSMA reported that in 2019, mobile technology and its array of services generated an average of 9% of GDP in Africa, this amounted to around \$155 billion of economic value (Intelligence, 2019). While researchers and policymakers have constantly linked ICT and development in the developing world, particularly in SSA, other ICTs are highly localised to urban areas and the so-called 'elite' of society. As people increasingly partake in the digital economy, the revenue generated increases exponentially.

In Zimbabwe, the telecommunication industry is booming while the other economic sectors are facing a downward trend (POTRAZ, 2021). The Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) is the regulatory board of the telecommunications sector in Zimbabwe. Established in 2000, the board prescribes and governs the operations of this sector. The sector was liberalised by the government to ensure efficiency, which ensures adequate provision of telecommunication services in the country. At the time of this research, there were three main mobile operators, namely Econet, NetOne and Telecel. The other two operators, Africom and Powertel, are new to the mobile front although they are well established on the internet provision side.

The operation of this sector in Zimbabwe started during the economically turbulent years of 1996. The sector survived the economic meltdown years and today the sector is going strong. The subscriber base increased astronomically since the economy was dollarized in 2009. In the first quarter of 2020, there was a 4 % growth in mobile subscriptions to reach 13,724,522 subscribers from 13,195,902 subscribers recorded in the fourth quarter of 2019 (POTRAZ, 2021). Zimbabwe's penetration rate of mobile services was reportedly above 100%, which is above the world average of 67 mobile lines per 100 inhabitants (Potraz, 2016a; Pikirayi, 2017). Table 3.3 below shows a summary of subscriptions per mobile operator in Zimbabwe.

Table 3.3: Number of mobile phone subscribers per mobile operator

Name of Operator	Fourth Quarter 2019	First Quarter 2020	Variance
ECONET	9,117,826	9,575,796	5.0%
TELECEL	910,677	825,478	9.4%
NETONE	3,167,399	3,323,248	4.9%
TOTAL	13,195,902	13,724,522	4%

Source: POTRAZ, Operator Returns 2019

The data presented in Table 3.3 shows that Econet Wireless, the leading operator in the sector, realised an increase of 5% in its subscriber base and Net One managed a growth of 4.9%. However, the story is very different with Telecel, whose subscriber base fell by 9.4% as the operator decided to deactivate all inactive subscribers on its network. Generally, these statistics indicate the popularity of mobile technology with the Zimbabwean populace, even in such difficult times as the country finds itself, with more people being self-employed. All these mobile network operators are 100% digitalised and they offer modern services like 2G, GPRS, EDGE and 3G and are currently implementing 5G services (POTRAZ, 2020).

The telecommunication sector is the most dynamic in Zimbabwe and mobile network operators are continuously working on new strategies to outmanoeuvre each other. This requires capital investments to be injected from time to time. The 2020 POTRAZ second-quarter report shows that investment by mobile operators increased significantly. *EcoCash* currently dominates the mobile money transfer and payments in Zimbabwe and the introduction of the bank to mobile wallet transfers has led to the proliferation of mobile money transactions. The introduction of the bank to mobile wallet transfers has also contributed to the growth in mobile money transactions. As smallholder farmers are unbanked hence, they are among the key beneficiaries of mobile money payments and transfers (Levin, 2013) Mobile money became a popular and appropriate way of paying for goods and services amidst cash shortages. The transformation of the mobile telecommunication sector is vital to the Zimbabwean economy in general and smallholder farmers. Like most countries in SSA, most of the Zimbabwean populace is unbanked and consequently, mobile banking became their ultimate choice. That is why the researcher

believes that smallholder farmers can benefit greatly from the transformation and revision of policies in this sector.

3.5.1 Mobile phone device elements in Zimbabwe and applications they support

Mobile phones can be categorised into three different groups: basic phones, feature phones and smartphones (Carroll & Heiser, 2019; Khayyat & Heshmati, 2012; Mushroor et al., 2019). It is essential to understand the mobile device elements applications these devices support. Basic mobile phones, sometimes referred to as 'dumb' phones, can use voice and text-based services as well as basic embedded applications like calculators, calendars, clocks, flashlights, etc. (Choudhury et al., 2014). Feature phones are mobile phones with additional features beyond voice and text. Smartphones are the next step up from feature phones and are currently the most sophisticated mobile phones on the market (Provazza, 2020). Unlike feature phones that have only basic GPS functionality, smartphone apps can use GPS to provide users with location-specific information for whatever someone has dreamed up and developed.

They can also run *Java*-based applications (often associated with games, but also other functionalities), download audio, send multimedia content such as images and short video clips through MMS (multimedia messaging service) and typically contain an on-board camera (Beranek & Mellow, 2012). Applications are a great example of how features that exist on feature phones (such as GPS) can be applied in countless directions. They also tend to have higher-quality cameras than feature phones. In most cases, basic phones are in the majority, in most rural communities. They are usually less costly, more durable and consume less energy because they have fewer applications that run; hence, they can last for days or weeks without having to be recharged.

Table 3.4: 2020 to 2021 global phone market share statistics
 (<https://www.oberlo.com/statistics/smartphone-market-share>)

Date	Samsung	Apple	Xiaomi	Huawei	Oppo
2020-10	30.25	26.53	9.67	10.44	4.83
2020-11	30.36	28.19	9.6	10.43	4.8
2020-12	29.14	26.91	10.02	9.83	5.02
2021-01	28.97	27.47	10.04	9.72	5.03
2021-02	28.52	27.33	10.27	9.62	5.07
2021-03	28.35	27.41	10.31	9.27	5.29
2021-04	28.15	27	10.43	9.19	5.31
2021-05	27.84	26.46	10.63	8.84	5.39
2021-06	27.48	26.35	10.8	8.66	5.67
2021-07	27.33	26.92	10.94	8.19	5.54
2021-08	27.92	26.42	11.38	7.91	5.61
2021-09	27.55	26.75	11.51	7.88	5.65
2021-10	27.06	28.21	11.4	7.64	5.37

Collectively, Samsung dominates the global mobile phone market share falling from 30.25% in October 2020 to 27.06% in October 2021 (Statista, 2020). On the Zimbabwean market, statistics again show that Samsung dominates the mobile phone. Table 3.4 presents the global mobile phone handset market share; Table 3.5 shows the percentages of mobile phone handsets in the Zimbabwean market. In both tables, other brands have been omitted; however, in Table 3.5, unknown brands also appear and are shown to make a significant contribution.

Table 3.6: Zimbabwean mobile phone market share (<https://gs.statcounter.com/vendor-market-share/mobile/Zimbabwe>)

Date	Samsung	Huawei	Apple	Intel	Unknown
2020-10	39.18	16.6	9.92	7.83	7.81
2020-11	37.47	17.28	10.96	7.52	7.8
2020-12	35.85	18.16	10.6	10.31	6.45
2021-01	36.7	17.09	14.64	9.84	4.77
2021-02	36.65	18	12.55	11.01	5.14
2021-03	34.94	18.4	11.02	12.68	5.73
2021-04	34.44	18.83	11.77	12.07	5.54
2021-05	33.5	19.56	10.87	12.72	5.53
2021-06	32.7	20.21	11.05	13.26	5.8
2021-07	33.21	19.43	12.6	12.39	4.85

2021-08	34.69	19.46	11.78	11.22	5.61
2021-09	33.74	20.25	10.88	11.64	6.26
2021-10	35.79	19.77	10.95	10.71	6.03

Nevertheless, it is imperative to note that basic and feature phones are generally more prevalent in the hands of rural inhabitants, including smallholder farmers.

3.5.2 Mobile agriculture applications and services in Zimbabwe

Zimbabwe boasts several mobile agriculture applications that were designed to make the agriculture business smarter, not harder, than ever before. These farming technologies have enabled farmers to reduce costs and maximise their yields and profits. In addition, there is perhaps no better example of smart farming than the mobile app. Some of the applications are briefly discussed below.

Seedco's Agronomy app.

The Seedco Company in Zimbabwe designed Seedco's *Agronomy* app which has an array of services that are very useful to farmers. The application provides detailed information about a variety of crops' seeds, ranging from maize to soya beans. The application provides short but delayed information about different types of seeds and their benefits to farmers (Chaparadza, 2018). The application provides information on seed varieties, for example, for maize seed, there are over 10 types of seeds provided on the application, along with useful information about the optimum conditions for each type to thrive. The growers' guide is another feature which is like a library for agriculture information. The information contained there include growing procedures for various crops, a list of various pests and diseases that attack all crops, the optimal planting time and the application of fertiliser and manure. Other features include weather forecasts, as the app gives farmers weather forecasts for the next five days. On the pests and diseases feature, the app provides symptoms and the remedies for the diseases are also inscribed in this app as posited by Chaparadza, (2018).

EcoFarmer

The *EcoFarmer* mobile agriculture application platform was designed and deployed by Econet wireless and operates on the Econet mobile phone. The application was launched in 2013 as a weather-indexed insurance business. The application was launched during the US\$ era and following its launch, *EcoFarmer* empowered some farmers to insure their crops against all known drought-related risks for as little as \$2.50 per year, for \$25 worth of cover for maize (Food and Agriculture Organisation, 2018). Insured farmers also received free maize advisory tips and market information. This service was widespread among smallholder farmers in some, but not all areas. After evaluations had been conducted, areas of improvement were identified, and modifications were made to that effect. One of the features found on the platform is *EcoFarmer* SMS Advisory Tips, a subscription-based advisory service offering tips to subscribed farmers. The tips offered by the service include maize, groundnuts, tobacco, cattle, goats, bees, and sorghum. Tips for each crop are charged weekly and monthly. Farmers can choose the language of their choice. The application is very useful and offers more facilities than most applications. Its major drawback is the lock-in effect. One must be an Econet subscriber to be able to subscribe and access the service. More can be found at <https://www.ecofarmer.co.zw/about>.

There are other mobile agriculture applications that were available when this research was being carried out and this include *eMkambo*, an application offering a piece of agricultural information and knowledge through a mobile app, call centre, USSD service, Agri Fin Mobile, operated by Mercy Corps Zimbabwe and funded by Swiss Agency for Development (SDC) (Rapsomanikis, 2015). This application offers agricultural advisory services to smallholder farmers. *ESOKO* is an agricultural marketing application tool that provides farmers with market information for different products on all markets in Zimbabwe and the prices being offered, as reported by Etwire et al. (2017). The *Kurima Mari* Mobile Farming Application is a mobile application designed to assist farmers with marketing expertise and foster the sustainable development of smallholder farmers. Since *Kurima Mari* is available offline, there is no need to purchase data. The application is updated regularly by an extension officer and the changes are transferred over *Bluetooth*, making it free to the farmer (Mukeredzi, 2020). *AgriShare* is an online-based system that

allows farmers to obtain the best information for agriculture in their homes, reducing mobility expenditures.

Agro access

A credit rating system is included in this app which stores information on a farmer's access to inputs and/or financing from contractors, as well as their following harvest repayments (Mukeredzi, 2019). The system can alert contractors to any 'double-dipping' or side-marketing activities, such as when a farmer receives input from two different contractors for the same piece of land. This data is accumulated over time to construct credit profiles, which are then utilised by financial service providers and other contractors for following a farmer's actions and creditworthiness (Mukeredzi, 2019). Once enrolled, the app checks the farmers' credit to determine whether they have any outstanding debts with other contractors. The next section examines the digital divide.

3.6 THE DIGITAL DIVIDE

Visions of a global knowledge-based economy and universal electronic commerce, characterised by the 'death of distance' must be tempered by the reality that half the world's population has never made a telephone call, much less accessed the Internet. (Wyckoff & Colecchia 1999))

The above quotation indicates that the aspiration for an inclusive globalised knowledge economy is a very difficult goal to accomplish. This indicates that ICTs arrived in SSA at a later stage. As a result, most of the populace are digital immigrants and, therefore, digital illiteracy among most people is a critical contributor to the digital divide in developing countries, including Zimbabwe. While access to ICTs and the internet is increasing at a faster rate (World Economic Forum, 2018), this must not end up being limited to access and use only, but rather meaningful use if the digital divide is to be bridged. Developing countries are characterised by high unemployment rates, usually slightly above 50%, overpopulation in terms of resource-to-people ratio, poor digital infrastructure, limited availability and unaffordable ICT services, as posited by World Economic Forum, (2012). To close the inter- and intra-digital divide within a given context, there is a need to understand the factors contributing to the digital gap within that context.

Due to this development, the digital divide has since shifted the focus from not having access to technology to having meaningful access to technology (Nilsson, 2012).

The world economic forum has proclaimed that each additional 10% of internet penetration may result in a 1.2% increase in per capita GDP growth, in developing countries (World Bank, 2017). However, the mobile phone coming on board has had a huge impact on the digital divide in the developing world, as it has since become the device of choice for the poor. Therefore, there is a need to put some measures in place for meaningful access and use to happen and consequently, bridge the digital divide. Tremendous efforts have been expended in an attempt to eliminate the digital divide in the world, yet it remains in place, even in developed countries (Simpson et al., 2016). Hence, a digital divide still exists between the developed and developing countries in the world.

The digital divide is the variance in inequality between those people who have access to ICTs and/or the internet and those who don't have that access, as reported by Mwim and Kritzinger (2016). People from developed countries have more access to affordable and better ICTs and the internet than their counterparts in the developing world (UIT, 2020). For SSA, there have been concerted efforts to this divide and as a result, significant development of ICT services in the last 10 years is getting realised (Liu, 2021). Mobile phone technology is fast bridging the digital divide because it has become more than just a phone. In general, countries in the developed world are characterised as the 'haves' while the developing countries are the 'have nots'.

The next section, therefore, deliberates on factors contributing to the digital divide in Zimbabwe, a SSA country which, therefore, possesses all the traits of the region. The rapid growth of digital technology has largely reshaped people's daily lives and how business is conducted globally. Most ICTs like computers and telephone landlines are particularly expensive for most of the populations in the developing world (Dahms, 2010). Smallholder farmers are among the underprivileged in the developing world and SSA, this group constitutes most of the populace. Mobile phone technologies have become ubiquitous while fixed landline telephone services and access to the Internet are still very

much localised. SSA is one of the major beneficiaries of this development and coupled with the plummeting prices of smartphones, access to the internet is increasing quickly in the SSA region.

3.7 FACTORS CONTRIBUTING TO THE DIGITAL DIVIDE IN ZIMBABWE.

In Zimbabwe, there is a digital divide between those who not only own ICTs but can easily use these ICTs, particularly through high-tech connections, and those who don't have them and ultimately cannot use them. ICT, particularly mobile telecommunication, is now the transmitter of economic prosperity in the country. Despite the rapid growth in ICTs, particularly mobile technology, the digital divide is widespread among SSA countries. In Zimbabwe, key issues contributing to the existence of the digital divide are:

- a) ***Localisation of digital infrastructure*** Mobile telecommunication companies have tried to reduce the digital divide by bringing mobile phone technologies to the rural populace but again, they concentrate on densely populated rural areas when establishing the base stations that support their networks. The ICT infrastructure is mainly localised to urban areas and some rural areas that are generally accessible especially growth points and other hyperactive business centres. This results in more availability and accessibility of ICTs in urban areas than in rural areas. Thus, urban centres have become hubs of economic activities and urban dwellers have access to economic opportunities (Adams & Akobeng, 2021).
- b) ***Digital literacy*** Most of the population has low-level literacy skills, yet very few technologies are user-centrally designed to cater to low-literacy users (Dixon, 2012; Antonio & Tuffley, 2014). Even government sites that target poorer citizens are usually written at a level that requires a university degree to comprehend. There is a need for the government of Zimbabwe to establish measures to ensure that less literate people are also accommodated. Low literacy is the web's biggest accessibility problem, yet nobody cares about this massive user group.

- c) **Education** General education, that is, the ability to read and write is a critical requirement for the acquisition of ICTs. Even though Zimbabwe's literacy rate is comparable to none in Africa (Zimbabwe National Statistics, 2012; Tsokota, 2017) the lower percentage of literacy greatly contributes to the existence of the digital divide in the country. Therefore, it is of paramount importance that these members of the population who are illiterate are considered for educational programs.
- d) **Gender** In the developing world, gender disparities are a very topical issue (Ayanso, Cho & Lertwachara, 2014). The gender digital divide is highest in Africa because fewer women are literate and fewer women are actively working or studying; hence, they generally have smaller incomes. This situation extends to issues of the acquisition and ownership of ICT devices and in some areas, women are banned from owning or using ICTs (Mittal & Mehar, 2016). As a result, one of the most fundamental disparities amplified by the digital revolution is the gender digital divide. In a family, when a woman gives birth to a girl, they would be despised, in contrast to giving birth to a boy. Research into internet use specifically found that women in developing countries are less likely to use the internet than men (Asongu et al., 2019).
- e) **Age** In the developing world, senior citizens face the second-biggest accessibility problem after women. ICTs arrived in the developing world at a later stage and consequently, the aged are digital 'immigrants' compared to digital 'citizens' (Mwim & Kritzinger, 2016). Therefore, an age digital divide exists in Zimbabwe because the aged are 'immigrants' to the digital era and most of the elderly are illiterate and economically challenged.
- f) **Rural vs urban** The cumulative causation theory explains the development and continued existence of the digital divide (OECD, 2001; Zinnbauer, 2007). The developed and urban areas continue to develop and grow at the expense of the underdeveloped rural areas. As a result, urban areas have ICT infrastructure, while rural areas do not. This resulted in rural areas with very few investments in telecommunication infrastructure. Urban areas are the economic hubs and most businesses are located there (Hikwa, 2014). Businesses are run to make a return on

investments and do not invest in high-risk areas. It is crucial to address the issue of infrastructure differences between rural and urban areas to close the digital divide. To address the infrastructure issue, particularly mobile telecommunication infrastructure, the Government of Zimbabwe, through POTRAZ, levies 5% of telecommunication operators' profits to use for infrastructure development in sparsely populated rural remote areas (POTRAZ, 2017). The next section explores the ICT development index in Zimbabwe and its potential impact on the digital divide.

3.8 THE ICT PRICE BASKET INDEX

The International Telecommunications Union (ITU) ranked Zimbabwe as the second most vibrant country on earth in one of the three key categories that are used to measure the development of ICTs in a country (Society, 2012). In this regard, the level of ICT development is measured by the ICT Development Index (IDI), which the ITU board uses to establish the ICT readiness of a given country, the level of use of ICTs in that country and the impact of the efficient use of ICT in a country. According to Sanou (2014), the ICT Development Index (IDI) is an amalgamated index or catalogue that combines a total of 11 pointers into one gauge which serves to supervise and evaluate progress in ICTs across all countries in the world.

According to the (UIT, 2020), Zimbabwe's IDI percentage has risen over recent years, which makes it a very dynamic country in terms of ICTs. The report shows that the country made significant progress on both the access and the use of sub-indices of the IDI. It is more fascinating and essential to note that in both sub-index categories in question, it is in the mobile or wireless indicators where the most progress was consistently made. The ICT development process and a country's transformation into becoming an information society can be depicted using the three-stage model depicted below (Chanyagorn & Kungwannarongkun, 2011)

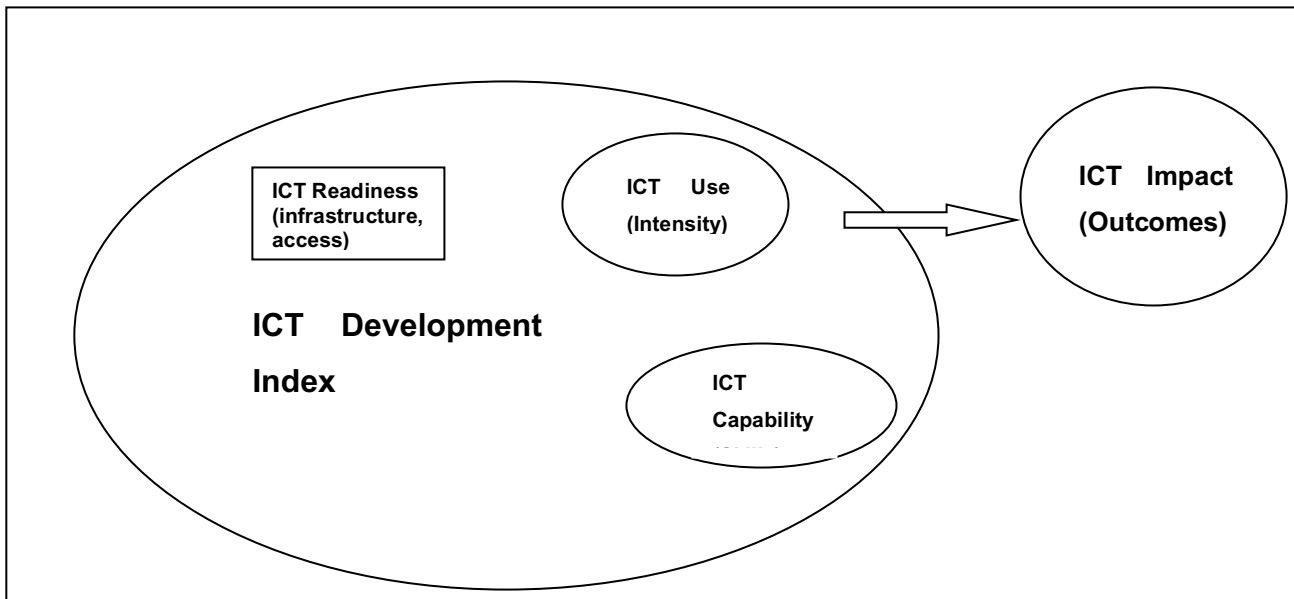


Figure 3.6: Three stages in the evolution of an information society

Given the fact that its ICT Price Basket (IPB) is very high (Mothobi, 2019). ICT Price Basket (IPB) is a unique indicator which is used to keep track of the cost and accessibility levels of ICT services across all countries, amounting to more than 160 nations worldwide (International Telecommunication Union, 2018). The IPB index examines regional differences in connection costs by measuring the costs of communicating, which entails the cost of a call per unit, evaluated as a proportion of Gross National Income (GNI), per capita (Society, 2012). Zimbabwe is classified as the most expensive country in the world to make calls and use data services (UIT, 2020). This indicates the need for policymakers to act on this issue.

3.9 CHAPTER SUMMARY

The chapter provided a background account of the research and outlined the context of the study in Zimbabwe, as well as the sites of the study and characterises the study site of Gokwe South, Mbare farmers' market and Kombayi farmers' market. The chapter went on to look at the human development index and the digital divide and how they impact potential development. The next chapter, (Chapter Four) presents the research methodology guiding this research.

CHAPTER FOUR: RESEARCH METHODOLOGY AND DESIGN

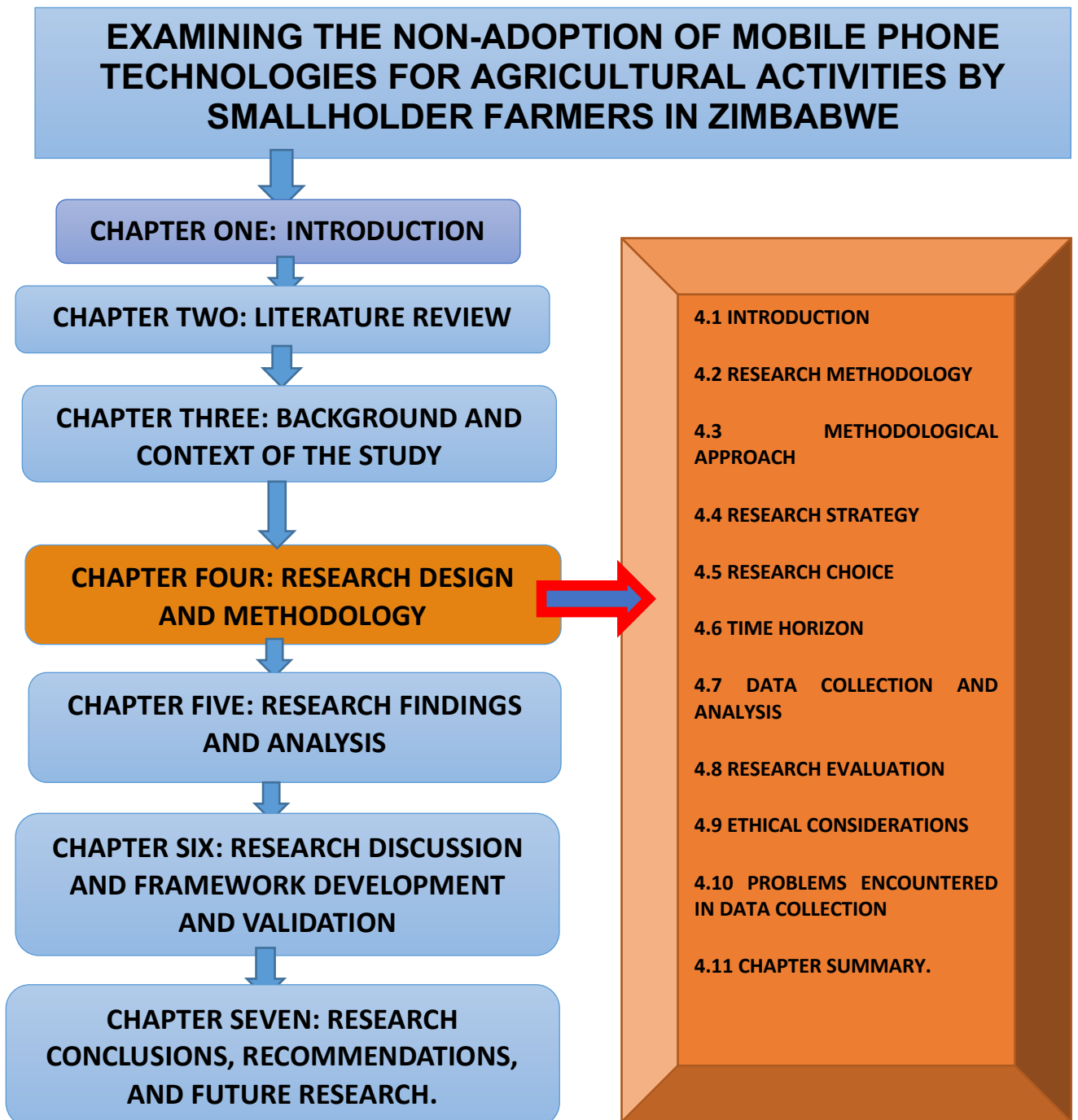


Figure 4.1: Thesis and Chapter Three navigation map (author's construction)

4.1 RESEARCH METHODOLOGY

Qualitative research design uses naturalistic paradigms that help understand phenomena in context-specific settings such as real-world settings (Smyth, 2011). In this context, the researcher must not attempt to manipulate the phenomenon of interest under investigation (Patton & Cochran, 2002). This paradigm aims to understand how people in everyday settings create meaning and interpret events in their world (Wimmer & Dominic, 1997). Marshall and Rossman (1989) suggest that this entails immersion in the everyday life of the setting chosen for the study; the researcher enters the participants' world and, through interaction, seeks to understand the participants' perspectives and meanings. This study utilised a qualitative and exploratory research design and is guided by the onion framework designed by Saunders et al. (2019). The researcher chose this design because it enables a researcher to identify, describe and explain all the stages the research process must pass through when formulating an effective research methodology correctly and systematically.

The framework is like an onion with layers; these layers must be 'peeled off' until the centre is reached (See Figure 4.2). The first, outer layer covers the philosophy which the researcher ought to identify correctly to undergird the research. The next layer explores the research approach to be used and again, this must be consistent with the philosophical perspective of the study (Future People, 2014). The third layer covers the research strategies to be employed and these must be correctly aligned with the philosophy and research approaches. The fourth layer considers time horizon and choice while the fifth layer addresses data collection methods. According to Walsham (1995), the interpretivist philosophy is the lens through which qualitative methods are employed most commonly.

Therefore, this researcher found it fit to construct this research design on qualitative grounds, as prescribed by the interpretive philosophical perspective. Although the genesis of qualitative research methods is in the social sciences (Creswell et al., 2014), the information systems field is diverse and cuts across several disciplines, as explained by Kroeze and Van Zyl (2014). The diversity of disciplines espoused under information

systems has resulted in equally diverse research methods being applied in information systems research (Nguyen, 2015). That is why the qualitative research methods are relevant in this case scenario since the researcher is investigating the social, economic and cultural phenomena characterising smallholder farmers and mobile phone technologies in Zimbabwe.

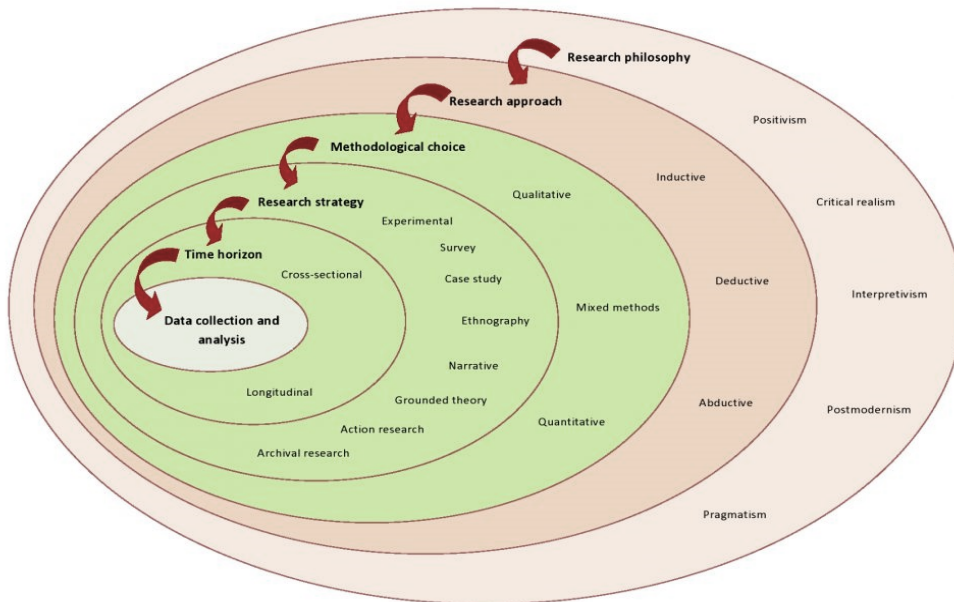


Figure 4.2: The research onion: Source (Saunders et al., 2019)

The researcher chose qualitative research over quantitative research because humans are different from the natural world owing to their ability to talk; therefore, they can express their feelings and perceptions and provide reasons for doing something (Gray, 2012; Guba, 1981). Whenever textual data are quantified, the aim of comprehending specific phenomena from the viewpoint of the research participants and their distinctive social and institutional environment may be lost (Hong & Lang, 1988; Merriam, 2002). This researcher engaged the research subjects in their natural settings and elicited their views on the subject of mobile technology adoption and its continual use in their everyday farming activities in line with Hunt (1989). In qualitative research, meanings are a product of time and context, and research should be a collaborative process between the researcher and the subjects (Lincoln & Guba, 1988a).

No single definition encompasses all qualitative research, mainly because it is a field of inquiry concerned with many interrelated complex terms and concepts (Patton & Cochran, 2002; Spencer et al., 2003). The generally accepted basic definition close to describing qualitative research can be summed as 'it is research that generate non-numerical data based on an interpretive philosophy'. Such research intends to gather in-depth knowledge of human behaviour and thought through enquiry and exposition of the reasons for a particular human phenomenon (Given, 2008b; Press, 2011). Qualitative researchers should choose numerous approaches and procedures to achieve their aims (Mack et al., 2005; Merriam, 2002). The premise of this research is smallholder farmers' perceptions of mobile technology usage and its implications for their agriculture activities. The study examined these perceptions and discovered suitable influencing factors in the Zimbabwean context.

Research methodology should be correctly aligned with the research title, the overall objectives of the study and the research questions (Saunders et al., 2009a; Willies, 2007). Qualitative research methods are understood to get closer to research participants' perspectives, due to their detailed data collection methods (Charmaz & Henwood, 2007; Patton & Cochran, 2002). Qualitative data collection methods enable the collection of rich descriptions, which are particularly valuable when little is known about a topic (Lincoln & Guba, 1988b). This culminates in the evolution of unrestricted data rather than being constrained or predetermined by more specific enquiry (Richards & Morse, 2006). Qualitative research inherently allows for all participants to have an individually situated milieu which influences the individual's subjective world and perspective (Fernández, 2004). Therefore, qualitative research had a better chance to enable this research to be conducted in an environment that enables the eliciting of valuable information, which this work sought to establish. The next sections focus on the sub-sections in detail, starting with the philosophical stance guiding this research.

4.2 RESEARCH PHILOSOPHY

All research should be based on specific deep-seated philosophical assumptions regarding what characterises valid research and consequently, this guides the research methods that are suitable for that research. According to Hong and Lang (1988), research enquiries are informed, either consciously or unconsciously, by the philosophical assumptions of the researcher. According to Lincoln and Guba (1988b), what constitutes evidence, and therefore, what justifies it, is the result not only of what questions are posed but also of the framework within which they are posed. Many philosophical perspectives expound on what constitutes knowledge and how it should be acquired. These perspectives vary from each other in their guidance to research and include realism, pragmatism, positivism and interpretivism, among others. This research is viewed through the interpretive lens, as suggested by Walsham (2006).

4.2.1 Chosen philosophy: Interpretivism

The Interpretivist research philosophy is a well-renowned and tailored research paradigm for qualitative research (Kroeze, 2012; Williams, 2000). Interpretivism is one of the paradigms most frequently used in information systems research in contemporary global research investigating social phenomena (Walsham, 1995, 2006; Willies, 2007). The philosophy underpins how a researcher interacts with the research respondents in creating novel concepts resulting from the research process (Goldkuhl, 2012; Hussey, 2007). Under this perspective, the researcher's mind serves as the best tool for data analysis and can be enhanced by the ideas of others when work and concepts are presented to them (Williams, 2000).

The interpretivist genesis is found in Spinoza (1911). It is also linked to Weber's *Verstehen* (Gann & Ph, 2017) which means understanding something within its context (Merriam, 2002). The proponents of the interpretivist philosophy (Denzin & Lincoln, 2011; Hussey, 2007) agree on the purpose of understanding the multifaceted world of lived knowledge from the perspective of the people who live it (Yin, 1987). Interpretive philosophy was chosen because of its suitability for this kind of research where the

researcher seeks to understand (Hunt, 1989) the aspects impacting the acceptance, adoption and ultimate, usage of mobile phone technology by smallholder farmers and the implications on agriculture activities from the farmers' perspectives.

Table 4.1: Interpretivist assumptions concerning this research

Assumptions	Description	This study intends to;
Research purpose	Understand and interpret social structures and the meaning people give to the phenomena.	Understand the meanings that social actors (the smallholder farmers and agricultural extension officers) have on the use of mobile phones to support the development of smallholder agriculture in Zimbabwe.
The nature of reality (ontological position)	Reality is subjective; thus, there are multiple realities and hence, there are different constructs, as perceived by participants in the study.	Use quotes and themes in the words of the research of smallholder farmers and agricultural extension officers to present evidence from different perspectives.
Nature of knowledge (how knowledge is acquired and accumulated) (epistemological position)	The researcher is a participant-observer, is contacting the research subjects.	Collaborate with smallholder farmers and agricultural extension officers in an interactive process involving listening, talking, reading and writing.
Methodology (the research process)	The researcher uses inductive reasoning to provide rich data for theory building.	Describe the context of the study in detail, concentrating on particulars before making generalisations.

Source: Adapted from Chang (20011).

This paradigm is relevant where the researcher focuses on the emic perspective (Merriam, 2002). An emic perspective is an approach to research which focuses on the phenomena from an inside perspective (Meihami & Razmjoo, 2016). Five different sub-branches emanate from the interpretivist paradigm and these include symbolic interactionism, phenomenology, realism, hermeneutics and naturalistic inquiry (Ponelis, 2015). While all these forms of approach are relevant, in this work, this research gives primacy naturalistic enquiry.

4.2.2 Naturalistic enquiry

The roots of naturalistic enquiry can be traced to the fieldwork of Junkers in 1960 (Athens, 2010a). Therefore, this approach is more about fieldwork and doing this type of research requires the researcher to spend a substantial amount of time in the field with the research subjects to be able to observe the phenomena. Participants must be found and observed

in their local settings in a manner that is acceptable to them while allowing for close observation of specific aspects of their behaviour (Myers, 2013).

This researcher observed smallholder farmers in their marketplace at Mbare agriculture marketplace in Harare and Kombayi agriculture marketplace in Gweru as well as in Chief Njelele's area (Gokwe District) where smallholder agriculture is very active. The actual data collection commenced on the 1st of July 2019 and went on until November 2019 and the researcher went on to visit the area for clarification of some issues with participants until 2021, because the grounded approach required the researcher to spend a substantial amount of time in the field to understand phenomena until they reached a point of saturation. Naturalistic enquiry is premised on the supposition that phenomena ought to be studied in their normal settings (Denzin, 1971). This type of enquiry endeavours to be 'real' to the nature of the phenomena under study (Hunt, 1989; Lincoln, 1985) so as "to tell it like it is" (Rai et al., 2010). It encompasses issues around the way people are portrayed and represented and these should be fair, accurate and reasonable (Mack et al., 2005).

This researcher observed and upheld these values, and therefore, respects and truly represents the smallholder farmers in an as truthful, respectable, and responsible manner. The naturalistic enquiry approach attempts very much to be as close as possible to the language, meanings, thoughts, activities and contexts of the research subjects (De'et al, 2018; Valentine et al., 2010) and to depict them in ways that are relatable to them so that others might comprehend them (Van Zyl, 2013). The researcher is conversant in two languages, English and Shona, which are more dominant among Zimbabweans. Ndebele is another language used in many conversations; hence, the researcher enlisted the services of a research assistant who is fluent in English and Ndebele. Although the researcher did not initially prioritise other languages, he entered the field with an open approach to cases where a participant is not conversant in any of the three languages above whereby the researcher would make use of community gatekeepers in the research areas. However, this researcher engaged the smallholder farmers in English and Shona, depending on the participant's choice, some even mixed

English and Shona. However, not one farmer attempted to use Ndebele or any other language other than English and Shona. Naturalism behaviourism means:

The studied commitment to actively enter the worlds of native people and render those worlds understandable from a standpoint of a theory that is grounded in the behaviours, behaviours, languages, definitions, attitudes, and feelings of those studied. (Lewin & Somekh, 2011, p.132.)

Naturalistic enquirers reflect on themselves and others, and their behaviour in the interaction process and those are the central pieces of data (Athens, 2010). The naturalistic paradigm views realities as multifaceted, fashioned in different ways and holistic, and views the knower and the known as mutually interacting and integral to the process (Guba, 1981). It proffers the idea that social research should be conducted in the real world, as opposed to a lab or other artificially created environment (Sharma, 2022). Naturalistic enquiry takes several forms: the case study approach (Yin, 1987), the comparative research approach (Strauss, 1987), the retrospective interview approach (Valenzuela & Shrivastava, 2002), the longitudinal study approach (Elliott & Timulak, 2005), the ethnographic approach (Baskerville & Myers, 2015), the grounded theory approach (Glaser, 2016; LaRossa, 2005), phenomenological approach (Butler, 1998; Davidsen, 2013) and the biographical approach. Although there are overlaps among these approaches, this researcher used a case study approach fused with the grounded approach for this study to make what is known as a progressive case study the two are explained in detail under the research strategy.

4.3 METHODOLOGICAL APPROACH

This study employs an inductive approach because it offers a straightforward and logical set of actions that could be used for analysing qualitative data and could produce reliable and valid findings from the research. The approach was chosen because it is associated with qualitative methods of data collection; as such, this research is premised on qualitative research.

[An] Inductive research approach commences with detailed observations of the world, and then moves towards more abstract generalisations and ideas at the end. (Neuman, 2003 p. 51)

A qualitative approach was chosen to understand the perceptions (Mbele-Sibotshiwe, 2014; Pickens, 2005) of smallholder farmers towards mobile phones, to evaluate the decision-making process involved in the acquisition and continual usage of mobile phones (Harden et al., 2018; Nunkoo, 2016) by smallholder farmers in their agricultural activities, using the constructed conceptual model. A qualitative approach is mainly linked to an inductive approach to theory generation (Boyatzis, 1998; Thomas, 2003), supported by interpretivism, which acknowledges the existence of multiple realities (Kroeze, 2012; Williams, 2000) from research subjects and knowledge construction (Goldkuhl, 2012). Thus, one could argue that a qualitative research approach is based on observations, in-depth interviews and focus group discussions (Woods, 2011) taken from the real world to meet the research requirements. The researcher observed and interviewed the research participants (smallholder farmers at the Mbare Musika market and Kombayi and Kudzanayi markets) for the pilot study and the main research in Chief Njelele's area (Gokwe district) and agricultural extension officers based in Ward 15 of Gokwe district in Zimbabwe.

4.4 RESEARCH STRATEGY

A research strategy is the common guide that enables the researcher to address the research questions meticulously (Boeije, 2009; Bryman, 2009). The research strategies employed in this research are the case study approach and grounded theory approach.

4.4.1 Case study

According to Bryman (2009); Fernández (2004) and Yin (2009), a case study is research that involves the assessment of a single unit to establish its key characteristics and be able to draw generalisations from the study. A case study can offer insight into the smallholder farmers' activities and their general use of mobile phones and establish the significance of geographical context and precise differences between cases. The researcher aimed to learn about the perceptions and decision-making processes underlying the adoption and usage of mobile phone technologies by smallholder farmers in Zimbabwe's Gokwe South District and evaluate the productivity of mobile phone

technology-supported agriculture. This is why case study research was useful in this study.

Unit of analysis

The unit of analysis is the entity that should be analysed when conducting case study research (Salkind, 2018). It is the 'what' or 'who' (Dul & Hak, 2008) that is being studied in any case study research project; the typical units of analysis (in order of prevalence) include individuals, groups, social organisations and social artefacts (Yin, 2009). Consequently, this researcher understands that a unit of analysis might be an individual and the case study might be the life history of that person. It is imperative to explain the unit of analysis that the researcher used and this is interconnected with the research questions of the study (Yin, 2009). According to Woodside (2010) and Yin (2013), there are three units of analysis in case study research: a holistic single case, an embedded single case with multiple units of analysis, multiple cases with multiple units of analysis or multiple cases with one unit of analysis. This is illustrated in Figure 4.3.

In this research, the main unit of analysis is the smallholder farmers in each village in the Gokwe South District in Zimbabwe. This research involves many smallholder farmers; hence, it involves multiple cases. In these case studies, there is a need to provide a well-informed description of every single case and its themes (Yazan, 2015). According to Yin (2011), this process is referred to as 'the within-case' analysis and in this case analysis type, a researcher analyses data from the selected smallholder farmers in the five villages in Ward 15 in Gokwe South to derive individual case site-specific themes.

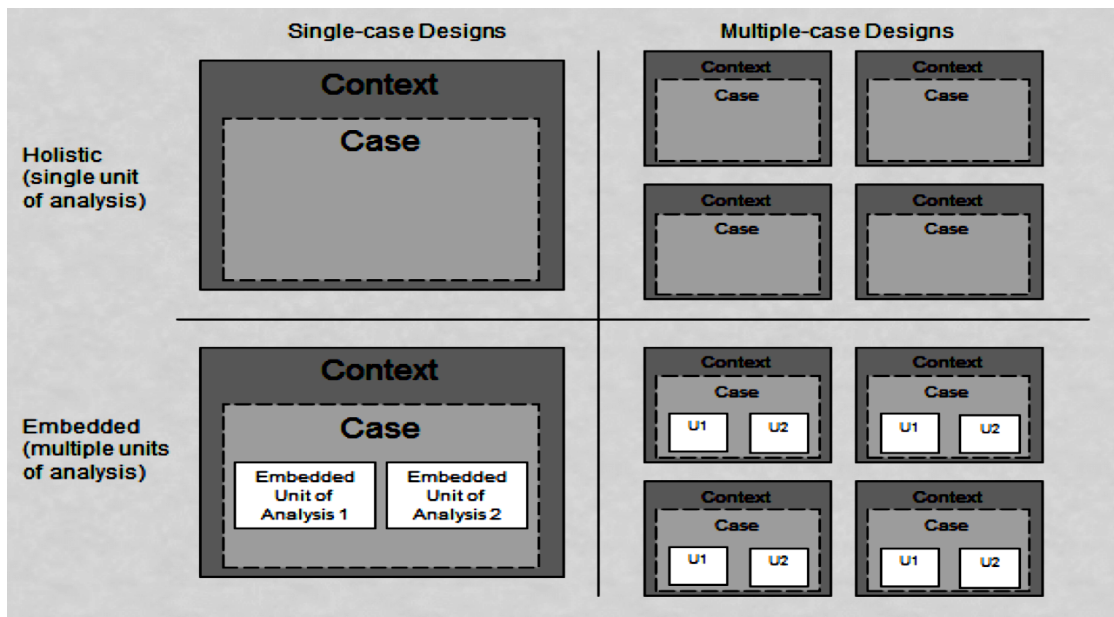


Figure 4.3: Types of case study designs (Yin, 2013)

Conversely, cross-case analysis is appropriate for a collective case, when a researcher wants to scrutinise multiple cases to form global themes (Stake, 1995). Global themes across all cases are inspected to establish the themes that are prevalent in all cases. In holistic case analysis, the researcher assesses the entire case and then presents themes, interpretations and descriptions that are related to the whole case (Sedgwick, 2014). The holistic case analysis approach is used when there is a need to improve the trustworthiness or generalisability of a study where it is difficult to have multiple units of analysis (Stake, 1995). This researcher employed a multiple case data analysis to obtain detailed information on each smallholder household unit. The reason for utilising multiple case studies in the research is that it enables the generalisation of data across cases (Almqvist et al., 2011). The data collected from interviews and focus group discussions were analysed separately. Cross-case analysis was conducted to compare each smallholder family to make comparisons between cases. The researcher briefly provides insight into the grounded approach in the next section.

4.4.2 Grounded approach

Presently, the grounded approach is the most dominant paradigm for qualitative research in social sciences (Charmaz & Henwood, 2007). It involves the transcription and coding

of the interview data, after which the data are classified according to the common factors exhibited by respondents. According to Fernández (2004), the grounded research technique is a qualitative methodology that relies on an inductive approach in which patterns are discovered in the data before a study commences. The researcher in the current study believes that the strategies employed enabled the collection of rich data, which is adequate for satisfying the requirements of the current research.

4.4.3 The progressive case study approach

Different existing approaches to case study research include the grounded theory approach, which advocates for very minimal if any, prior literature survey in the relevant field under study (Glaser & Strauss, 1967; Eisenhardt, 1989; Yin et al., 1989). This approach promotes a more directed study with *a priori* conceptions. Even though case study research has historically adhered to the positivist school of natural sciences model of developing hypotheses from underlying theory and their ensuing confirmation or rebuttal in controlled studies, it (case study research) is indeed frequently understood as a regulated, field experimentation approach. However, the grounded theory perspective is not well categorised because while it has positivist origins, it also reflects a naturalistic approach to ethnographical research and interpretation (Steenhuis & De Bruijn, 2006). In so doing, the theory stresses the use of observations and open-ended interviewing, as well as the use of sensitising notions and an inductive approach to theorising that can be both substantive and formal (Denzin, 1994).

Despite these disparities, it is possible to fuse the two approaches (grounded theory and case study) to create case study research that can closely mimic the standards of "good [case study] practices", following and implementing the tenets of Yin et al. (1989) by employing the grounded theory technique in case study research. The researcher acknowledges the existence of these two contrasting approaches to case study research. In this understanding, the research employs the progressive case study approach proposed by Steenhuis and De Bruijn (2006). This strategy blends the best elements of both approaches, including the informative component of grounded theory and Eisenhardt (1989) and Yin et al. (1989) more structured strategy.

4.5 CHOICES

The research onion identified three (3) choices that are available for use in research (Saunders et al., 2009a). These choices are the mono method, mixed method and multi-method (Turnbull & Lathlean, 2015). These procedures' nomenclatures are self-explanatory. In contrast to the mono-method research technique, which employs a single methodology throughout the study, the mixed-methods research approach typically (but not always) permits the use of two or more methodologies and includes both qualitative and quantitative procedures (Boeije, 2009). The multi-method is a research approach in which a wider selection of methods is used (Esteves & Pastor, 2003). This research did not use the multi-method but employed three qualitative data collection methods, namely a focus group discussion, interviews, and observation, and triangulated them. However, the focus of the enquiry is on the smallholder farmer.

4.6 TIME HORIZONS

A 'snapshot' time collection was chosen for this work (Chepken et al., 2012; Glaser, 2013). Although this is called a snapshot, qualitative research is highly contextual and data collection is done in a natural (real) setting for a considerable period (Smyth, 2016). This study goes beyond providing a snapshot. This was preferred because of its suitability in this research because it is concerned with the study of a particular phenomenon at a specific point in time. In this case, this study is concerned with the investigation of the perceptions and decision-making processes concerning mobile phone adoption and continual use by smallholder farmers. Agriculture extension officers (Agritex) play a significant role in smallholder agricultural activities in Zimbabwe. The findings can have lasting ramifications on the smallholder agriculture landscape in Zimbabwe and probably also in sub-Saharan Africa and the rest of the developing world. The timeframe for data collection spanned from July to November 2019.

4.7 DATA COLLECTION AND ANALYSIS

This research was done intensively as stipulated by Wolcott (1995, p 67). It required a monumental amount of time in the research field for the researcher to become familiar with the setting, collect data and understand what factors are considered as vital by the

smallholder farmers when deciding to acquire mobile phones, their value to people and how they are using them. Primary data are the principal data of any research and, therefore, should best be understood as data that are directly analysed in this research, not through the perspective of another viewpoint (Churi et al., 2012). The researcher followed smallholder farmers during their farming activities and agriculture extension officers doing their fieldwork of farmer supervision.

The nature of this research demanded empathy with the research subjects by the researcher. Naturalistic enquiry requires that the researcher theorises with research subjects rather than about them (Lincoln, 1985; Stake, 1995). Hence, this researcher engaged smallholder farmers and agriculture extension officers in their settings and tried to understand them within their context and hear them relate their own stories. How data is collected and analysed is critical to the successful conclusion of naturalistic enquiry research. This researcher has published several research articles and attended and presented research papers at various international conferences. The researcher was also under the guidance of two experienced researchers in qualitative research. This research followed a qualitative explanatory research design (Mitchell, 2014). The study narrates, interprets, reflects and explains the experiences of smallholder farmers in Zimbabwe and those of the agricultural extension officers. Thus, the researcher used a case study approach and grounded approach together, known as a progressive case study approach (See Section 4.4.3).

The research is two-dimensional because it has two purposes. The study addresses the primary objective, i.e., to reach a better understanding of why smallholder farmers in Zimbabwe are not adopting mobile phone technology even though they (the farmers) successfully use the technology in general day-to-day activities. Thereafter, the research proceeds to address the secondary aim. The secondary goal of the research is to devise an ideal framework for the application of mobile devices in agriculture to promote sustainable growth. The nuances produced by the outcomes of the literature review analysis and empirical data will serve as the foundation for this framework. According to

Verbrugge (2016), a framework is an abstract structure or summarised system created with the express intention of achieving a given objective.

4.7.1 Samples

In research terminology, a sample is a fraction of a larger population which possesses characteristics that resemble the whole population that it represents (Bryman, 2009; Gray, 2012). The sample size and how it is selected can be used to establish the reliability and validity of the results of a study in quantitative research. Therefore, how a researcher goes about selecting the population is critical. This research is qualitative in nature and uses purposeful strategies ahead of procedural rules and enquiry approaches ahead of statistical formulas. Accordingly, there are no rules for sample size in qualitative enquiry (Creswell, 2003; Patton & Cochran, 2002). The sample characteristics are important in qualitative research, although much smaller samples are typically used until data saturation is attained.

4.7.2 Sample size

As alluded to above the sample size is less important and the concepts of representativeness and generalisability are not strong requirements for the research to be validated (Compeau et al., 2012; Creswell, 2003). The sample size in qualitative research generally depends on what is supposed to be known, the purpose of conducting the investigation, what is at stake, what is credible and the availability of time and resources (Baqir & Palvia, 2009). A pilot study was conducted in Phase One of the research in which five (5) smallholder farmers were interviewed: two (2) were at Mbare Musika, two (2) at Kombayi and one (1) at Gokwe Musika. This helped the researcher to gauge what to expect in the main study, as well as to calibrate the research interview guide.

The researcher chose to interview thirty (30) smallholder farmers who had been purposively sampled and three (3) agricultural extension officers who work in Ward 15 and conducted one (1) focus group discussion with twelve (12) participants. This follows over twenty-nine (29) days of observation conducted at the Mbare farmers' market in Harare city and the Kombayi farmers' market in Gweru city Zimbabwe. The observations

commenced on the 10th of July 2019. The actual interviewing occurred as follows: Mbare in Harare on the 8th of August 2019, Kombayi in Gweru on the 12th and 13th of August 2019, while the interview in Gokwe centre was conducted on the 15th of August 2019. The researcher then made numerous visits to Gokwe engaging with the stakeholders like headmen, agreeing with officers and other stakeholders of interest on the appropriate day to conduct the focus group discussion. Finally, the focus group discussion took place on the 26th of September 2019. The researcher then analysed the FGD data to attempt to make sense of the participants' input. The details of the data collection roadmap are given in Table 4.2.

Table 4.2: Data collection roadmap

	Data collection form	Venue	Start day	End day
1	Observation	Kombayi	10 July 2019	20 July 2019
2	Observation	Mbare	25 July 2019	05 August 2019
3	Pilot study interviews	Mbare	08 August 2019	08 August 2019
4	Pilot study interviews	Kombayi	12 August 2019	13 August 2019
5	Pilot study interviews	Gokwe	15 August 2019	15 August 2019
6	Visits to Gokwe to meet key stakeholders	Gokwe	16 August 2019	15 September 2019
7	Focus group discussion	Gokwe	26 September 2019	26 September 2019
8	Observations and main interviews (Mutanhaurwa village)	Gokwe	26 September 2019	03 October 2019
	Observations and main interviews (Nyamazana village)	Gokwe	07 October 2019	10 October 2019
	Observations and main interviews (Mutoranhema village)	Gokwe	14 October 2019	21 October 2019
	Observations and main interviews (Mashove village)	Gokwe	25 October 2019	29 October 2019
	Observations and main interviews (Dzawanda village)	Gokwe	05 November 2019	9 November 2019

4.7.4 Sampling techniques

Many sampling techniques can be employed for conducting research. Purposive sampling and snowballing were employed in this research. Purposive sampling was chosen because it enables a researcher to choose cases with copious information for in-

depth analysis (Patton & Cochran, 2002). Information-rich cases enable a researcher to discover a great deal about matters that are essential to the purpose of the research, hence the term purposive sampling (Arsal, 2008). The snowball technique was then employed where the purposively selected subjects were further used to identify other participants. The researcher sought for smallholder farmers who at least owned a mobile phone.

4.7.4 Data analysis

After completion of data collection, data is then analysed.

Data analysis is the process of bringing order, structure, and meaning to the mass of collected data. It is a mess, ambiguous, time-consuming, creative, and fascinating process. It does not proceed linearly; it is not neat. Qualitative data analysis is a search for general statements about relationships among categories of data. (Marshall & Rossman, 1989, p. 111)

According to Flick (2014. p. 370), the analysis of qualitative research data seeks to uncover and depict the big picture:

Qualitative data analysis is the interpretation and classification of linguistic (or visual) material with the following aims: to make statements about implicit and explicit dimensions and structures of meaning-making in the material and what is represented in it. Meaning-making can refer to subjective or social meanings. Often qualitative data analysis combines rough analysis of the material (overviews, condensation, summaries) with detailed analysis (development of categories or hermeneutic interpretations). Often the final aim is to arrive at statements that can be generalised in one way or the other by comparing various materials or various texts or several cases. (Flick, 2014. p. 370)

Although there are no specific rules that must be followed, a fundamental understanding of the basic processes is critical to arriving at meaningful understandable knowledge correctly. The knowledge of the researcher becomes critical in this process. There are three orientations of qualitative data; the first is to describe a phenomenon (Mislove et al., 2007). With this approach, the researcher observes the subjective experiences of research subjects [the smallholder farmers] in Zimbabwe, specifically in Gokwe of mobile phone use in their everyday agricultural activities. This orientation also focuses on making comparisons of the differences and similarities between individuals and groups.

In this study, the research can explain differences in the decision-making processes and perceptions of smallholder farmers who are using mobile phones and those who are not, as well as the differences in use and success among those smallholder farmers who are using mobile phones in their everyday agriculture activities. Lastly, qualitative data aim to construct a theory of the lived experiences of the participants in the current study by examining empirical material (Flick, 2014). The researcher will commence this analysis by transcribing data from audio and video recordings into text. After all the data had been transcribed, the researcher embarked on coding and thematic analysis.

The researcher used three data collection methods, i.e., video and audio recordings and the researcher's field notes. There are two approaches to the analysis of video and audio data, one of which is transcript-based analysis, which generates volumes and volumes of pages. According to Krueger and Casey (2000) and Onwuegbuzie (2009), one focus group discussion recording can generate about 50 to 70 pages of text data (Millward, 2012; Rabiee, 2004). The second approach is called tape-based analysis. This approach requires the researcher to listen to the audio recordings carefully or watch and listen to the video recordings. Thereafter, based on their understanding, the researcher creates an abridged version of the transcript (Onwuegbuzie, 2009). With this approach, the researcher focuses on the objectives of conducting the research through the research questions that must be responded to, after which only the portions that assist in a better understanding of the phenomena in question are transcribed (Onwuegbuzie, 2009). The research involved conducting 30 interviews and a focus group discussion, which collectively, generated volumes of video and audio recordings. The researcher opted for a recording-based analysis approach. The researcher will keep the recordings for five years to comply with best practices for handling research data material. The unit of analysis was both individuals and groups of smallholder farmers and agriculture extension officers.

The researcher also utilised the constant comparison analysis (CCA) technique to analyse data. The texts generated from the interviews and a focus group discussion through the transcription process constituted the basis for the analysis process used to

interpret the data and reconstruct the perspectives of the smallholder farmers, agricultural extension services officers and other key stakeholders in the agricultural value chains. Deconstructing and connecting concepts, codes and themes were the two activities that constituted the data analysis process. Both components are essential and maintain equilibrium for one another, as posited by Boeije (2002). Deconstruction focuses on an individual organising process germane to the research questions and highlights the distinct themes that emerge during the interview (Fram, 2013). The fragmenting procedure removes the coded fragments from either the focus group discussion or the interviews' overall contexts.

The CCA technique was initially used in grounded theory; it can be applied to analysing many types of qualitative data, as suggested by Halabia (2013). There are three main steps in the CCA technique. The first step is called open coding, during which data items are grouped into small units; the researcher attaches a description to every unit. Thereafter, the second step, axial coding, commences, during which the units are organised into sub-categories. The third and final step is selective coding, during which the researcher develops themes representing the content of each category of code (Onwuegbuzie, 2009). The following is an extract from Boeije (2002, p. 94):

By comparing, the researcher can do what is necessary to develop a theory more or less inductively, namely categorizing, coding, delineating categories and connecting them. Constant comparison goes hand-in-hand with theoretical sampling. This principle implies that the researcher decides what data will be gathered next and where to find them based on provisional theoretical ideas. In this way it is possible to answer questions that have arisen from the analysis of and reflection on previous data. Such questions concern interpretations of phenomena as well as boundaries of categories, assigning segments or finding relations between categories. The data in hand are then analysed again and compared with the new data. The units should be chosen with great care and in a way that enables questions, new or otherwise, to be answered efficiently and effectively, thereby allowing the process of analysis and in particular the comparative process to progress. The cycle of comparison and reflection on 'old' and 'new' material can be repeated several times. It is only when new cases do not bring any new information to light that categories can be described as saturated. Boeije (2002, p. 94)

The quotation above explains that the processes of data collection and data analysis are somewhat intertwined as the analysis of data collected first can influence the subsequent data collection and so on. For this reason, Figure 4.4 represents a diagrammatic illustration of CCA.

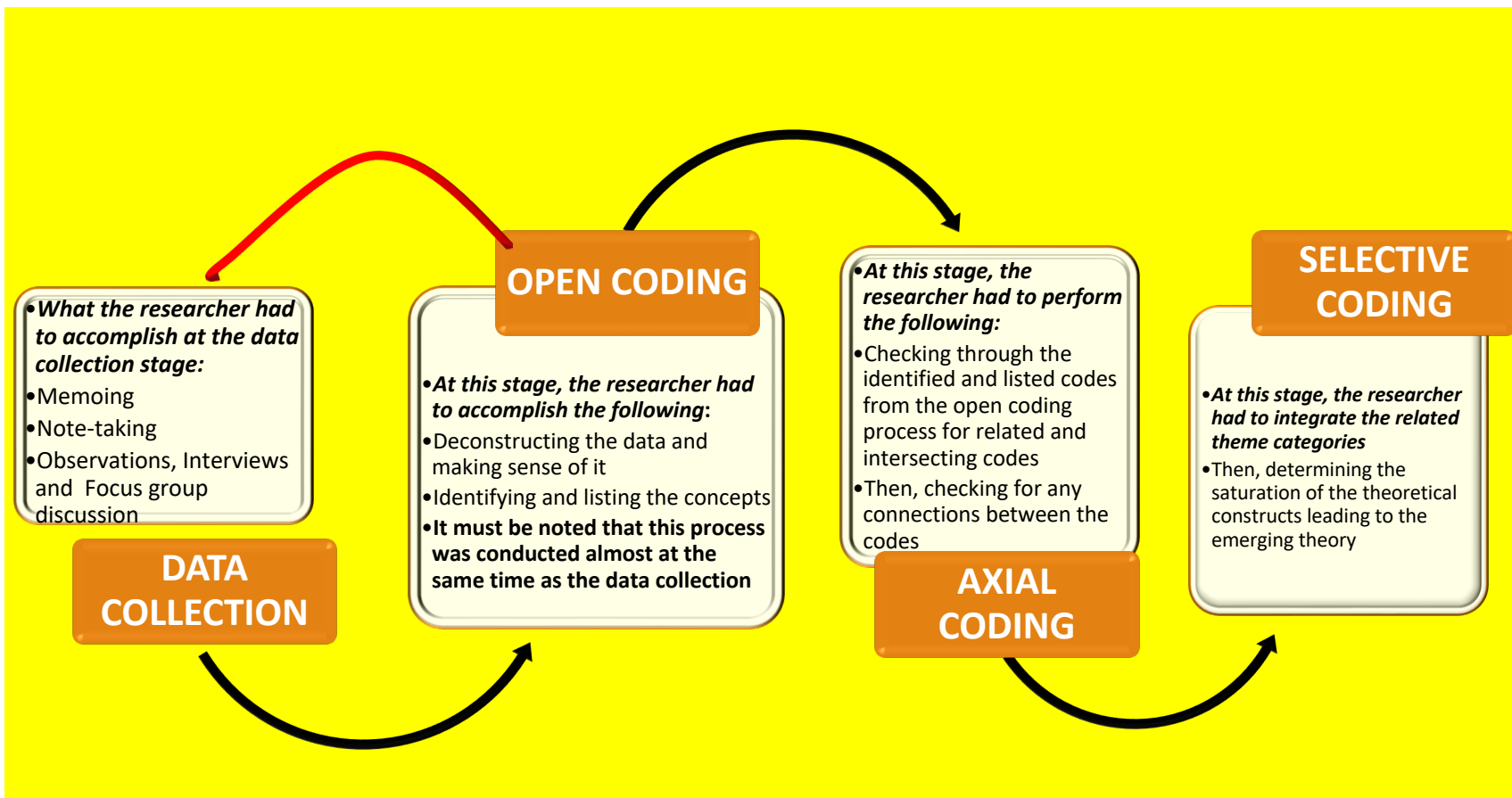


Figure 4.4: Illustrating the data collection process and the constant comparison analysis process (author's construction)

4.8 RESEARCH EVALUATION

This research is qualitative and by its nature, qualitative research is premised on subjective, interpretive and contextual data. As a result, the findings of qualitative research are more likely to be scrutinised and questioned (Leung, 2015). Consequently, qualitative researchers must take the necessary steps to ensure the reliability and validity of their research findings (Alhojailan & Ibrahim, 2012). The researcher must ensure that the findings are believable, consistent, applicable and credible if they are to be useful to readers, policymakers and other researchers (Anney, 2014). Interpretive research must satisfy the seven ideologies for conducting interpretive field research (Klein & Myers, 1999). See Table 4.3 for these details.

Qualitative research has gained popularity in the past two decades (Golafshani, 2003; Halabia, 2013; Thomas, 2017). As a result, much time has been devoted to reviewing ways to judge the reliability and validity of qualitative research findings (Cypress, 2017; Noble & Smith, 2015). Anney (2014) briefly defines validity as the degree to which a measure reveals a characteristic of interest, while reliability is the consistency with which a measure produces the same results with similar populations. Validity is crucial for effective research as invalid research is worthless (Guha, 2005; Zohrabi, 2013). The researcher addresses these two concepts in detail in the next sections.

4.8.1 *Reliability of Data*

Trustworthiness is a measure that ensures quality in qualitative research (Anney, 2014; Guba, 1981). Lincoln and Guba (1988a) opine that the trustworthiness of a research study is central to evaluating its substance. According to Shenton, (2004), trustworthiness consists of four dimensions:

- a) **Credibility** - confidence in the 'truth' of the findings.
- b) **Transferability** - the findings can be applied to other contexts.
- c) **Dependability** - the findings are consistent and could be repeated.

- d) **Confirmability** - the degree of neutrality or the extent to which the findings of a study are shaped by the respondents and not researcher bias, motivation or interest.

Credibility

Credibility is mainly concerned with the internal validity of research, how realistic its findings will be (Noble & Smith, 2015). Internal validity refers to the believability and trustworthiness of the research findings; this depends more on the richness of the data than on the quantity of the data (Anney, 2014). Credibility is the ability to illustrate that the research was designed in a way that correctly describes and identifies a situation under investigation (Scaife, 2004). This encompasses the establishment of whether qualitative results are believable from the angle of the research participants (Guest et al., 2012) since qualitative research explores the participants' feelings, beliefs, experiences and perceptions (Spencer et al., 2003). Research participants are considered the best adjudicators of whether findings accurately reflect their thoughts and views (Guest et al., 2012). The participants in this research are semi-literate, yet their level of understanding was sufficient for supplying feedback. Accordingly, after analysing the data for themes from the interviews, the researcher discussed the themes generated from the analysis of the results with the agricultural extension officers for confirmation who agreed with the identified themes. However, to attain sound credibility, the researcher must be able to answer the following questions (Eriksson & Kovalainen, 2011):

- 1) Is the researcher familiar with the topic?
- 2) Are the data sufficient to merit the claims?
- 3) Have links been made between categories and observations?
- 4) Can any other researcher use their material to confirm their claims or be closer to their findings using the interpretations that the researcher has made?

Thus, the credibility of this research findings requires assurance that the research was done in line with the canons of good research practice (Scaife, 2004) and submitting findings from the research to participants for confirmation that the researcher has

understood a particular social word (Noble & Smith, 2015). Loh (2013) suggests that credibility can be implemented using the following strategies:

- ❖ Prolonged engagement
- ❖ Triangulation
- ❖ Peer debriefing
- ❖ Negative case analysis
- ❖ Referential adequacy
- ❖ Member-checking
- ❖ Persistent observation

The researcher utilised prolonged engagement, meaning the researcher spent much time in the field to obtain an understanding of the phenomenon under study. This enabled the researcher to develop a relationship with the research subjects through socialising and establishing relationships with them (Phellas et al., 2011). This allowed the researcher to build trust with the participants (Anney, 2014) and subsequently, become adapted to the environments of the research subjects, thereby facilitating easier appreciation and understanding of the phenomenon (Gray, 2012). This enabled the researcher to rise above presuppositions and unjustified misrepresentations in the data (Shenton, 2004). The researcher merged interviews to enable participants to feel comfortable in divulging information that would not abide by the official party position (Schultze & Avital, 2011). It is very useful to have a range of participants who understand the context to obtain different perspectives (Shemmings & Ellingsen, 2015). The researcher also engaged peers in this research to analyse and explore the research and this liberates the researcher as peers can uncover any biases, views and assumptions that the researcher might possess (Korstjens & Moser, 2017). In addition, the process enabled the researcher to become aware of his stance concerning the data and emerging theories acceptable to his peers.

Transferability

Transferability is one of the weaknesses of interpretivist research. However, reliability is not valued for its own sake but as a precondition for validity (Lincoln & Guba, 1988a). The first criticism levelled at qualitative research is that of small sample sizes; hence, it does not meet statistical generalisation thresholds. This is in sharp contrast with the canons of survey research which suggest that an appropriately selected sample is easily generalised to a broader context (Yin, 2003), thereby justifying its transferability. However, Rodon and Sesé (2008) argue that case studies rely on analytical generalisation, while survey research focuses on statistical generalisation. Thus, the thrust of case study research is to generalise a specific collection of data to a larger theory through analytical generalisation. This research follows a case study approach, focusing on smallholder farmers and their perceptions of the use of mobile phones in their everyday agriculture activities (Seddon & Scheepers, 2012).

Therefore, regardless of the knowledge concerning the research findings being context-bound, the general environments in which the phenomena being investigated may share traits and characteristics with another context guarantees the transferability (Rodon & Sesé, 2008). As a result, the transferability of this research's findings is dependent on the similarities and differences between those shared traits and setting characteristics (Seddon & Scheepers, 2006). Based on this, this research conducted in Zimbabwe, a developing country in sub-Saharan Africa, shares traits and characteristics with other countries in the region and accordingly, its findings may be transferable to sub-Saharan and other developing countries.

Confirmability

Confirmability is the measure of the objectivity used in evaluating research results (Anney, 2014; Shenton, 2004) and describes the degree to which the research findings are supported by the data collected when the research is evaluated by other researchers (Gregor, 2002; Mack et al., 1989). Individual researchers bring their unique perspectives to the research process; thus, data interpretation can be subjective in qualitative research (Brink, 1993). While complete objectivity is unattainable in research, the researcher is

required to demonstrate that they have acted in good faith by not allowing their subjective beliefs to impact the execution of the research and the findings (Bryman, 2012; Resnik, 1998). Thus, objectivity is the degree to which the research findings can be confirmed or validated by others (Kothari et al., 2014). If the findings are corroborated or confirmed by others who examined the data, then no inappropriate biases affected the data analysis. The strategy attempts to relate the research results and interpretations to the data in as simple a way as possible (Alhojailan & Ibrahim, 2012). According to Loh (2013), confirmability can be implemented using the following strategies:

- ❖ Confirmability audit
- ❖ Audit trail
- ❖ Triangulation
- ❖ Reflexivity

This researcher implemented triangulation and reflexivity in this research to ensure that this research is confirmable. Reflexivity is the monitoring that is done by a researcher of their influence on the situation being studied (Lincoln et al., 2011). At this stage, researchers situate themselves within a qualitative research study by communicating their background information. This encompasses general and work experience and history and ethnic backgrounds, which enlighten how the information in the study was interpreted and the benefits the participants will derive from the study.

Dependability

Dependability is the consistency with which the research could be repeated and yield the same results (Anney, 2014; Guest et al., 2012). The dependability of the research findings also provides legitimacy to the research methodology employed (Rabiee, 2004; Toma, 2016). Qualitative research often results in a dynamic setting and context (Cypress, 2017; Guha, 2005; Kanis, 2014). The researcher must document any changes or unexpected occurrences to further explain the findings. Thus, this strategy matches reliability by trying to establish whether the results will always be applicable. It is prudent for the researcher to adopt an auditing approach to establish the merit of trustworthiness (Brink, 1993). This involves intensive record-keeping of all the research processes that the researcher has

executed in that research project. Such processes include the problem formulation, research participants' selection process and the amount of time spent in the fieldwork, transcripts of the interviews and decisions from data analysis (Cypress, 2017; Golafshani, 2003).

These should be stored in a way that makes the records readily accessible as and when required (Anney, 2014) thereby enabling peers to audit the research process to determine whether the proper procedures were followed (Long & Johnson, 2000). The auditing might involve the assessment of the degree to which theoretical interpretations can be justified (Bryman, 2012) and ultimately confirm whether the same research findings could be obtained should an observation of the same phenomenon be repeated (Cypress, 2017; Pini, 2012). Thus, to obtain independence and flexibility in qualitative research, the researcher should keep a transparent trail of all processes for enabling peers to repeat these processes, to ascertain the level of dependability (Astalin, 2013). According to Loh, (2013), dependability can be implemented using the following strategies:

- ❖ Overlap methods (Triangulation of methods)
- ❖ Dependability audit

Therefore, this researcher implemented the two strategies by utilising several data collection methods that included interviews, FGD and observations. In addition, dependency audits on how the data were collected, the derivation of categories and the rationale for decisions were also utilised, which showed that the research is reliable.

4.8.2 Validity of Data

In qualitative research, validity is derived from the analysis procedures of the researcher, based on information gleaned from research participants and external reviewers (Cypress, 2017; Norris, 1997); accordingly, the transparency of the process is critical to enhancing the validity of a study's findings and interpretations (Miles et al., 2014). Cresswell (2014) states that in qualitative research, data validity entails the researcher checking the accuracy of the findings using certain procedures (Kumar, 2011). Cohen et al. (2017) submitted that techniques such as descriptive validity, interpretive validity,

theoretical validity, generalisability and evaluative validity could be used to ensure the validity of qualitative data (Brink, 1993; Noble & Smith, 2015).

Descriptive validity provides a descriptive accuracy of the research that is not distorted or made up (Kihn & Ihantola, 2015; Toma, 2016). The interpretive validity of the research is its ability to capture the meanings, interpretations, intentions and terms that events have for the subjects in their understanding (Holton, 2018; Taylor-Powell & Renner, 2003). Theoretical validity explores the theoretical constructions brought about by the research (Miles et al, 2014; Yazan, 2015), while generalisability is concerned with how the theory that has been generated by research may be useful in understanding other similar situations in specific groups or communities and circumstances. Evaluative validity is concerned with the application of a judgement understudy rather than an explanatory, descriptive or interpretive framework (Cohen et al., 2013).

To ensure that the findings of this research are valid, the researcher ensured that there is theoretical validity by engaging an expert to evaluate if the findings indeed apply to the research context. Brink (1993) opines that four areas need to be scrutinised to ensure the validity of qualitative research, namely the research respondents, research context, researcher, data collection methods and data analysis. From a researcher's standpoint, the issues of concern are bias, and the trustworthiness of the data are paramount. Bias refers to any influence that might distort the findings of a study (Gray, 2014). Thus, to ensure that trustworthiness prevailed in this research, the researcher spent a great amount of time in the field, visiting research subjects and familiarising themselves with the environmental settings. This culminated in friendly interaction with the research subjects, thereby increasing the probability of obtaining accurate accounts from those research subjects. Accordingly, building trust with research subjects is vital for them to open and answer the research questions as honestly as possible.

The researcher presented the field notes to an independent researcher for validation and the identification of any inconsistencies. Additionally, the researcher had already ensured the research participants' anonymity by assigning all participants coded identities. To avoid bias, the researcher conducted interviews and focus group discussions at different

time intervals to counter factors such as fatigue, anxiety, mood, and health status. For example, a response from an individual can differ from that of a group. However, the researcher made sure that the respondents were selected using the snowball technique. To ensure the adequacy and accuracy of the data, the researcher used his judgement in identifying themes from the data collected. The interpretation of data and research conclusions and recommendations are covered in Chapter Five. Hermeneutical principles were applied during data interpretation, under the seven steps prescribed by (Klein & Myers, 1999). Thus, this researcher endeavoured to adhere to the fundamental principle for conducting and evaluating interpretive studies as provided for by the hermeneutical principles (Klein & Myers, 1999; Nilsson, 2012). Table 4.3 provides details of the hermeneutical principles.

Table 4.3: The hermeneutical principles applied in this research (Myers, 1999)

The fundamental principle for conducting and evaluating interpretive studies.	How and where it is applied in this study
<p>1. The Fundamental Principle of the Hermeneutic Circle: It refers to the notion that one understands the text by referencing its parts, and one understands each part by referencing the whole. As a result, all human understanding is attained by repeatedly comparing the interdependent meaning of the individual parts and the overall meaning that they create. As a result, the idea is that human cognition is fundamental to all other ideas.</p>	<p>Data analysis using Cresswell (2014), Yazan (2015) and Yin (2006) within-case, cross-case and holistic-case analysis templates. As the cases will be brought together, triangulation will ensue.</p>
<p>2. The Principle of Contextualisation: For the intended audience to understand how the current situation under examination came to be, this concept necessitates that the researcher critically examines the social and historical context of the research setting.</p>	<p>This was achieved when the researcher gave an account of the contextual settings of the research sites in the current Zimbabwean context.</p>
<p>3. The principle of interaction between the researchers and the subjects: The guiding concept calls for a critical examination of the social construction of the study data during interactions between the researcher and participants.</p>	<p>The role of the researcher involved in collecting data from all participants (smallholder farmers and agricultural extension officers).</p>
<p>4. The principle of abstraction and generalisation: The principle calls for connecting the idiographic specifics discovered by data interpretation, using principles one and two to theoretical, broad ideas that define the characteristics of human comprehension and social activity.</p>	<p>The researcher believes that the results of the research and the proposed framework will be used to inform policymakers in Zimbabwe and other developing countries in sub-Saharan Africa, taking context-specific factors into consideration.</p>

The fundamental principle for conducting and evaluating interpretive studies.	How and where it is applied in this study
<p>5. The principle of dialogical reasoning: With future rounds of revision, the principle calls for awareness of any inconsistencies between the theoretical notions that guided the research design and actual findings (the story that the data tells).</p>	<p>The data will be interpreted in relation to the literature review, semi-structured interviews, FGDs and expert review.</p>
<p>6. The principle of multiple interpretations: The principle calls for consideration of potential variations in participant perceptions, which are frequently expressed in various narratives or stories of the same sequence of events under examination. Like other witness reports, even if they all accurately recount the events.</p>	<p>Interpretations of data from all sources will be useful to ensure that differences are addressed.</p>
<p>7. The principle of suspicion: This requires awareness of potential biases and deliberate distortions in the participant-collected tales.</p>	<p>Data collection from participants was done anonymously by identifying participants as A, B, C, etc. Multiple sources and measures for data collection will be employed.</p>

4.9 ETHICAL CONSIDERATIONS

In every academic research, there are three stakeholders usually involved and these are the research subjects, the researchers, and the research financing body (Dooly et al., 2017; Ethics, 2008). The researcher is the person who is responsible for the collection of information for a particular purpose, following an acceptable code of conduct governing the research process (Resnik, 1998). The research funding body provides the required funds and facilities for the research to be executed professionally (Khan, 2014). Each of the stakeholders has different perspectives, aims, purposes and motivations, which might affect the way a research activity is conducted and also the way results are communicated and utilised (Fouka & Mantzorou, 2011; Kamat, 2006). The goal of ethics is to prevent anyone from being negatively affected or injured in any manner by research activities (Kamat, 2006). Generally, ethical issues entail that the research design should not in any way subject research participants to embarrassment, harm or anything that puts the research subjects at a disadvantage (Dooly et al., 2017).

Researchers should consider what is ethically acceptable during the data collection process and presentation (Kamat, 2006). Therefore, research ethics relates to the moral and responsible ways of collecting and analysing data, and the process of writing up research findings. Thus, the researcher must ensure that the research is both methodologically sound and morally defensible to all the participants (Gregory, 2003; Lincoln & Guba, 1988). Research ethics is governed by three main tenets: informed permission, confidentiality and participant anonymity (MacFarlane, 2009). The procedures of this study took all the basic and universally accepted ethical guidelines that are required for conducting academic research into account. The researcher sought consent from all research subjects in this study and will briefly address informed consent, confidentiality, and anonymity of participants in detail in the upcoming sections.

4.9.1 Informed consent

Informed consent is an ethical, professional and legal prerequisite for any research that involves human participants (Hammersley & Traianou, 2012; Nijhawan et al., 2013). Informed consent ensures that every participant is informed about all aspects of the research process, which are vital for the participant to make an informed decision. After studying all aspects of the research process, the participant then voluntarily confirms his or her willingness to participate in that particular research (Hammersley & Traianou, 2012). Informed consent is rooted in the principles of the Nuremberg Code, The Declaration of Helsinki as well as The Belmont Report (MacFarlane, 2009; Nijhawan et al., 2013). Informed consent is an inexorable condition to be met with any research involving a human being as the subject of study.

To achieve the principle of informed consent in this research, the interviewees and focus group discussion participants were presented with an informed consent certificate to read and sign. Regarding the recordings, the researcher sought permission to record the interview. The research subjects were made aware that they could decline to take part in the research or withdraw at any time after initial participation, without incurring any harm. The next section outlines confidentiality.

4.9.2 Confidentiality

As part of their ethical duty of confidentiality, researchers have a responsibility to safeguard data from unauthorised access, use, disclosure, modification, loss or theft (Fouka & Mantzorou, 2011; MacFarlane, 2009). Fulfilling the duty of confidentiality is vital to the trust relationship between researcher and participant, and ultimately, to the integrity of the research project (Hammersley & Traianou, 2012). Thus, to preserve the ethical duty of confidentiality, The researcher made sure that the information collected from the participants was only utilised for the purposes specified in the study, and during data analysis and presentation, coded identities were used instead of the individuals' names in the focus group discussions and interviews.

4.9.3 Anonymity

Anonymity refers to data collected from the research participants who are completely unknown to anyone associated with the survey (Fouka & Mantzorou, 2011; Hammersley & Traianou, 2012). This is satisfied if the respondent solely knows that he or she participated in the research and the researcher cannot identify the participants (Lavrakas, 2008). Thus, anonymity can be referred to as data collected through surveys in which the respondents are de-identified and all possible identifying characteristics are separated from the publicly available data (Allen & Wiles, 2016). Therefore, anonymity requires that information collected from research participants does not identify individual subjects (e.g., name, home address, email address, phone number, etc.) or that the research cannot relate the individual research participants' responses to their identities (Walford, 2005). According to Monette et al., (2013), the information gathered from study participants shouldn't be connected to them personally. As a result, the identities of the study participants were kept a secret. The information collected did not expose the identity or source of its origin, to preserve confidentiality. In addition, codes were used to identify the participants. The research participants were given pseudonyms to identify them in this research. Smallholder farmers were identified as SHF1, SHF2, SHF3, SHF4 and SHF5 for the pilot study and for the case study, the smallholder farmers were labelled SHFA, SHFB, SHFC up to SHFAD, while the agricultural extension officers were labelled AGEXT1 to AGEXT3.

4.9.4 Ethical issues for the researcher

Five key ethical issues governing the researcher are the avoidance of bias, correct reporting, using information, using appropriate research methodology and the provision or deprivation of a treatment (Dooly et al., 2017; Hammersley & Traianou, 2012). First, bias refers to an attempt to deliberately hide the findings of the study or misrepresent information. In this study, the researcher provided feedback to the participants and the findings of this research are a correct account of the data collected. Second, a researcher is required to use an appropriate methodology. In this research, the sample was unbiased, the instruments were appropriate, and the conclusions were correct. Third, a researcher is required to report correctly and follow proper procedures (Hammersley & Traianou, 2012). This researcher presented the research findings in the correct manner, such that the findings do not serve personal or others' interests. The researcher made sure that the information collected complied with confidentiality and anonymity. The information was collected and used in a manner that would not damage the reputations of the subjects (Hammersley & Traianou, 2012; Scaife, 2004a). Lastly, the research must be tested for effectiveness (Long & Johnson, 2000; Magnusson & Hanson, 2003). In this research, the researcher reported the results to the respondents to receive feedback from them.

4.10 PROBLEMS ENCOUNTERED DURING DATA COLLECTION

Despite having much knowledge and providing explanations to participants about the purposes of the research beforehand, the researcher encountered such questions as "what do we gain from answering all these questions that you are asking us?" during the data collection process. The researcher had to explain repeatedly to the participants that the research would only inform the government and other stakeholders and that the researcher had no power to do anything other than inform the relevant authorities about the outcome of the research. Some of the questions related to their general welfare were difficult for some participants because the researcher noted the expressions exhibited on their faces.

Another challenge was that of monetary benefits for participants and the researcher resolved to give focus group participants money for lunch (US\$10-00 per participant) and the FGD was held with smallholder farmers in Gokwe South and other stakeholders in the agriculture value chain. Zimbabwe is a highly polarised society (Beaufort, 2018; Esteban & Schneider, 2008) with everyone treating 'intruders' with a high level of scepticism. This was a huge challenge that threatened to derail the research process. This researcher first experienced this in the Gokwe district where some people did not like to be seen in the company of a stranger. The researcher made three trips to the area to familiarise himself with the setting, farmers and community gatekeepers, to conduct the research process.

The researcher is indebted to the community gatekeepers of the area. The (then) acting district agricultural extension officer for Gokwe South directed the researcher to the agricultural extension officers for Njelele, Ward 15. The agricultural extension officer for Njelele, together with the ward councillor of the area, enabled the data collection process to proceed very smoothly and quickly. They provided unwavering support and assistance to me throughout the data collection process, from the time the researcher had contacted them and because of this the researcher is forever indebted to them. The two invited the researcher to address the farmers at a meeting and to ask them to make themselves available for interviews. After the researcher had finished talking to the farmers, the two officials went on the stage and reinforced the need for the farmers to participate in such exercises as they would help the government to ascertain what is happening around the country. After the meeting, almost everyone wanted to be interviewed and the researcher had to select participants purposively for interviewing. At the time of the fieldwork, it was in the rainy season in the area. As such, heavy rains made it difficult for the researcher to manoeuvre in remote areas where the data was being collected. On one of the trips to meet farmers at their households, the researcher's vehicle was stuck in the mud and had to spend three days there.

4.11 CHAPTER SUMMARY

This chapter presented the research design of this study. The design included the philosophical perspectives guiding this research. The research strategy about how the research was conducted and the empirical techniques that had been applied were availed. The chapter further presented the scope and the weaknesses of the research design and situated the research amongst existing research traditions in information systems. The chapter also presented data collection methods, which include observation, a focus group discussion, and structured and semi-structured interviews. Data analysis approaches and techniques for qualitative data analysis (in line with the data collection methods) were presented. Ethical considerations in this research were provided, in line with precise information on the application of the chosen data-gathering methods. The researcher also presented the challenges encountered in the research during data collection.

CHAPTER FIVE: RESEARCH FINDINGS AND ANALYSIS

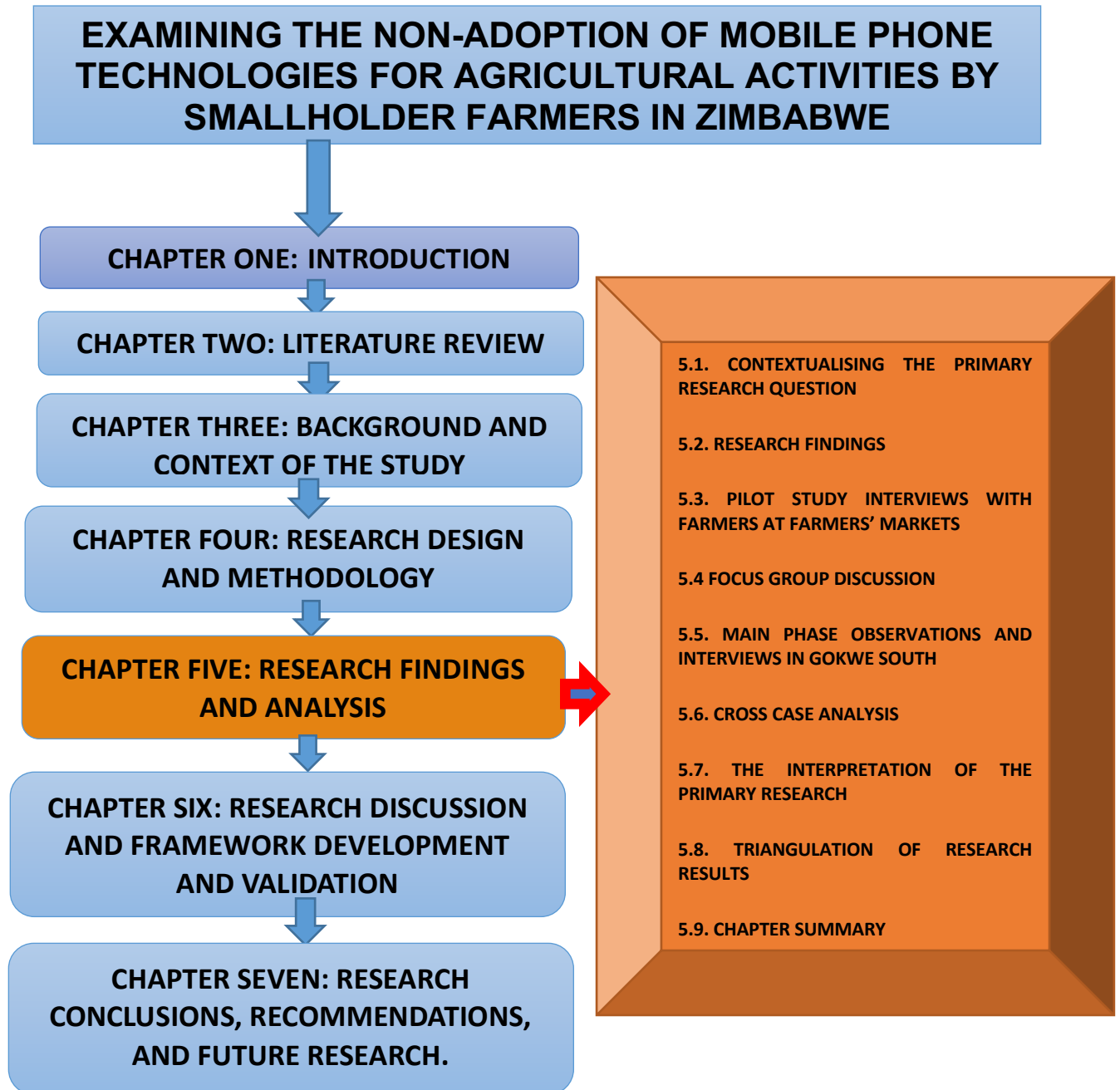


Figure 5.1: Thesis and Chapter Four navigation map (author's construction)

Chapter Four introduced and discussed the research method used in this study. Chapter Five presents the research findings and analysis of the data. The researcher collected data using field observations, a focus group discussion, and semi-structured individual interviews. Data were mainly collected from Gokwe South District, Ward 15. The focus group discussion (FGD) was used to identify both regular and newly emerging themes, and the results were fused with those from interviews. The observations were used to identify the features that are commensurate with agricultural activities.

5.1 CONTEXTUALISING THE PRIMARY RESEARCH QUESTION

The primary research question in this study is:

Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully use them in their general, everyday lives?

To address this research question, the researcher reviewed the literature, conducted individual interviews with smallholder farmers and agricultural extension officers, conducted FGDs and consulted experts. The researcher achieved this by answering the research sub-questions which are provided in Table 1.1 in Chapter One. To gain insight into the research issues in this study, the researcher reviewed the literature on smallholder agriculture and mobile phone technology adoption and use in agriculture, conducted a pilot study by observing and interviewing smallholder farmers at the following farmers' markets (*Musika*), Mbare in Harare, Kombayi and Kudzanai in Gweru, and Bomba in Gokwe. Findings from the pilot study enabled the researcher to gain insight into the issues affecting smallholder farmers in the context of Zimbabwe. After the pilot study, the researcher embarked on the crucial phase of the research in the Gokwe South District. The researcher then carried out a focus group discussion with five (5) community gatekeepers who are the village heads of the five (5) villages identified for conducting the research, two (2) agricultural extension officers and two (2) smallholder farmers as well as two (2) representatives of the mobile telecommunication service providers operating in the area and one (1) individual from the Cotton Company of Zimbabwe (Cottco).

Information gleaned from the pilot study enabled the researcher to improve the interview guide for the crucial research phase.

During this phase of data collection, the researcher conducted individual, recorded interviews with smallholder farmers at a rate of at most two interviews per day. At the end of each day, the interviewer would listen to data recordings to gain insight. With subsequent interviews, the researcher cross-checked issues that had been raised by previous interviewees but were not mentioned by the (then) current interviewees. Thus, subsequent interviews served as an independent data source and a verification tool for previous interviews. The focus group discussion was audio-recorded, transcribed and coded for data presentation and analysis. Table 5.1 below shows the data collection instruments that were used to answer the research sub-questions.

Table 5.1: Data collection instruments used to address the research sub-questions

Research sub-question	Literature survey	FGD	Individual interviews with smallholder farmers	Individual Interviews with agricultural extension officers
	Research Sub-Question 1	Yes	Yes	Yes
Research Sub-Question 2	Yes	Yes	No	Yes
Research Sub-Question 3	No	Yes	Yes	Yes
Research Sub-Question 4	Yes	Yes	Yes	No
Research Sub-Question 5	No	Yes	Yes	Yes
Research Sub-Question 6	Yes	Yes	No	Yes

The researcher collected data relating to participants' experiences in smallholder agricultural activities and the usage of mobile phones in their farming activities.

5.2 RESEARCH FINDINGS

The research findings are presented for (1) the pilot study conducted at three farmers' markets, namely Mbare, Kombayi and Gokwe; (2) the focus group discussion conducted with key informants at Gokwe centre and (3) the interviews conducted with farmers in Gokwe South. The interviews conducted in Gokwe South are grouped into five sections, according to the cases studied, that is, research findings from five villages, namely

Mutanhourwa, Nyamazana, Mutoranhema, Mashove and Dzawanda in Gokwe South, Ward 15. The researcher integrated the results, thereby supporting within-case and cross-case analysis, respectively (see Section 5.6.4.3). Figure 5.2 summarises the presentation of research findings.

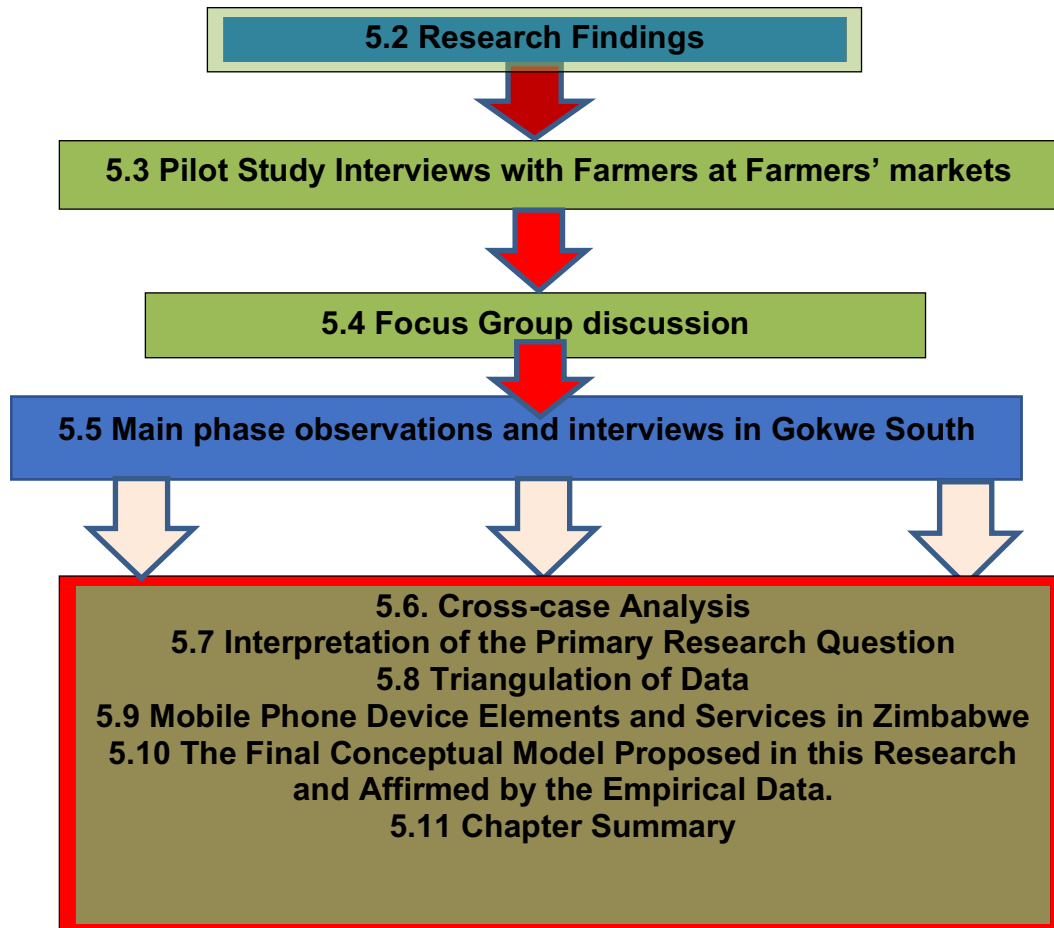


Figure 5.2: Research findings summary. (author's construction)

5.3 PILOT STUDY INTERVIEWS WITH FARMERS AT FARMERS' MARKETS

This section presents the data collected from the interviews conducted at three farmers' markets for the pilot study. These took place in August 2019; the smallholder farmers interviewed at the farmers' markets were coded as SHF1 up to SHF5, for 'smallholder farmer' and the digit chronologically showed the farmer's number as interviewed during fieldwork. Mbare Musika (Harare), which derives its name from the surrounding high-density suburb, Mbare, is the oldest farmers' market in Zimbabwe. As mentioned in Chapter Three, Sub-Section 3.4.5, Mbare Musika has three marketplaces, the farmers' market, the vendors' wholesale market and the vendors' retail market. Well-established vendors are usually into wholesaling since they can afford to buy in bulk directly from farmers and then resell farm products to other vendors. Like real wholesaling, these vendors buy, for instance, truckloads of cabbages, tomatoes, fresh maize, fruits, tonnes of groundnuts and so on, from different farmers who offer such produce.

The researcher visited the Mbare farmers' market in Harare on the 8th of August 2019 at 07:35 am and observed smallholder farmers' and vendors' interactions and transactions for three hours. The researcher purposively sampled two smallholder farmers for interviewing. The individual interviews lasted 27 minutes for SHF1 and 24 minutes for SHF2. The researcher then visited the Kombayi market on the 12th and 13th of August 2019 and observed smallholder farmers' and vendors' interactions and transactions for a period ranging from two to three hours each day. On each separate occasion, the researcher purposefully selected one smallholder farmer for interview. The individual interviews at Kombayi took 28 minutes for SHF3 and 23 minutes for SHF4. The researcher then travelled to Gokwe on the 15th of August and visited the farmers' market, observed the farmers' and vendors' interactions and activities, and then purposively selected a smallholder farmer for interviewing, labelled as SHF5, which took 26 minutes. The rationale for choosing these smallholder farmers was that they met the researcher's criteria. These smallholder farmers found at the farmers' market were observed actively

selling their products to customers and using their mobile phones. Some were witnessed and heard talking to some customers on their mobile phones.

5.3.1 Findings from individual interviews

This section presents the research interview findings of the pilot study. The research sub-questions answered in this section were regarding questions in the interview guide.

General Demographic information of pilot study participants

The demographic information of interviewees at the farmers' markets presented in this section includes gender, age, farming experience, level of education and marital status. These demographic characteristics are useful because they influence the farmers' attitudes towards the acceptance, adoption, and effective usage of mobile phone technology in agriculture. Thus, they inform the discussion of the results (see Sections 3.8 and 3.10.1–3.10.9). Additionally, these demographic traits help to classify farmers according to the difficulties they encounter. Knowledge about educational level was crucial for ascertaining the general degree of literacy among research participants. Given that experience is a crucial factor in influencing the acquisition of technological advancements, the researcher wanted the smallholder farmers' general farming experience to provide insight into the tenure of farmers.

This research used purposive sampling because it enabled the researcher to select information-rich cases to study. Thus, five (5) research participants were chosen for the pilot study. Three (3) research participants were male and the other two (2) were female. The literature review highlighted the influence of gender as a significant factor which shapes the perceptions of smallholder farmers on the adoption and use of ICTs in agricultural activities. The ages of the participants are 38, 43, 46, 49 and 54 years old. The researcher interviewed seasoned farmers at the farmers' markets, with farming experience spanning 12 to 27 years. The farmers participating in this research had some level of education. All of them had at least attended secondary school. However, it was not within the ambit of this research to establish whether these participants had completed and passed the 'O' Level examination. Having attended secondary school level study is

enough for someone to be able to read and write, which is an essential skill for effectively using mobile phone technology.

Factors affecting the adoption and sustainable use of mobile phones by smallholder farmers

Smallholder farmers showed that they were partially getting weather information from their mobile phones. Some farmers make calls to their clients and plan for them to collect their products, which are sent by bus. In addition, some farmers cooperate and organise themselves into a club and then take turns to accompany the products to the markets. Some farmers have relationships with different vendors in different markets and they always enquire about the prices before deciding to sell to specific markets. (The researcher posits that the decision on which market to sell to would be based on a comparison of prices in the different markets.)

I come from Mutoko, and I have been a farmer for 23 years. I bought my phone in 2003. I am using a smartphone and I can say this is my fifth handset [...] I alternate Econet and NetOne lines [SIM cards]. Buddie [Econet]. I brought many products from my club members for their customers. The customers came, collected their wares, and called farmers to confirm the received products. Depending on their agreement with the farmers, some vendors will send the money to the farmer's phone through *EcoCash*, but some gave me the money in cash. **[SHF1]**

Other farmers interviewed at the farmers' markets affirmed this. The interviewees were using their mobile phones to call and text (either via *WhatsApp* or SMS) the different markets at different times, and some have created *WhatsApp* groups whose members comprise farmers and vendors. They discuss any information relating to farm produce and prices. The farmers showed that the mobile phones assist them because after calling different markets, they establish that there are slight variations in prices in different markets. However, when factoring all issues involved like transport costs and inconveniences involved and the time used in travelling, they may settle for markets closer to them:

The mobile phone is precious to me in my farming activities. It is very useful for agriculture information sharing with other farmers and vendors. I have two phones, one Buddie and one NetOne but Buddie is mainly more useful for me because in Gokwe where I come from the other

networks are very erratic. Buddie is also a treasurable asset for the movement of money from customers through *EcoCash*. [SHF4]

The interviewees in the pilot study showed that the high costs of data, voice calling, and handsets affect their intentions to use mobile phones. Ironically, four farmers interviewed at the Mbare Musika and Kombayi markets had smartphones, except for one farmer interviewed at the Gokwe market. However, two of the farmers showed that they had bought their mobile phones second-hand (not new). The interviewed farmer at Gokwe market said he could not afford a smartphone because of their high prices, compared with his income, which is low. The interviewees showed that they indeed use mobile phones and that they find them very helpful. The female farmer interviewed showed that society does not face any discrimination issues regarding their usage of mobile phones.

The farmers showed that the mobile phone is very compatible with their activities as they move around, they receive new valuable information when travelling to other places, and they could change their destination on the way.

Econet is very useful because I receive money from many customers through *EcoCash* ... the current handset cost me US\$23-00 as it is a basic phone. [SHF5]

However, the erratic network causes problems for farmers because they sometimes experience network blackouts in their areas or when travelling, thereby missing crucial messages which they then only receive later. Some missed messages contained crucial actionable information, which they would have failed to receive. In most cases in rural areas where smallholder farmers come from because there is only one network, Econet, rural farmers have limited options for network subscriptions:

I have used the mobile phone since 2009. I am using a smartphone, but the cost of data is very high for a farmer. The mobile phone is very handy in the work of a farmer because the market for farm produce is very volatile, and the prices can change in any instance. I have used the *eMkambo* application, but I think there are some problems. You can get the information that tomatoes are selling for Z\$250-00 a bucket at Mbare and Z\$300-00 in Bulawayo, but when you travel there, you will not find customers buying for that price. [SHF3]

The upcoming sections examine the focus group discussion conducted at the Gokwe centre.

5.4 FOCUS GROUP DISCUSSION

The researcher conducted a focus group discussion to gain insight into what to expect in Gokwe and to adjust the research interview guide. The composition of focus group discussion participants was the Gokwe area manager for Cotton Company (**FGDP1**), two smallholder farmers (**FGDP2 & FGDP3**), two agricultural extension officers (**FGDP4** and **FGDP5**), two Telecommunication company representatives (**NetOne FGDP6** and **Econet Wireless FGDP7**), community gatekeepers who are the village heads of the five villages (**FGDP8, FGDP9, FGDP10, FGDP11 and FGDP12**). The researcher employed a single-focused FGD to generate collective knowledge and opinions, which aided in refining and tweaking the interview guide questions and the meanings that lie behind those views. Because the focus group was qualitative in nature, the facilitator asked for open-ended comments, allowing participants to express themselves freely. This allowed for the transmission of participants' ideas or feelings, resulting in a rich comprehension of participants' experiences and views. The focus group discussion was held at the Gokwe centre on Thursday 26th of September 2019.

5.4.1 The findings from the focus group discussion.

The FGD participants concurred that farmers in the Gokwe South area mainly produce field crops, followed by horticulture, livestock and then poultry. Although the crops differ, there is a convergence on cereals, with maize being the key product as it is the staple food for many Zimbabweans. Pig and dairy are other farming practices, which also came out of the responses in Gokwe.

Field crops I produce include maize, potatoes, cotton, and sunflower. However, market gardening is very important to farmers in this area. [**FGDP 2**]

A substantial number of farmers in Gokwe South are said to produce numerous crops like tomatoes, vegetables, onions, beans, and sweet potatoes; some crops were cultivated by many farmers because of their multi-use nature. This is supported by **FGDP4** who pointed out:

Besides that, it is important to note that there are strategic crops like groundnuts, which can be used in multiple ways. Farmers in my area are also into poultry production ... chicken broilers and 'road runners' (roosters) and rabbits ... [**FGDP4**]

Smallholder farmers in Gokwe South face many challenges with their agricultural activities. These include a lack of capital, high costs of inputs, late distribution of inputs from the government, and lack of lucrative markets for their produce. The issue of very low producer prices by the government through GMB was identified as a major challenge.

FGDP 3 said:

One of the major challenges is that the produce market price to be offered by the Grain Marketing Board (GMB) is pronounced by the government after harvesting is usually terrible, [such] that a farmer may not recover money for input costs. **[FGDP3]**

Although farmers are not forced to sell their produce at the gazetted prices, it was indicated that circumstances obtained on the ground compel them to sell anyway:

As farmers, we are compelled to sell our products either to private buyers [intermediaries], who come with their cars, but the prices will still be below, or to the GMB because of challenges with these intermediaries. **[FGDP 9]**

Very rudimentary and uncoordinated infrastructure like roads and bridges, and very high transport costs are some of the drawbacks faced by smallholder farmers in the Gokwe South District. Moreover, natural disasters like droughts, pests and diseases highly affect agricultural productivity. **FGDP5** stated:

Farmers face many challenges like drought because rains are now very erratic, so timing becomes very critical ... There are pests and diseases that are always threatening farmers' crops and livestock. New pests and diseases are constantly coming up ... some that even we agricultural extension officers have never learned about ... some show multi symptoms. **[FGDP5]**

Nonetheless, farmers' obstacles were deemed to be surmountable, and the focus group participants proposed potential ways to solve the challenges. Farmers' training, according to the FGD participants, is a critical answer since a trained farmer is an equipped farmer. Participants proposed that development plans incorporating communities address infrastructure challenges such as roads and bridges in the region for accessibility. Several methods have been proposed, including the timely delivery of government input programs, contract farming partnerships between organisations such as Cottco and farmers, input loan and livestock loan schemes, and grouping farmers and lending them

inputs in groups. The other suggested solution was to provide tractors to till the fields, as some farmers do not have draught power. As **FGDP8** pointed out:

The government should reintroduce the District Development Fund tillage scheme, which was being run some years back. **[FGDP8]**

The government was challenged to pronounce market prices for produce after factoring in the costs incurred by farmers. Participant **FGDP10** stated:

Government should pronounce market prices after factoring [in] the costs incurred by farmers. **[FGDP10]**

Participants suggested that the gazetted prices should capacitate the farmers as experienced in other countries. The smallholder farmers are supposed to be considered in the decision-making process involving the setting up of prices of both agricultural inputs and produce. **FGDP12** suggested that:

Government should involve the farmers in the negotiating forum that recommends the setting up of prices. **[FGDP12]**

Participants in the FGD agreed that an agricultural Extension Officer in the local region provides agricultural information to farmers in Gokwe. Radio was recognised as the second-most popular source of agricultural information, followed by television. Additionally, participants said that a sizable percentage of farmers in Gokwe obtains farming information by word-of-mouth. For example, **FGDP4** indicated that:

Whenever farmers receive information from any source, they always share a lot of information among themselves. **[FGDP4]**

There are agriculture processing companies like Cottco which also provide agriculture information about their cotton crop only. **FGDP9** said this:

Agricultural extension officer gives us all the information we want ... we get general weather and other information from the radio. **[FGDP9]**

Some FGD participants indicated that a few farmers receive agricultural information via their mobile phones, as **FGDP7** pointed out:

Econet has a mobile phone service called *EcoFarmer* where all registered farmers receive agriculture information, however those who would have subscribed to the services. **[FGDP7]**

However, this position was said to be very limited as many farmers were not subscribers of the service in Gokwe South. Below is an extensive extract of the statement by one FGD member who is an agricultural extension officer in Gokwe South:

All agriculture information about crops, inputs, pests, and diseases, whether the broadcast is obtained on the radio ... is supposed to be conveyed by agricultural extension officers. We are always on the ground relaying any critical and ground-breaking information to farmers ... if [I] get anything critical that should be communicated to farmers, even if it was communicated on the radio. It is my responsibility to ensure that the information has reached all farmers in the area that I preside over. However, given the challenges of transport and the area size that I should cover ... I have now turned to the mobile phone. Every household has a mobile phone and I have their entire mobile phone numbers ... I buy bulk SMSs from the telecommunication services provider. I then, broadcast one message to all farmers advising them of a meeting at a viable position and time ... there are five meeting points in my area and each meeting point has two farmers that I appointed to lead. I then record myself explaining everything and then send the recording to each of the farmers leading at the meeting points. There are different times for distinct meeting points ... when it is time for the meeting, the audio is played, and everyone will listen. If there are questions from any farmer, they are noted down. One of the meeting leaders will then call me and give me the questions. ... I will then advise the person who called to put the phone on the loudspeaker. ... I will then address every question raised at that meeting ... this happens to all groups. [FGDP5]

The following section analyses the responses relating to Section B of the FGD:

The consensus by the FGD participants was that there was a high level of mobile phone ownership in Gokwe, as suggested by **FGDP7**, a representative of Econet in the area:

There is a high level of mobile phone ownership in Gokwe, particularly from an Econet perspective. Given the statistics of mobile phone users of our services, I would like to believe a good number of people in the area have mobile phones if they are farmers. [FGDP7]

Even though not every individual farmer had a mobile phone, almost every household was reported to have at least one mobile phone handset of some sort. Some households had more than one mobile phone handset. Some households had a smartphone while most households had feature phones. The FGD also pointed out that some farmers may have a Subscriber Identity Module (SIM) card but no handset. These would usually seek to use their colleagues' handsets while there were some reported isolated cases of

households with no mobile phone of any sort. As a critical factor for inclusion in this research, the researcher omitted those two cases.

According to FGD participants, farmers in Gokwe South use their mobile phones to perform most of the basic functions, that is, voice calling and receiving, SMS messaging, and *EcoCash* transactions (mobile money services). This can be supported by what **FGDP2** said:

I use my mobile phone for making and receiving voice and SMS messages. ... I use it for *EcoCash*. **[FGDP2]**

A good number of farmers also used their mobile phones for performing calculations, as a clock, as an alarm for waking up and for diary reminders. A substantial, but limited, number of smallholder farmers were said to be effectively using *WhatsApp* messaging and to a lesser extent, accessing *Facebook* and the internet. Some farmers use their mobile phones to receive agricultural information, especially from the agricultural extension officers but very few are directly accessing, enquiring or searching for information for themselves. **FGDP4** said:

I have some farmers who have been so enthusiastic about using mobile phones ... these farmers have created WhatsApp groups where they discuss and interrogate issues ... I am a member of such groups. **[FGDP4]**

According to the FGD participants, some farmers in Gokwe South are beginning to appreciate the value of using their mobile phones in their agricultural activities. Although at the time of this research, the level of use was said to be not extensive, the bottom line was that farmers in the area were beginning to appreciate the value of the mobile phone to their agricultural activities. Table 5.2 categorises agricultural activities.

Table 5.2: Farming activities are done via mobile phone according to the FGD.

	Farming activity via mobile phone	Projected rate of farmers possibly using the mobile phone for that activity.
1	general farming housekeeping	The bulk of farmers is estimated at +60%.
2	enquire for inputs	Around 60% of those farmers use mobile phones.
3	[obtain] weather information	Around 50% of those farmers use mobile phones.

4	[obtain] market price for inputs	Around 50% of those farmers use mobile phones.
5	pre-planting management	Very few around 15% of those farmers own mobile phones.
6	[obtain] pest and disease control information	Around 30% of those farmers own mobile phones.
7	animal husbandry	Around 40% of those farmers own mobile phones.
8	post-harvesting management	Around 20 % of those farmers own mobile phones.
9	[obtain] market price for produce	Around 50% of those farmers own mobile phones
10	[pay] for agriculture inputs and [receive] payments for their produce via <i>EcoCash</i> .	Around +80% of those farmers with mobile phones.

EcoCash dominates mobile money services in the Gokwe South District. Activities such as general farming housekeeping, enquiring about inputs, receiving information, searching, and obtaining a market price for inputs for agriculture and markets for the products attracted at least 50% of farmers with mobile phones. The following activities were reported to be attractive to the more affluent farmers: pre-planting management, seeking and getting pest and disease control information, animal husbandry and post-harvesting management.

The mobile phone is useful in the everyday life of a farmer as it facilitates the provision of actionable, groundbreaking and context-specific information to farmers in real time. Furthermore, mobile phones enable the elimination of arbitrages. Through the usage of mobile phones, farmers can communicate easily, cheaply and in real time. This saves farmers time and energy and consequently, boosts production. **FGDP1** stated:

I feel that the mobile phone is very useful in the everyday life of a farmer as agriculture is information centric. It requires information actionable in actual time at the point in time. As Cottco we occasionally provide information to cotton farmers ... it is not as frequent. [**FGDP1**]

Mobile phones also enable farmers to access services, lucrative agricultural markets for their produce and nascent farming technologies. The participants suggested that even though the agricultural extension officer gives them all the valuable agricultural information, without a mobile phone there are several things' farmers would not be able

to do. The mobile phone enables farmers to record information and this recorded information can then be referred to later and to some extent, the recorded audio or videos can be shared with other farmers. The farmers were also reportedly using their mobile phones to communicate with customers from far places like Bulawayo and Harare. This enables farmers to send products by bus to faraway clients and when the client receives the product, they could then make the payment through *EcoCash*.

The FGD participants indicated that smallholder farmers in Gokwe South face many challenges, which hinder their progression in their usage of mobile phone technologies for agricultural purposes. Farmers lack the acquaintance and information to fully exploit mobile phone technologies. There is a lack of infrastructures like base stations, and this results in erratic network availability as pointed out by **FGDP7**: “Infrastructure is a real challenge and I agree”. The proliferation of '*zhing zhong*' (cheap, poorly manufactured, Chinese) handsets of poor quality is doing farmers a disservice as these phones malfunction a short time after their acquisition. As one participant **FGDP10** suggested:

Farmers are also exposed to [the] dealers who sell counterfeit handsets, these are phones that would appear reasonably priced and affordable for their appearance and unsuspecting farmers are attracted by that. [**FGDP10**]

Perhaps this is a result of the high price of the authentic mobile phone considering the farmers' incomes. Participants also talked about the cost of general mobile phone services and specific agricultural services and applications. **FGDP3** pointed out that:

The cost of mobile phone agriculture applications and services is very high and is not affordable for many ... erratic network availability, only Buddy is found in many places. [**FGDP3**]

The other challenges identified by the FGD participants include illiteracy (as some farmers may not be digitally skilled to operate mobile phones), old age, gender dynamics and the socioeconomic status of some farmers. **FGDP4** suggested that the “education and training of farmers is critical”. The participants suggested that the farmers should be educated on the importance of mobile phones in their everyday agricultural activities. It is regarded as paramount for the farmers to be equipped with the necessary knowledge and information for them to fully exploit the advantages brought about by mobile phones. The

participants expressed a need to address the lack of infrastructure like base stations and POTRAZ was called upon to play a leading role in this issue, to solve erratic network availability. On the proliferation of *zhing-zhong* handsets, a solution of having mobile phone loan schemes for farmers was suggested, which might enable farmers to secure mobile phones at zero deposit.

POTRAZ, the regulatory authority, should gazette affordable prices for telecommunication services and lobby companies that provide mobile agricultural applications and services like *EcoFarmer*, *eMkambo*, *Mubatsiri* and *ESOKO*, among others, to reduce their current prices for the use of their services. It was also noted that agricultural extension officers needed to be trained on a variety of services and in return, teach farmers as they are highly influential on the farmers. Farmers listen to them and somewhat venerate them.

The mobile telecommunication operators and other application developers should engage agricultural extension officers of the area where they want to deploy their applications and services before launching them. ... an educated farmer is informed and empowered to act and put into practice what they know. [FGDP4]

The government should educate and train all farmers about the use of mobile phone applications in their agricultural activities and then notify them that all agriculture information about crops, inputs, pests and diseases, the weather is broadcasted on their mobile phones. [FGDP5]

5.4.2 Summary of focus group findings

Farmers in the Gokwe area mainly produce field crops, followed by horticulture, livestock, and poultry. Although the crops differ, there is a convergence on cereals, with maize being the main product as it is the main source of nutrition for most Zimbabweans. Gokwe farmers face a myriad of challenges in carrying out their agricultural activities. These include a lack of capital, the high costs of inputs, the late delivery of inputs from the government, droughts, pests, diseases, and the lack of lucrative markets for their produce. Very rudimentary and uncoordinated infrastructure like roads and bridges result in very high transport costs. Nevertheless, the challenges faced by farmers are surmountable. Awareness campaigns, education and training are the proposed solutions. Community involvement in development schemes could address the issues of roads and bridges in the area. Several measures proposed include delivering government input

schemes on time, contract farming partnerships between organisations like Cottco and farmers, input loan schemes and cattle loan schemes. Grouping farmers and loaning those inputs in groups was also suggested. There is a high level of mobile phone ownership in Gokwe. However, the challenge was using those phones for agricultural purposes. The next section presents the findings from the five (5) main research sites.

5.5 MAIN PHASE OBSERVATIONS AND INTERVIEWS IN GOKWE SOUTH

The Gokwe South District is very large, it is the largest district in Zimbabwe by geographical area and population. Due to its size, the district was divided into five (5) electoral constituencies comprising 33 wards. Each ward has an approximate average of 1800–2100 households (family units). It is one of the most active agricultural communal areas characterised by smallholder farmers in Zimbabwe. Each ward has an assigned agricultural extension officer to oversee the farming activities of the smallholder farmers in the area. Some wards are very large, such that they assign more than one agricultural extension officer. Ward 15, for example, has three agricultural extension officers due to its size. There are several villages in Ward 15 from which the researcher purposively chose five (5) villages, namely Mutanhaurwa, Nyamazana, Mutoranhema, Mashove and Dzawanda.

These villages were preferred because they share many of the same attributes, they are all in Ward 15 and they are all almost an equal distance from the Gokwe district commercial centre. In these five (5) villages, smallholder farmers were purposively sampled; six (6) farmers were chosen from each village, based on the criteria of having practised farming for the past five years, owning a mobile phone and having a family to provide for. All these chosen families are smallholder farmers who depend on agriculture for their livelihoods. All the sampled villages derive their names from the village head (*Sabhuku*) of each village. The village head of each village comes from a very established family in the area. Sometimes, eight (8) families shared the same surname with the village head, which is also the name of the village. These villages are named after the first family to set up a household in the area long ago. As children grow up and start their own

families, their father would set up their homesteads by allocating pieces of land in the area to them. They also gave some people coming from elsewhere seeking to establish households' portions of land based on mutual understandings between them and the village heads. A cross-case analysis of the findings is presented next (For a detailed case-by-case analysis of the five villages, see Appendices G 1–5 on case sites).

5.6 CROSS CASE ANALYSIS

The research results from the five villages, namely Mutanhaurwa, Nyamazana, Mutoranhema, Mashove and Dzawanda are summarised and discussed in this section.

5.6.1 Observation findings from Gokwe South

The five (5) villages mirrored all homesteads virtually identically, and the fields of the studied farmers had comparable characteristics. Many homesteads had corn fields, along with cattle, poultry, vegetables and a communal granary. Vehicles, piggeries and rabbits were present in a few families. In Nyamazana Village 5, one farmer had established a dairy venture. There are farmers' clubs where members manage many community projects in Dzawanda village, which sets it apart from others. Moreover, the farmers in that village often have more possessions than those in the other four research sites.

5.6.2 Interview findings from Gokwe South

The next section presents the demographic information of all the farmers in all the research sites.

Demographic data

The constraints faced by smallholder farmers in Gokwe South can be categorised considering their demographic attributes. To ascertain the overall degree of literacy predominant among many of the research participants, the participants' levels of education are considered crucial. Since experience is a major factor in determining the adoption of mobile phone technology, it was necessary to gain insight into the smallholder farmers' general farming experience. The female farmers in this study made up 30% of the population and 70% were male.

The maximum level of education acquired by farmers across all five research sites is displayed in Table 5.3. Twenty-two of the 30 participants (73.33%) had completed elementary education and five of those participants had earned a national certificate or a diploma. There were four people with junior certificates and four people with certificates that were below junior level, with a total of 13% for each. Based on this information, one can conclude that farmers in Gokwe have a basic education and can receive technical training for topics like the usage of mobile phones for agricultural activities. The family sizes as determined across all case sites, including the interviewee and any spouses, are displayed on the pie chart. Family size five had the most respondents, 11 or 36%, followed by family size six with seven respondents or 23%, family size seven, with seven participants or 20% and family sizes four, eight and above 10 with two respondents or 7%, respectively. One farmer had 17 family members, 12 children, four spouses and the head of the family, while the other had 24–19 children, four spouses and the head of the family.

Table 5.3: Demographic data of interviewees in Gokwe South

Demographic Variables		Male		Female		Total	
1	Gender	Count	Percentage	Count	Percentage		
		21	70%	9	30%	30	100%
2	Age			Count	Percentage		
	Younger than 35 years			2	7%		
	35–44 years			13	43%		
	45–54 years			12	40%		
	55 years and older			3	10%		
	Total					30	100%
3	Level of Education			Count	Percentage		
	Below junior certificate			4	13%		
	Junior certificate			4	13%		
	Ordinary level			17	57%		
	Ordinary level plus			5	17%		
	Total					30	100%
4	Family Size			Count	Percentage		
	Five or fewer members			13	43%		
	6–8 Members			15	50%		
	10 or more members			2	7%		
	Total					30	100%
5	Size of Land Owned			Count	Percentage		
	Below five acres			6	20%		
	five to seven acres			16	54%		
	Above seven acres			8	26%		
	Total					30	100%

6	Farming Experience			Count	Percentage		
	5–10 years			11	37%		
	11–15 years			8	27%		
	16–20 years			4	13%		
	Older than 20 years			7	23%		
	Total					30	100%

5.6.3 Agricultural activities, earnings and challenges faced by farmers in Gokwe South

This section presents the findings from all five case sites on land ownership, the size of land owned, agriculture knowledge acquisition, the farming experience accumulated by farmers and agricultural activities practised by farmers in Gokwe South. The section further presents the challenges faced by farmers in Gokwe concerning their agricultural activities and the general incomes earned by farmers. These are crucial to the study since they allow for the determination of the individual's overall level of wealth. Smallholder farmers' overall agricultural experience is crucial since it sheds light on their tenure and is a significant determinant of whether they would adopt mobile phone technology.

According to findings from all research locations, all farmers own the land on which they are engaged in agriculture, as shown in Table 5.3. However, the size of the land owned is variable across all cases, with the lowest at approximately 3.5 acres and the largest at five hectares. The bulk of respondents across all research sites own, on average, five to seven acres of land for private agricultural use. There is also land collectively owned by the community, like grazing land, which is designated for collective community projects. Other than the problem of small land sizes, farmers could use their land as productively as possible.

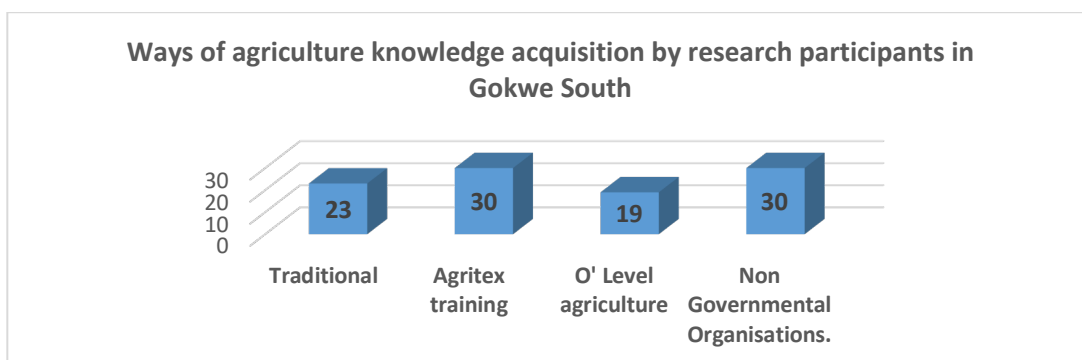


Figure 5.3: Ways of agriculture knowledge acquisition by research participants in Gokwe South

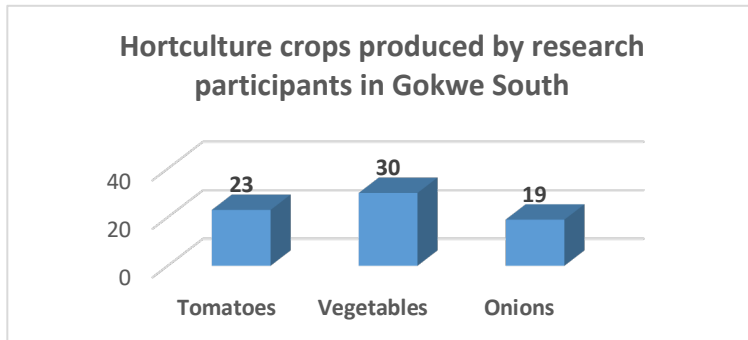


Figure 5.4: The most popular horticulture crops produced by research participants in Gokwe South

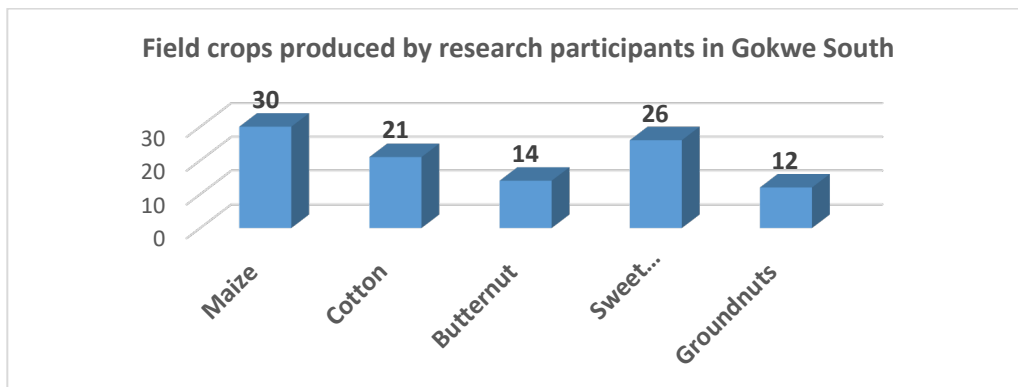


Figure 5.5: The most popular field crops produced by research participants in Gokwe South

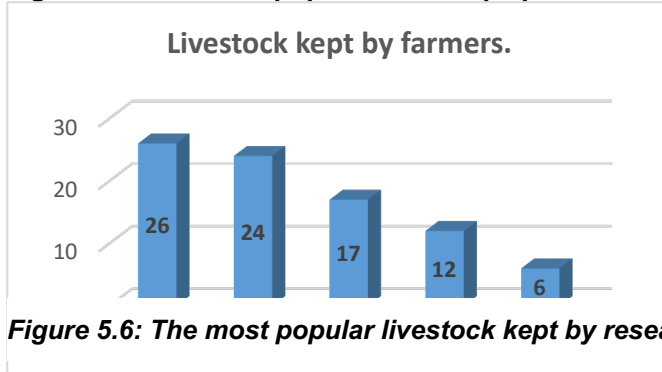


Figure 5.6: The most popular livestock kept by research participants in Gokwe South

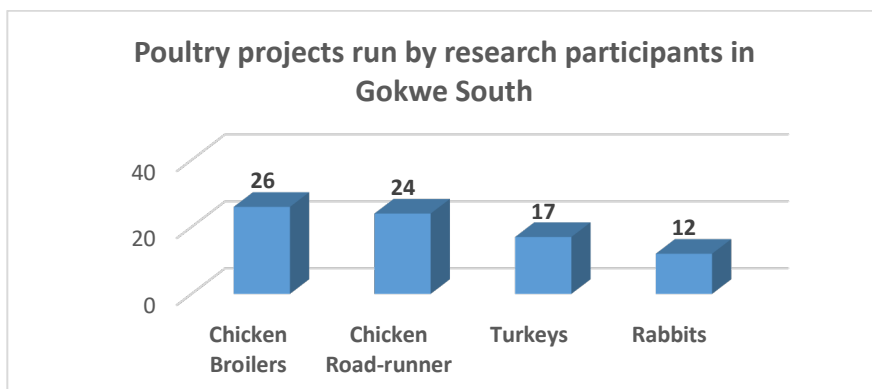


Figure 5.7: The most popular poultry projects run by research participants in Gokwe South

Table 5.4: Themes of challenges faced by research participants in Gokwe South

Themes of challenges faced by research participants	Examples	The number of participants who identified the theme.
Rain	Drought, Inadequate rain, changing rainfall patterns, late rainfall, and early ending rainfall. Recurrent droughts.	26
Pests and diseases	Avian influenza, anthrax, armyworm, fall armyworm. Maize lethal necrosis, tomato leaf miner.	23
Inputs and costs	Scarcity, limited options, limited suppliers, limited varieties, costly prices.	24
Market and prices for produce	Unavailable markets, less lucrative markets, price of produce imposed on farmers, unviable prices offered by GMB, CMB, etc.	25
Asymmetric information	The farmers are always handicapped by a lack of information, and they always negotiate from a weak position.	21
Absence of real-time actionable farming information	Farmers always get stale information, which does not help them in their quest to be productive in their farming activities.	19

The largest number of the farmers interviewed depend on agriculture for their survival, as 27 out of 30 (90%) of the respondents pointed out that they depended on their agricultural activities. Only three (10%) of the farmers had spouses working in South Africa. The farmers who were interviewed disclosed a range of agricultural income. The farmers in Gokwe South demonstrated that they conduct their assessments differently since some felt at ease disclosing their revenues monthly, while others preferred to do so quarterly, biannually, and annually. Below are the excerpts from the interview transcripts:

Farming is a livelihood, and I must live on it, my family depends on it ... every three months get \$3000-00 to \$6000-00 collectively from my farming activities. [SHFF]

I am into farming full time, and I don't have other activities. ... I must make sure I am equipped. Farming is a livelihood, and I must live on it, my family depends on it ... every year I get on average \$25000-00 to \$48000-00 collectively from all my farming activities depending on the year. [SHFL]

I must live on it; my family depends on it ... every year I get on average \$15000-00 to \$23000-00 collectively from my farming activities depending on the year. [SHFP]

The other crops are multipurpose that is they are for consumption and selling. The pleasurable thing about cotton is that we are paid in US\$ and as result inflation does not affect your money. [SHFP]

Table 5.5: Earnings from agricultural activities by research participants in Gokwe South

Earnings/Month	No farmers earning the amount
Z\$1000–Z\$2000	7
Z\$2001–Z\$3000	13
Z\$3001–Z\$4000	5
Z\$4001–Z\$5000	3
Z\$5001 +	2

5.6.4 Mobile phone ownership and general use by research participants in Gokwe South

This section presents findings collectively from all five research sites relating to mobile phone ownership by farmers in Gokwe South, their general mobile phone use and the costs associated with it. The level of mobile phone ownership, period of ownership, type of mobile phone owned, current mobile phone usage expenditure, level of mobile phone accessories accessibility and the general mobile phone uses of research participants in Gokwe South is important for this research. This information is important since it is a precursor to the acceptance, adoption, and effective usage of mobile phones in any social application. All the sampled farmers had mobile phones because that was a requirement for participation in the study. Farmers ranged in the length of time of their ownership of mobile phones from five to 22 years.

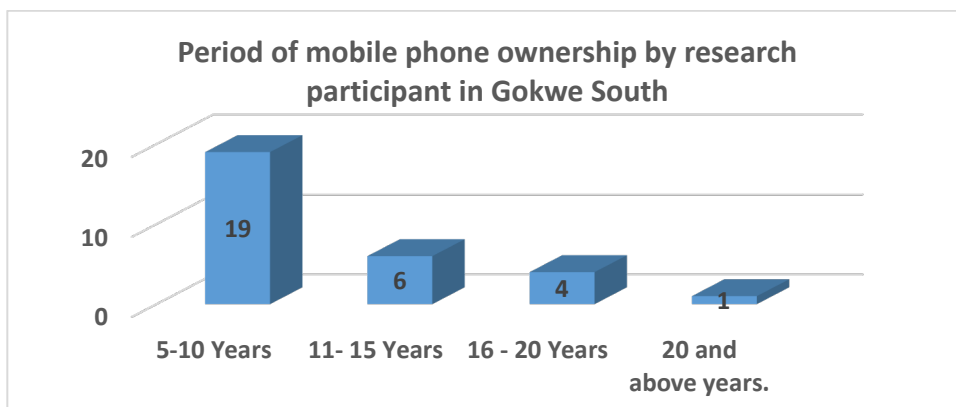


Figure 5.8: The period that research participants in Gokwe South have had mobile phones.

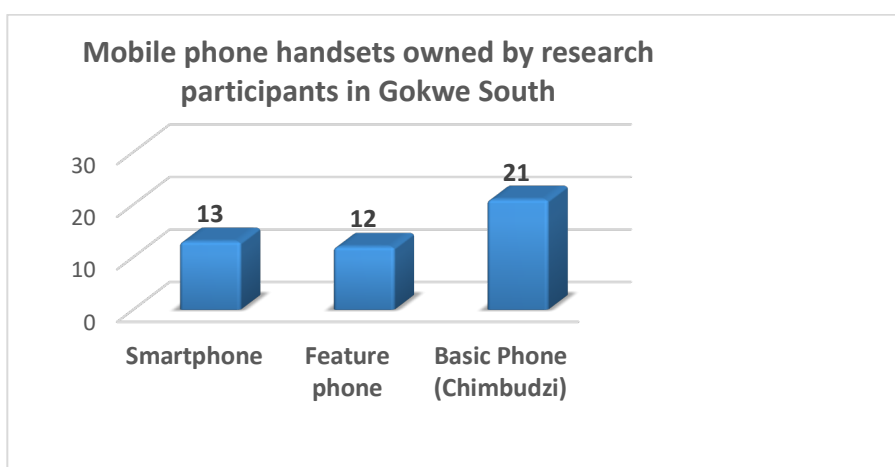


Figure 5.9: The mobile phone handsets owned by research participants in Gokwe South

The mobile phone handset ownership presented in Figure 5.9 shows that 13 farmers owned smartphones, 12 farmers owned feature phones, and 21 owned basic phones. The total number of handsets owned is 46 against 30 farmers interviewed. That accounted for the multiple device ownership by some farmers. Four farmers had three handsets each (two at Dzawanda village, one at Mashove and one at Mutoranhema), while a total of eight farmers had two handsets each (Nyamazana four, Dzawanda three and Mutanhaurwa one). The interviewed farmers who possessed smartphones indicated that they paid various amounts ranging from US\$70-00 to US\$120-00 while the feature phone was purchased for between US\$19-00 to US\$29-00. Figure 5.10 shows the farmers' subscriptions to different telecommunication service providers. Thirty-one participants subscribed to Econet (one subscriber with two SIM cards for Econet). The

sim cards do not tally with the number of handsets in the participants' possession. This is explained by the farmers interchanging SIM cards between their handsets. These farmers were using their basic phones most of the time and were only using their smartphones at specific times to check *WhatsApp* messages and other important information in the mornings and evenings. Most information pertaining to this can be obtained in the Appendices in this thesis, where the individual case site data are presented (See Appendix G:1 Case Site A-Mutanhaurwa village, pages 306–307; Appendix G:2 Case site B-Nyamazana Village 5, pages 320–321; Appendix G:3 Case site C-Mutoranhema village, pages 330–331; Appendix G:4 Case site D- Mashove village, pages 337–338 and Appendix G:5 Case site E- Dzawanda village, pages 346–347).

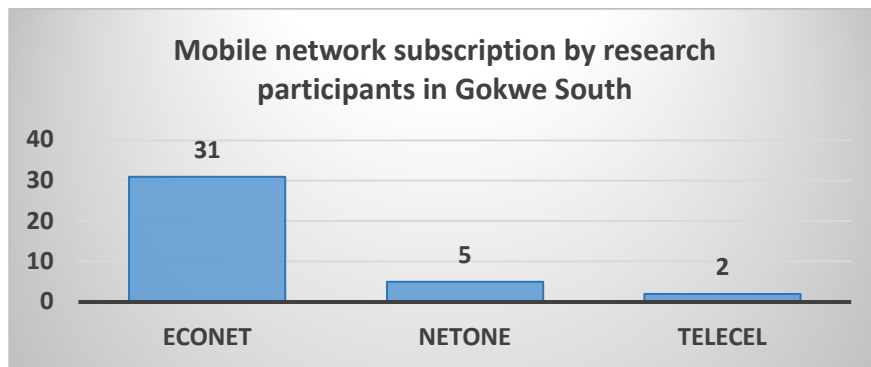


Figure 5.10: Network subscriptions by research participants in Gokwe South

The respondents demonstrated that purchasing mobile phone handsets is difficult since they have had experience purchasing counterfeit phones, which were allegedly imported from China by unscrupulous traders in Zimbabwe. Most people know these as ‘*mazhanga*’ (*zhing zhong*). It is simple to obtain Econet airtime through mobile money transfers, retailers and *EcoCash* agents. Customers of NetOne and Telecel struggle to purchase airtime because, at the time of this research, they could only do so at the Gokwe Centre, as revealed by the excerpts below:

I use Buddie [Econet] because I usually receive money from relatives and customers through EcoCash and the network of Econet is available in Gokwe. [SHFC]

The mobile phone is very handy for the work of a farmer and farmers need to get phones and use them for agriculture activities. [SHFP]

The general mobile phone uses by the research participants in Gokwe South is depicted in Figure 5.10, which demonstrates that farmers are proficient mobile phone users. Such statements below, extracted from the interviewees demonstrate this:

My phone serves as a radio receiver, a phone for making calls and sending SMS messages, a calculator, a camera, a mobile money service, *WhatsApp*, *Facebook*, and the internet. [SHFZ]

The way my phone has recently developed into a multipurpose device that allows me to talk to anyone, anywhere, about anything, at any time. In one gadget, there is a clock, radio, bank, payment system, communication device, data storage device, and photo and video camera. [SHFAD]

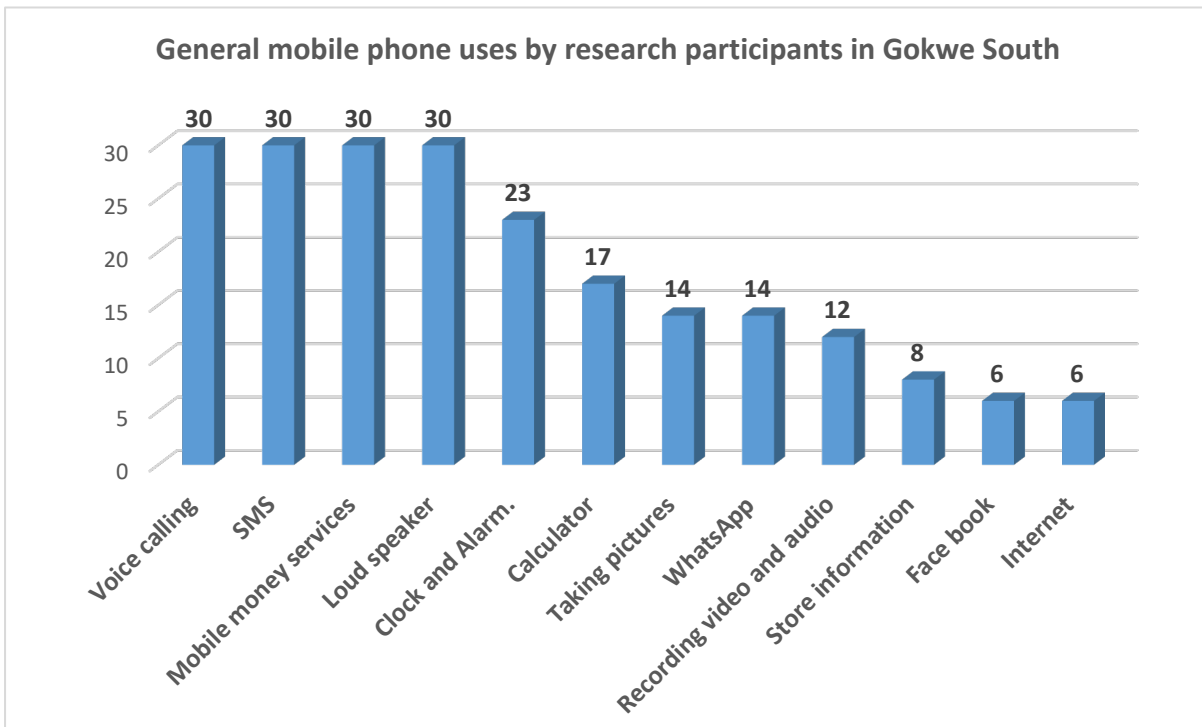


Figure 5.11: The general mobile phone uses by research participants in Gokwe South

Additionally, participants in the Gokwe South generally agreed that anyone could use a mobile phone, including women. Male participants stated that they purchased better mobile phone handsets (smartphones) for their spouses than for themselves. The married female farmers who were interviewed stated that their spouses do not place any restrictions on their use of mobile phones, as evidence for this claim.

5.6.5 Mobile phone use in agricultural activities by research participants in Gokwe South

Generally, some smallholder farmers in Gokwe revealed that they use their mobile phones for marketing purposes as they showcase their agricultural products to potential customers. A good number of the interviewed farmers use their mobile phones to make calls to different marketplaces to establish market prices for their commodities. Some farmers use their mobile phones to call the agricultural extension officers as well as to share information with other farmers. Some smallholder farmers upload agricultural product images to their *WhatsApp* statuses, while others upload to *WhatsApp* groups. Generally, farmers use mobile phones for agricultural purposes variably. Farmers at Dzawanda village were the most active in terms of using their mobile phones for agricultural purposes as they claimed that they used some of Zimbabwe's mobile agriculture application services.

These farmers indicated that they actively used the data packages offered by mobile telecommunications companies Econet Wireless, NetOne and Telecel. They identified *EcoFarmer* as a mobile agriculture application developed by the largest telecommunication company in Zimbabwe, Econet wireless, while German Agro (Welthungerhilfe), a non-governmental organisation in Zimbabwe, provided *Kurima Mari*. They further pointed out that they had difficulty adopting various mobile agriculture applications due to the costs associated with their use. Some mobile phone technologies are inaccessible and unusable without data. They further stated that the permanent lack of some network services in particular areas make it difficult for smallholder farmers since they are constrained to using a single service provider and hence, have no other options. The *EcoFarmer* application is also inaccessible through other mobile phone telecommunications carriers because Econet developed it for its consumers. However, the researcher noted that, while most of the interviewed farmers were using their mobile phones for different agricultural activities, all the farmers interviewed from the other four research sites did not use mobile agricultural applications in contrast with the farmers interviewed in Dzawanda village.

This is the crux of the current research as the level of mobile phone technology use or underutilisation by research participants in Gokwe South reveals deeper insight into the contextual issues and challenges around mobile phone use for agricultural purposes in Zimbabwe. Such insight enables the emergence of a theory illuminating the reasons for the lack of smallholder farmers' adoption of mobile phone technologies and their subsequent underusage, which is the main aim of the research. The emerging theory then assists in attaining the secondary purpose of this research by establishing the foundation for the development of a framework for harnessing mobile phones for the sustainable development of smallholder farmers in Zimbabwe. This information is important since it is a precursor to the successful and effective usage of mobile phones in any social application. The mobile phone utilisation in agriculture by farmers in Gokwe South is summarised and tabulated in Table 5.6. Below are the interview excerpts on mobile phone use by farmers for agricultural purposes:

I've called specialised markets on my phone ever since I first started using a mobile device. My mobile phone allows me to obtain information about the best seed varieties, best planting dates and illnesses and agrochemicals to use to combat pests and diseases. This increased knowledge can have a greater impact on the productivity of my agricultural activities. **[SHFJ]**

I continuously interrogate the latest technology in agriculture to mechanise and modernise our agriculture. agricultural extension officers are not the same, we used to have an old officer operating in this area when we were children and he retired three years ago. He was behind and he was finding it difficult to embrace new technology, yet agriculture is information-intensive and always embryonic ... but the new officer on the forefront, always demanding that every farmer must have a mobile phone, as he would want to send information to every farmer any time. **[SHFC]**

I use my mobile phone to [communicate] the [agricultural extension officer] for consulting about crops and livestock, parasites and diseases, and other stakeholders in the value chain in the current time. No other gadget or medium can facilitate tailor-made information that is actionable. It's good that we use these applications, and they help us ... I am an *EcoFarmer*, and this is the way to go for farmers. **[SHFAC]**

The mobile phone technology applications for agriculture are very good, but I think there should be continuously updated with new content and information every day ... now there are new

evolving pests that are not curbed by mobile phone technology applications use. ... We usually call the agricultural extension officer for solutions. [SHFY]

Table 5.6: Themes about how research participants in Gokwe South were using mobile phones in agriculture

Theme	Example	Participants who identified it.
Access to agriculture inputs.	Calls agro-business dealers to enquire about input availability and prices.	29
Farming education and training.	The agricultural extension officer makes a phone call to give instructions on what should be done for Master Farmers and Advanced Farmers.	17
Access to market information.	Calls agro-business operators and markets to enquire about market prices for products.	30
Financial transactions.	The farmers pay for their inputs, buy products and receive money from customers using <i>EcoCash</i> .	30
Agriculture emergency issues.	Call the agricultural extension officer, consulting on emerging issues around crops and animal pests and diseases.	23
Video and Voice recording.	Agricultural extension officer records voice/video instructing farmers/performing a demonstration on what they should do using the mobile phone and sending it via <i>WhatsApp</i> to farmers.	13
Using loudspeaker.	Farmers meet at an agreed location to listen to the instruction from the agricultural extension officer via audio, video recording or voice call.	30
Storage of information	Some farmers store valuable instructional messages, audio, and videos on mobile phones for future reference and to share with others.	13
Calculator use.	Farmers use mobile phone calculators to perform different calculations in their agricultural activities.	21
Clock/Alarm	Farmers use their mobile phones as clocks for time reading and as alarms for waking up early and reminders.	27

There was inadequate information for gauging the value of the mobile agricultural applications from the perspective of the farmers and the cost associated with the applications because the interviewed farmers were not using the applications. However, since most mobile applications use data, the farmers complained about the cost of data and other mobile-associated services, which may imply that the applications are expensive. The excerpts from the interview transcripts below reiterates this:

I buy data for Z\$10-00 every week (Z\$60-00 per month) and Z\$15-00 per month for voice calling for Buddie. I check messages *WhatsApp* messages three times a day, morning, afternoon and evening, the rest of the time I switch data off. [SHFP]

Data is expensive ... I buy the smallest monthly data bundle of **fusion** which costs Z\$110-00. This save[s] me well the complete month. [SHFAB]

The farmers demonstrated how useful they found their mobile phones in their agricultural endeavours. There is convergence across all five research locations about the efficacy of mobile phone technologies in agriculture for acquiring information about inputs, prices and marketplaces. Farmers claim their mobile phones provide valuable information that has allowed them to lower their input costs and improve the income they realise from their agricultural activities.

Since many agricultural products are perishable, farmers frequently suffer significant losses when they are unable to secure a market. So, eventually, the use of mobile phones increases profitability. [SHFJ]

The mobile phone is compatible with our agricultural information and operation requirements as farmers. The mobile phone can message, call, record videos, take pictures, and transact. [SHFO]

Sometimes I even call before harvesting and many a time I have harvested after securing the market. [SHFS]

The functionalities of mobile phones are compatible with auxiliary agricultural duties performed by farmers, making mobile phones suitable for most of their activities. The study discovered that the mobile phone is the only technological device that can provide context-specific, up-to-date and actionable information, which is necessary for the information-intensive practice of agriculture. Many of the interviewed farmers concurred that adopting and using mobile phones in agricultural operations could help farmers overcome difficulties accessing information about agriculture and information asymmetry.

5.6.6 The challenges regarding the use of the mobile phone to access agricultural information

This section presents findings relating to the challenges faced by farmers regarding the use of mobile phones for agricultural purposes. The interviewed farmers identified the lack of support from the telecommunication service providers of mobile and telecommunication services as affecting the adoption and use of mobile phones for agriculture. They mentioned the almost complete lack of NetOne and Telecel base stations in many rural communities inhabited by smallholder farmers. Even Econet, the company with the widest coverage nationwide, has weaknesses. Its agricultural application service *EcoFarmer* has not received the same promotional support and investment as the company's other application services like *EcoSure*, *EcoCash* and *Maisha* health, among others:

The networks of the other two operators, NetOne and Telecel, are exceedingly unpredictable, and no supporting organisations are available to them. The airtime or mobile agencies for them are nowhere to be found. In addition, where there is no electricity, the Telecel network is nonfunctional. [SHFX]

The interviewees also cited a lack of knowledge of how mobile phone technology agricultural applications work and all farmers in Gokwe South are discouraged from using mobile cellular services due to their perception of their high costs, but they are using them in their general everyday lives except for farmers at Dzawanda. The interviewees cited that mobile phones are very expensive beyond the means of most farmers and as a result, most farmers are compelled to look for alternatives and, more often, they fall victim to counterfeit handsets that do not last long.

The network is very erratic, and most people travel from their homesteads to access the network. The cost of calling, SMS messaging and data are very high. [SHFJ]

The lack of digital literacy among many farmers exacerbates the costs of mobile phone services, with voice calling and data being out of the reach of many. Poor or inconsistent network coverage is caused by a lack of essential infrastructure, which includes energy, mobile communications (such as base stations) and others. As a result, there are several network blackout patches over substantial geographic areas. Farmers who access the internet over an inconsistent, bad network might also be affected by this. Farmers

generally occupy a low socioeconomic status which makes it difficult for them to use mobile phones effectively because the devices 'compete' with other farming obligations for limited resources.

Farmers generally cannot afford mobile phone services like voice calling and data, which presents a challenge. [SHFC]

The usage of mobile telecommunication services by all farmers in Gokwe South are hindered by their perceived high costs. [SHFR]

5.6.7 Other sources of accessing agricultural information in Zimbabwe

This research established that farmers had other sources for accessing agricultural information. They disclosed that they received agricultural information through agricultural extension officers, radio, word-of-mouth and (partly) television and newspapers. However, when comparing them to the mobile phone they all fell short. agricultural extension officers are reliable sources of agricultural information, but they are ill-equipped because they cannot cover their areas effectively to disseminate information to all farmers; however, mobile phone technology could complement the officers' tasks. Radio and television offer universal information in most cases, yet farmers require real-time, context-specific, and actionable information. The newspaper offers state and generalised agricultural information. Word-of-mouth has limitations since the chain of communication involves many people and that could distort messages every time another person passes on the message. The mobile phone is superior in this sense because it is the only medium that offers real-time, context-specific, and actionable information to farmers.

We receive agriculture information about crops, inputs, pests, and diseases, weather on radio television, but and in most cases, it is general and not geographically specific, hence it is not actionable for us as farmers. [SHFN]

5.6.8 The positive factors that prevail in Gokwe South, which gives hope that the use of mobile phones in communicating agricultural information may improve.

This study found that all the families had at least one mobile phone since all farmers interviewed had one, while some had basic phones only and few had smartphones. All the farmers were competently utilising their mobile phones for general purposes, which

was a very promising start. According to the farmers questioned, Gokwe South is distinctive due to the high rate of mobile phone ownership in the area. The interviewed farmers in Gokwe South also stated that the primary sociocultural barriers affecting the adoption and usage of mobile phones by everyone in society, including women, are already outdated. Many of the farmers questioned in Gokwe South had some formal education and vary in age from late 30s to early 50s; hence, they can be educated to utilise mobile phones efficiently for agriculture. The farmers' socioeconomic situation is not dire. Farmers in Gokwe South have spent a significant amount of time using mobile phones, which aids their comprehension of the benefits provided by mobile phone technology. Most of the farmers questioned had reasonably small and manageable families, consequently, they were not overburdened with duties.

I once spent five weeks with my SIM card in my pocket after my handset broke down. I use Buddie [Econet] because it is the only operator with a network available in Gokwe. [SHFA]

I would like to believe that since the bulk of farmers is in their 40s [age range], they are in the prime age where they are responsible [have families to support] and able to learn unfamiliar things. [SHFL]

Gokwe has perceived positive subjective norms, which favour the harnessing of mobile phones in agricultural activities. [SHFO]

It is a huge advantage to have your livestock because if you do not have livestock, you will not have the benefits listed above. [SHFW]

I am a member of the ABC group of farmers in Ward 15 ... these farmers are farmers who have created a *WhatsApp* group where members share and discuss any information about agriculture. [SHFX]

5.6.9 The actions that should be taken to improve the adoption and use of mobile phones as sources of agricultural information among smallholder farmers in Zimbabwe

The recommendations in this section are intended to increase the rate of uptake and sustained use of mobile phones as agricultural information sources among smallholder farmers in Gokwe South and, as a result, among all smallholder farmers in Gokwe and Zimbabwe. The actions are grouped into two sections: (a) the role mobile telecommunication companies and other agricultural mobile application companies

should play and (b) the roles the government ministries and associated agencies should play.

A. The role of telecommunications companies and other agricultural mobile applications developers

- a) Farmers think telecommunication companies like Econet and NetOne should ensure that there is sufficient telecommunication infrastructure like base stations in rural areas to ensure that the network is available.
- b) These telecommunication companies can also team up with mobile phone handset manufacturers like Itel, GTel, Samsung, Huawei or any other company and devise a contingency plan for handsets for farmers.
- c) For instance, tailor-making a mobile phone for farmers, which cannot be used by any other person other than the person registered for it. In addition, these phones should be given to farmers at an affordable price, once someone had been authenticated as a farmer:

The Zimbabwean government should encourage mobile telecommunication service providers like Econet, NetOne and Telecel and, to some extent, order them to provide subsidised mobile agriculture packages and a low service package like SMS and call services for smallholder farmers in [the] rural areas, through POTRAZ (the Postal Regulatory Authority of Zimbabwe).

SHFE

B. The role of government ministries and the associated agencies

The farmers surveyed claimed that the government could order agriculture and extension services to instruct and inform all farmers on how to use mobile phone applications for their agricultural activities before informing them that all agricultural information regarding crops, inputs, pests and diseases, and weather forecasts would be broadcast to their mobile phones. The government should educate farmers on the significance and benefits of mobile phones in agricultural growth. In addition, government should pass legislation that encourages the growth and spread of ICTs in all socioeconomic areas, notably agriculture, about which it appears to have been complacent over the years. The government should promote the installation of mobile phone infrastructure, such as base

stations, in rural and isolated locations. If the farming society is to embrace, utilise and apply mobile phones in their agricultural activities, capacity-building is essential. Smallholder farmers in rural areas should be encouraged or even urged to use subsidised mobile agricultural packages and low-cost services like SMS and call services from mobile telecom service providers. The government should also mandate that all mobile agriculture app makers instruct farmers on how to use them before their apps are released. This was derived from the following excerpts:

The Zimbabwean government through the Postal Regulatory Authority of Zimbabwe (POTRAZ) should deploy a base station in the rural areas. This would ensure the existence of a robust and dependable mobile telecommunication network in rural areas. [SHFG]

Government should educate farmers on the role/benefits of ICT in agriculture; it should enact legislation, which supports the growth and spread of ICTs in agriculture sectors and make it mandatory for companies developing mobile agriculture applications to train farmers before deploying their applications. [SHFM]

Capacity building is important if the society is to agree to take, adopt and use ICTs; otherwise, many farmers have their mobile phones, which means there are high mobile penetration rates as every household has at least a mobile phone. [SHFP]

The government should also take responsibility and make it mandatory for agricultural extension officers to use mobile phones and support the initiative with resources. [SHFW]

I think mobile telecommunication service companies such as Econet, NetOne, and Telecel should be encouraged to offer subsidised mobile agriculture packages and low service packages like SMS and Call services for smallholder farmers in the rural areas. [SHFY]

I believe that the education and training of farmers are critical. Farmers need to be educated and equipped on how to use mobile agriculture applications and services and understand the value of these applications to their farming activities. [SHFAC]

5.7 THE INTERPRETATION OF THE PRIMARY RESEARCH QUESTION

The primary research question is:

Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general everyday lives?

This section presents a thematic analysis regarding the summary of research findings from the focus group discussion, observations by the researcher and individual interviews with farmers and agricultural extension officers. Results obtained from all five case sites are relatively similar, with only Dzawanda village overtaking other sites in terms of appreciation, adoption, and usage of mobile phones in their agricultural activities. The results are structured into research sub-questions and themes.

5.7.1 Interpretation of research sub-question 1

The first research sub-question.

What are the smallholder agricultural activities, characteristics and challenges in Zimbabwe?

Most of the interviewed farmers in the Gokwe South District are practising field crop farming, horticulture, and livestock and poultry production. All farmers produced maize because it is the staple food of the people in Gokwe South and Zimbabwe in general. Other field crops produced on a variability scale by different farmers include cotton, sunflower, groundnuts, sorghum, and sweet potatoes (*mbambaira*). All farmers practise horticulture and produce vegetables mainly for consumption and some for selling. Some farmers produce tomatoes, green paper, and onions on a large scale for business. However, there is a notable difference found in Dzawanda village. Farmers in Dzawanda village have community working projects and individual commercial projects. The projects include a piggery project and a garden project with tomato plants. The other project, which was active at the time of collecting data, is the poultry project where farmers are collectively keeping traditional chickens together. In addition, there is also the rabbit project. The piggery project has seven members, the chicken project has 12 members, the rabbit project has eight members, and the garden project has 15 members. In Nyamazana, there is also a notable difference between dairy farmers. More on this is provided in the appendices.

5.7.2 Interpretation of research Sub-Question 2

What are the mobile phone agricultural applications and services available in Zimbabwe?

There are numerous mobile phone technology agricultural applications in Zimbabwe, namely *ESOKO*, *eMkambo*, *Kurima Mari*, *EcoFarmer*, the Seedco Agronomy app and *AgriFin*. However, in this empirical study, only farmers interviewed in Dzawanda village were using some of these mobile phone agricultural applications, specifically *Ecofarmer* and *Kurima Mari*, while across all other four research sites, all the sampled farmers showed that they were not using any mobile agricultural application or service. Only two farmers specified that they were aware of the existence of *EcoFarmer* and had, at some point, attempted to use *EcoFarmer* from Econet but had abandoned it, citing a lack of support from the service provider. Thus, most of the interviewed farmers in Gokwe South were not aware of the existence of mobile agriculture applications and services available in Zimbabwe and, as a result, they are not using mobile applications, save for those interviewed at Dzawanda village.

5.7.3 Interpretation of research Sub-Question 3

What are the perceptions of Zimbabwean smallholder farmers on the role of the mobile phone in the sustainable development of smallholder agricultural activities?

The mobile phone is a highly valuable tool for farmers in their daily work. There is consensus across the five research locations about the utility of mobile phones in agriculture for acquiring information about inputs, prices, and marketplaces. Farmers claimed that mobile phone technology has a liberating impact on their agricultural pursuits since it gives them access to invaluable information that has allowed them to lower input costs and enhance revenue from their agricultural endeavours. Farmers believe that the use of mobile phone technology released them from the reckless behaviour of intermediaries and other value chain participants. Farmers can manage their farming operations with the help of their mobile phone technologies.

Findings from all five research sites show that farmers view the mobile phone as an indispensable tool for farmers. This is in accord with the findings from the FGD and the interviews with agricultural extension officers. Although there were a few cases of some

farmers being reserved, the consensus is that a mobile phone is a vital tool for the sustainable development of agriculture.

5.7.4 Interpretation of research Sub-Question 4 ***How do smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes?***

Findings across all five research sites show that farmers have adopted mobile phones for general use in life. All farmers are using their phones from voice calls for receiving information to SMS messaging and mobile money services. Besides that, some farmers use their mobile phones to listen to the radio or as clocks, alarms, and calculators. Many of the farmers used their mobile phones for voice calls and receiving information from the agricultural extension officers, Cottco officials, other farmers, and vendors from the market. While all the interviewed farmers had mobile phones in this study, very few were effectively using their mobile phones for agricultural purposes. Only farmers, mostly from Dzawanda village, were using mobile phone technology agricultural applications, and *Facebook* and *WhatsApp* to communicate agriculture-related information. All the study participants in the Dzawanda village had smartphones; however, only two farmers had all three types of phones, while four had two handsets, respectively. Farmers from the Dzawanda village were applying mobile phone technologies for agricultural tasks, and there was significant mobile phone usage for both community initiatives and agricultural housekeeping. The Dzawanda interviewees revealed that having a mobile phone was very helpful because they were engaging in agriculture operations uncommon among the local farmers. These farmers were utilising their mobile phones to call, use *WhatsApp*, or SMS local community project groups to share knowledge and information about raising pigs and rabbits, growing crops and treating livestock for parasites and diseases. Farmers, mainly in Dzawanda village, also established *WhatsApp* groups for information exchange. These farmers indicated that they would take a picture or video of a sick animal or plant leaves and send it to the agricultural extension officer for advice.

The agricultural extension officer would provide immediate feedback after receiving a photo or video of, e.g., a sick animal that a farmer had shared with other farmers and the

agricultural extension officer. Farmers in Dzawanda village spent substantially more money than farmers in the other four (4) research sites, perhaps because they were ostensibly better equipped than the farmers in the other villages. Nevertheless, the research revealed that the following factors prevented farmers from adopting and using mobile phones: a lack of the knowledge and digital skills required to utilise mobile phones, semi-literacy, advanced age, the absence or complete lack of essential infrastructure, socioeconomic position, the high cost of mobile phone technologies and mobile services, and a lack of support from telecommunications firms and other service providers.

The main reason some agricultural extension officers never utilise mobile phones in their interactions with farmers is that they [agricultural extension officers] lack advanced mobile phone technology skills and, as a result, suffer from 'technophobia'. Government policy was also found to be a major impediment as the agricultural extension officers insisted that they are not allowed to submit their weekly reports through mobile phones to their seniors. These officers indicated that they are told that the government policy requires them to bring hard copies of their weekly reports. Some suggested that it could be an issue of older people in positions of power in the department of agricultural extension, who have technophobia and might fear the loss of their jobs if mobile phones are integrated into the information movement and submission process. Some suggested that it could be a deliberate ploy by the government whereby it does not want to recognise the usage of mobile phones by agricultural extension officers because this may trigger a demand for data provision from the government by the agricultural extension officers.

5.7.5 Interpretation of research Sub-Question 5

What are the factors affecting the adoption and use of mobile phone technology as sources of agricultural information, their upscaling and sustainable use among smallholder farmers in Zimbabwe?

Smallholder farmers in Gokwe South lacked digital capabilities. As a result, most farmers in Zimbabwe have failed to embrace and use mobile agriculture applications. Farmers may settle for basic phones (*Chimbudzi*) that cannot run mobile agricultural apps because they believe they lack the necessary expertise to use smartphones and mobile agricultural applications. Farmers with smartphones lack digital skills and consequently, are unable

to use the internet or mobile agricultural applications due to their lack of technical knowledge. They are hampered by the perceived high costs of data, voice calling and subscriptions to mobile agricultural applications.

While all farmers have cellphones, the majority do not have smartphones. Some of the farmers interviewed indicated they could not afford cellphones because of their exorbitant pricing in comparison with their low incomes. Most parts of rural Gokwe South have either no network, poor signal strength or unreliable network coverage, particularly NetOne and Telecel. The only network available is Econet, although it has a few challenges. This implies that the variety of network subscriptions is limited for farmers in rural areas. The intention of Gokwe South's smallholder farmers to use their mobile phones as sources of agricultural knowledge is hampered by this. If farmers employing mobile agriculture applications encounter technological difficulties, receive no or extremely limited technical assistance. Even Econet, the largest network, has not done its product, *EcoFarmer*, justice in terms of investment marketing and effort when compared to other products that are not related to agriculture, such as *EcoSure*, *EcoCash Maisha* health, and so on. This prevents smallholder farmers in Gokwe South and Zimbabwe generally, from adopting cell phones as informational tools for agriculture.

4.7.6 Interpretation of research Sub-Question 6
How to ensure most smallholder farmers in Zimbabwe can be made to use mobile phone technologies effectively and productively in their agriculture activities?

The study found that mobile phone technologies are changing how people function, work and interact with one another, how people are working in the contemporary world and getting much-needed information, and how people manage their social and economic lives. However, as previous researchers have discovered, not all smallholders have mobile phones and even those who do possess mobile phones are not maximising them in their daily farming activities. As these mobile phone technologies touch people's daily lives, they could have an impact on developing nations' macroeconomic growth, which has an indirect impact on society because it allows for the provision of conduits for the

enhancement of people's standard of living. The study presents a framework for leveraging mobile phone technology to promote smallholder agriculture in Zimbabwe. The framework's development is influenced by the results obtained in this study. The suggested framework enables smallholder farmers in Zimbabwe to embrace and fully use mobile phone technology. All the suggested framework elements are listed and briefly explored.

5.8 TRIANGULATION OF RESEARCH RESULTS

The triangulation of the research results was done by cross validating the results from the FGD, individual in-depth interviews and the researcher's observations. The findings from the in-depth interviews and the FGD were almost like the researcher's observations.

5.8.1 The theoretical model and factors affecting the adoption and use of mobile phones in agriculture

This sub-section answers research Sub-Questions 3, 4 and 5. The theoretical model constructs are applied to investigate factors affecting the adoption and use of mobile phones for the sustainable development of smallholder agriculture. The perceptions of farmers on the role of mobile phones in the sustainable development of their agricultural activities was elicited, using the conceptual research model constructs. Perceived Expressiveness (PE), Perceived Costs (PC), Perceived Mobility (PM), Perceived Ease of Use, Perceived Support of Service Provider (PSoSP), Perceived Compatibility (PComp), Perceived Usefulness (PU), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC) are the nine constructs that constitute the theoretical framework developed for this study as a sensitisation guide. Table 5.7 below summarises the main aspects of the perceived benefits of mobile phone technology used in agriculture, as discovered in the analysis of the study's findings. The concepts pertain to how smallholder farmers perceive the use of mobile phone technologies in their agricultural activities. The concepts are briefly discussed in Table 5.7 below, along with excerpts from the interviews and the focus group data.

Table 5.7: Perceived benefits of mobile phone technology use in agriculture

Theme	Sub-Themes	Literature	Pilot study	FGD	Interviews
Communication device	Enables communication with key suppliers.	x	x	x	x
	Could reduce information costs.	x	x	x	x
	Could help reduce information asymmetry.	x		x	x
	Capable of delivering real-time information on climate, weather, input costs, product market pricing, diseases and other hazards.	x	x	x	x
	Capable of enlarging markets.	x		x	x
	Capable of reducing losses of perishable agricultural produce.	x	x	x	x
	Capable of facilitating knowledge-sharing among farmers.	x			x
Financial facility	Capability to facilitate banking, transaction services and money transfers between buyers and sellers.	x	x	x	x
	Capable of uploading and saving money for future transactions.	x	x	x	x
	Using <i>EcoCash</i> , you can purchase goods, pay for inputs and collect payments from customers.	x	x	x	x
Education tool.	The agricultural extension officer records a video instructing farmers and performing a demonstration of what they should do by using their mobile phones and sending the video to farmers via <i>WhatsApp</i> .			x	x
	In meetings, farmers listen to instructions from the agricultural extension officer through voice calls and recorded video or audio.			x	x
	Mobile phones are used by farmers to save and exchange informative texts, audio files and movies for later use.			x	x
	When the agricultural extension officer calls, he or she gives directions on what Master Farmers and Advanced Farmers should do.			x	x

The perceptions of the farmers in Gokwe South concerning the role of mobile phones are positive. The farmers suggested that before the advent of mobile phones, they used to write letters to inform other people about any development like sicknesses, funerals or family issues and it would take days, weeks, or months before receiving a reply. The mobile phone with its communication ability has enabled people to call in real time and get a response within a day. Hence, they now call, message or *WhatsApp* other farmers, agricultural extension officers and vendors. The mobile phone is facilitating knowledge-sharing, identification and opening new markets, resulting in the reduction of losses due to the perishability of some products. The farmers claim that the cost of communication and agricultural information could be reduced by using a mobile phone.

Additionally, the mobile phone could liberate and empower farmers in their negotiations with stakeholders, notably dealers, by reducing information asymmetry. Since agriculture is an information-intensive industry that needs real-time, context-specific actionable information, the mobile phone would also provide information on weather forecasts, input pricing and the market price for crops, diseases and other disasters in real time. The smallholder farmers suggested that the mobile phone has become a financial enabling tool for them as it facilitates money transfer, banking and transaction services between buyers and sellers. Farmers are now able to upload money into their *EcoCash* wallets and save the money for future transactions. With that money in the wallet, a farmer could pay for inputs from different suppliers, buy grocery products and receive money from customers like vendors via *EcoCash*.

The farmers who had been interviewed consider their smartphones to be tools for agricultural education. This is because farmers communicate via mobile phones with the local agricultural extension officer to conduct agricultural demonstrations and Master Farmer certificate training. This suggests that the mobile phone is an essential tool that may help buyers and sellers conduct business, send money and access financial services. Some of the farmers indicated they couldn't afford mobile phones owing to the devices' exorbitant pricing in comparison with their low incomes. The majority of rural Gokwe South has no network, weak signal strength or unstable network coverage, especially from NetOne and Telecel. Econet is the sole accessible network, although it has several limitations. This implies that rural farmers have few options when it comes to network subscriptions. This undermines the ambitions of smallholder farmers in Gokwe Souths to use mobile phone technologies as sources of income.

Farmers report that if they encounter technical difficulties when utilising mobile agriculture applications, they receive little or extremely limited professional assistance. According to some farmers, even Econet, the best network, has not done justice to its product, *EcoFarmer* compared to other non-agriculture-related businesses such as *EcoSure*, *EcoCash*, *Maisha* health and so on, in terms of investment marketing and effort. These conditions prevent smallholder farmers in Gokwe South and Zimbabwe, in general, from

adopting mobile phone technologies as informational tools for agriculture. Table 5.8 presents the smallholder farmers' perceived mobile phone usage capabilities and the perceived challenges they face in their quest to use mobile phones in their agricultural activities.

Table 5.8: Themes and sub-themes about smallholder farmers' mobile phone user capabilities and the challenges they face in their quest to appropriate mobile phones

Theme	Sub-Themes	Literature review	Pilot study	FGD	Interviews
Smallholder farmers' mobile phone use capabilities	The ability to top-up airtime by most smallholder farmers	x	x	x	x
	The ability to make calls, SMS and <i>WhatsApp</i> messaging by most smallholder farmers	x	x	x	x
	The ability to perform transactions on a mobile money transfer platform (<i>EcoCash</i>) by most smallholder farmers	x	x	x	x
	The ability to search agriculture-related information on the internet by some smallholder farmers	x	x	x	x
	The ability to change <i>WhatsApp</i> 'status' and attach images of agriculture products by some smallholder farmers			x	x
	The ability to record audio and videos and take pictures by some smallholder farmers			x	x
	The ability to use <i>Facebook</i> by some smallholder farmers	x	x	x	x
Challenges impeding smallholder farmers' mobile phone usage	Mobile device prices are too exorbitant for most smallholder farmers	x	x	x	x
	Unreliable/counterfeit devices		x	x	x
	The perceived high costs of mobile phone services, like data, for most smallholder farmers	x	x	x	x
	A lack of necessary digital skills among smallholder farmers			x	x
	The advanced age of some smallholder farmers	x		x	x
	An absence of the necessary information to use mobile phones			x	x
	A lack of initiative of agricultural extension officers			x	x
	The low socioeconomic status of some smallholder farmers			x	x
	Poor/absence of telecommunication infrastructure in rural areas where the bulk of smallholder farmers reside.	x	x	x	x
	A perceived lack of service provider support			x	x
	A lack of government support			x	x

The themes populating Table 5.7 and Table 5.8 are positively related to seven constructs of the conceptual model listed below;

Perceived Usefulness (PU) The themes in Table 5.7 imply that the farmers view their mobile phones as practical tools for communication, financial transactions and educational purposes. Thus, the Perceived Usefulness (PU) construct is necessary for explaining and forecasting the uptake of mobile phone technology, generally and specifically in agribusiness activities.

Perceived Compatibility (PComp) The themes in Table 5.7 also imply that smallholder farmers view a wide range of agricultural communication needs, agricultural learning needs, and financial transaction activities as logically compatible with mobile phones. Therefore, one can argue that the general acceptance of mobile phone technologies, specifically in agriculture, can be explained and forecasted using the PComp construct.

Perceived Ease of Use (PEOU) The themes presented in Table 5.7 further imply that most smallholder farmers believe mobile phone technologies are simple to use in their daily lives. The adoption of mobile phone technology can be inferred to be significantly supported by the PEOU construct.

Perceived Expressiveness (PE) The themes in Table 5.8 indicate that some farmers use their mobile phones to interact with other farmers along with key stakeholders in the agricultural value chain. Hence, one could contend that the PE construct, a novel construct created in this work, is essential for both explaining and predicting the uptake of mobile phone technology in agriculture.

Perceived Costs (PC) According to the themes presented in Table 5.8, the perceived cost of mobile phones and the associated services present a barrier to smallholder farmers' adoption and use of mobile phone technologies. Therefore, one could infer that the PC construct is crucial for predicting adoption and illuminating mobile phone usage patterns in agriculture.

Perceived Support of Service Providers (PSoSP) The main themes in Table 5.8 additionally demonstrate that the PSoSP construct has a significant effect on the adoption and use of mobile phone technology in general, as well as in the farming operations of smallholder farmers. Given this effect, one could claim that the PSoSP construct, a novel construct developed in this study, has become crucial for predicting adoption as well as understanding the behaviour regarding the use of mobile phone technology generally, potentially even in agriculture.

Perceived Behavioural Control (PBC) The themes in Table 5.8 also imply that perceived behavioural control is a key element for assessing the adoption and usage patterns of mobile phones in Zimbabwe generally.

In the next section, the researcher accounts for the variations in mobile phone usage patterns in agriculture among smallholder farmers in Zimbabwe.

5.8.2 Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general everyday lives?

The research established several factors accounting for the variations in the usage of mobile phones for agricultural purposes in Gokwe South in the Midlands Province. However, some of these factors are common, yet some appear to have been established in Gokwe South for the first time. The main factor explaining the variation—as evidenced by the differences in usage by farmers in Dzawanda village compared to the other four villages—is the initiative taken by the agricultural extension officer of the area. This officer had trained and equipped farmers in her area of supervision effectively by forming farmers' groups and appointing coordinators of such groups for the implementation of various activities to boost agricultural productivity. The officer had also trained farmers on the use of *EcoFarmer* and other applications.

Although the usage of these applications (mobile phone technology, agricultural) has not gained as much popularity and scaled as much as other applications like *EcoCash*, Dzawanda village and the role of the agricultural extension officers in the adoption and usage of mobile phones for agricultural purposes can be considered vital in boosting the agricultural productivity of smallholder farmers in Zimbabwe. The reason for this importance is that the agricultural extension officer had only been appointed to Dzawanda village for a year (at the time of this research) but was already having a lasting impact on mobile phone technology usage as well as general agricultural productivity in the area.

One could further infer that other factors, like the Perceived Lack of Support of Service Providers, are vital factors in explaining the slow growth in the usage of mobile phone technology applications like *EcoFarmer*. Two issues from empirical data explain the significance of the PSoSP construct in predicting the adoption of mobile phone technology and explaining its usage or lack of it. The first is that all the smallholder farmers in Gokwe South were using Econet telecommunication services, and very few were using the other two telecommunication service providers (NetOne and Telecel), albeit as supplementary service providers. The reason was that no network and associated services for the NetOne and Telecel existed in most areas. The second issue was that even the Econet wireless company, despite its success, has not supported its product (*EcoFarmer*) as much as its other products like *EcoCash*; hence, *EcoFarmer* could be considered a 'neglected child'.

The other constructs, like Perceived Costliness, are critical factors significant within the circumstances of smallholder farmers since most of the farmers are not affluent, as established by the empirical evidence in this research. The study also found the Perceived Ease of Use construct vital to explaining the variations in use, as evidenced by the lack of mobile phone use by some agricultural extension service officers for the other four villages. One could claim that the other officers perceived the mobile phones as not easy to use; hence, they could not recommend their use to the farmers they supervised.

5.9 MOBILE PHONE DEVICES, APPLICATIONS AND SERVICES

The mobile penetration rate in Zimbabwe is above 100% and although they are arguably some of the most marginalised people in Zimbabwe, smallholder farmers on average have access to mobile phone technologies, as affirmed by this research. However, they use mobile phones variably since some have smartphones while others have basic phone handsets. As a result, those who have smartphones can access android powered mobile phone technology applications while those with basic phones are only able to access USSD services and SMS messaging services. The perception of mobile phone technology used by smallholder farmers has not been scrutinised in previous studies.

However, research has been conducted on mobile phone adoption and use but did not explore the reason why some people were not using it for agricultural purposes while successfully appropriating it in their general everyday lives (Masimba et al., 2019). Mobile phone technology applications and services are accessible variably online and offline. These research results have shown that some smallholder farmers have smartphones, therefore, they can access online agriculture applications via their mobile phones.

Many farmers have basic mobile phone handsets and must obtain agriculture information offline, which may be enabled by using SMS messaging and USSD apps. Many apps are utilised on USSD platforms. Mobile money services are the most popular among Zimbabweans, particularly the less fortunate smallholder farmers. The Econet mobile money service system, *EcoCash* symbolises mobile money services in Zimbabwe due to its large customer base and widespread usage among farmers. While this is true, there are more base stations for Econet wireless in both urban and rural regions, which paints a favourable picture of Econet and the need to capitalise on its popularity and infrastructure.

However, its services have often been expensive and given that this is an identified deterrent factor shaping smallholder farmers' negative perceptions about the adoption and usage of mobile phone technologies, this poses challenges. Therefore, it would be prudent to channel agriculture information via the Econet subscriber identification module (SIM) cards using USSD codes. It would be a positive step if the information is facilitated through all telecommunication companies' SIM cards. POTRAZ should strive to install many more base stations in rural areas and implement the infrastructure sharing policy for all the companies to share and use the base stations for a fee. Generally, smallholder farmers use the mobile phone for communication purposes like calling or SMS messaging as most of them have basic phones. Conversely, those with smartphones also use their mobile phones for communicating using *WhatsApp* messaging. Almost all farmers use their mobile phones for financial transactions while a fraction of them use their mobile phones as clocks, calculators and in emergencies. The next section focuses on general mobile phone technology applications which are used by smallholder farmers.

5.9.1 General mobile phone technology applications used by smallholder farmers

This section focuses on general mobile phone technology apps used by smallholder farmers that may be used to improve agriculture information transmission, communication and collaboration between smallholder farmers and agricultural extension officials, as well as among farmers themselves. *WhatsApp*, *Facebook* and in general, everyone's mass SMS texting were discovered to be utilised by a tiny fraction of smallholder farmers and agricultural extension officials using mobile phones. As a result, these apps and services might offer the possibility of installing agriculture information-designed platforms on mobile phones. People are naturally social beings and therefore, social media like *WhatsApp* and *Facebook* can be important platforms to facilitate communication with key stakeholders in the agricultural value chain since agricultural information is not usually sensitive in nature. Agricultural content about input prices, market prices for agricultural produce, pest and disease information, and remedies can be posted across social media platforms to inform smallholder farmers about these agriculture-related issues. In general, *Facebook* and *WhatsApp* are good vehicles to be used as conduits for communication.

5.9.2 The agricultural applications being used by agricultural extension officers and smallholder farmers

Many different mobile phone technology agricultural applications like *EcoFarmer*, *AgriFin Mobile*, *eMkambo*, *AgriShare*, *ESOKO*, *Kurima Mari* Mobile Farming Application and *AgroAccess* are already being used in Zimbabwe. However, this research found only a few smallholder farmers and some agricultural extension officers who were actively using *EcoFarmer* provided by Econet wireless and *Kurima Mari* by German Agro (Welthungerhilfe). These farmers use data bundles provided by mobile telecommunication operators to access the applications. However, the indication is that the agriculture applications that are being used in this case are *EcoFarmer* and *Kurima Mari* and they were only being used in Dzawanda village and not in any other village. The agricultural extension officer in the area was very enlightened on the significance of mobile technology agricultural applications. This was aided by the support of the owners of the applications German agro for *Kurima Mari* Mobile Farming Application and Econet for *EcoFarmer*.

This indicates that the other four villages were not using these mobile phone technology applications for agriculture partly due to a lack of initiative by the agricultural extension officers of the villages, apart from other problems. *EcoFarmer* is an Econet-designed application for its customers; the application is not available through other mobile phone communications carriers. This creates a barrier for consumers because they must be Econet subscribers before they can utilise *EcoFarmer*. Because smallholder farmers are constrained to using only one service provider and hence, have few options, the permanent lack of network services in some areas makes it difficult for them to access apps for agriculture. Mobile technology agricultural applications work in various ways, facilitating an assortment of agricultural information for various stakeholders and they all share various strengths and weaknesses. Hence, there is a need for a framework to integrate all vital agricultural information sources into a repository, to facilitate the collective functioning of all mobile phone technology agricultural applications and services.

The agricultural sector is an information-intensive endeavour; hence, it requires valuable context-specific information to be accessed by the rightful recipients in real time. The agricultural extension officers and smallholder farmers agree that mobile phone technologies are vital to their everyday agricultural activities. The younger age group of agricultural extension officers is integrating mobile phone services into their everyday work processes to augment their work. To improve the Zimbabwean smallholder farmers' agricultural outcomes, all the relevant agricultural information sources need to be linked with smallholder farmers and agricultural extension officers. Thus, all companies that play a fundamental role in the processing and production of agricultural products like seed companies, fertiliser companies and other agrichemical companies which provide among other things agricultural input seed varieties and fertilisers, pest and weed control chemicals should be integrated into the system. To enrich their knowledge base about new evolving agriculture-related information and pass that on to and educate smallholder farmers, agricultural extension officers should integrate information from the agricultural research council of Zimbabwe with the framework, mainly for accessibility. One of the major challenges faced by smallholder farmers in Zimbabwe is lucrative markets for their

produce. All the information about markets for all products from the agricultural marketing authority of Zimbabwe bodies like the grain marketing body (GMB), cotton-marketing body (CMB), and tobacco marketing body (TMB), as well as agricultural vending markets like Mbare Musika, Kombayi Musika, Renkini Musika and any other independent buyers should be linked.

5.10 THE FINAL CONCEPTUAL FRAMEWORK PROPOSED BY THE RESEARCH AND AFFIRMED BY EMPIRICAL DATA

This section presents the final conceptual model developed by the author, which served as a guide to develop the interview guide questions to elicit data from participants. This enabled the researcher to establish the factors influencing the smallholder farmers in Gokwe South in Zimbabwe's perceptions of the adoption and use of mobile phone technologies in their agricultural activities. The framework comprises nine constructs, as discussed in Chapter Two (see Section 2.11).

The first construct was Perceived Expressiveness and, according to thematic analysis, not all the interviewed farmers identified it except for a few who suggested that mobile phone technology enables positive expressiveness of their agricultural activities. The farmers indicated that they simply share their produce on their *WhatsApp* status on their mobile phones. Based on this practice, some farmers also receive calls and SMS messages from people soliciting their products. This positively influences the perceptions of smallholder farmers towards mobile phone technologies. Positive perceptions positively shape the motivations and intentions of smallholder farmers to accept mobile phone technologies, adopt and use them in their everyday agricultural activities.

The second construct is the Perceived Costliness of mobile phone technologies and there is a convergence on this construct from the literature review, the pilot study, the focus group discussion and all the research sites in this research. Almost all the research participants identified this as a major drawback to the importance of mobile phone technologies. The costs involved in the acquisition and use of mobile phone technologies for agricultural purposes are critical as it negatively influences smallholder farmers'

perceptions of mobile phone technologies. Negative perceptions negatively form the motivations and intentions of smallholder farmers to accept mobile phone technologies for agricultural purposes (Mehtap et al., 2012).

The third construct is the Perceived Lack of Mobility of mobile phone technologies and, like the second construct, on this construct, again there is a linking up with the literature analysis, the pilot study, the focus group discussion and all the research sites in this study. This is a characteristic of most rural areas and unfortunately, this is where most smallholder farmers reside. The absence of infrastructure to support the operations and functioning of mobile phone services like electricity and base stations results in the near absence or total absence of a network in most areas. That is perhaps why almost all the research participants identified this as a major drawback to the importance of mobile phone technologies.

The fourth construct contains a variety of elements: while many participants perceived mobile phones as easy to use, especially the younger participants, some perceived them as not easy to use. Perceived Ease of Use, therefore, influences the perceptions of smallholder farmers towards mobile phone technologies. This shapes their intentions to accept, adopt and use mobile phone technologies in their everyday agricultural activities. This, therefore, calls for the education, training and capacity-building of the smallholder farmers in Zimbabwe, in line with Whyte et al., (1997). Almost all the farmers perceived mobile phone technologies as being useful in their everyday lives, which has a direct positive influence on their perceptions and positively shapes their intentions to accept, adopt and use mobile phone technologies in their everyday agricultural activities, as postulated by Jahangir and Begum (2008). Both agricultural extension officers and smallholder farmers suggested that mobile phone technologies are compatible with agriculture information acquisition, dissemination and sharing among key stakeholders in the agriculture value chain. Thus, Perceived Compatibility positively influences the perceptions of smallholder farmers towards mobile phone technologies and subsequently, positively shapes their intention to accept mobile phone technologies, adopt and use them for agricultural purposes.

With this construct, almost all the research participants had strong opinions on the lack of support from mobile phone technology service providers. The absence or near absence of a network in most places due to the absence of the necessary infrastructure negatively affected all rural dwellers on their intention to adopt mobile phone technologies in their everyday lives. This negatively influences their perceptions of mobile phones, which, in turn, negatively shapes the Gokwe South smallholder farmers' intentions to accept, adopt and use mobile phone technologies in their agricultural activities. Even the Econet wireless company, the powerhouse in the telecommunication market in Zimbabwe, with the greatest number of infrastructural supports for its network, was cited as not effectively supporting its product, the mobile phone technology agricultural application, *EcoFarmer*, the way it invests in and supports its other product portfolios like *EcoCash*, which popularises the mobile money services in Zimbabwe.

There were positive perceived subjective norms in the Gokwe South community on the use of mobile phone technologies by all members of society, including women. Because these standards are prescriptive in nature, individuals are compelled to conform to them owing to peer pressure because they are a part of a larger cultural framework. Individuals are harmed by subjective standards because they believe that an influential person or group of people in their social setting would accept and encourage one behaviour while disapproving of another. The results of the research suggest that this is not the case in Gokwe South.

Perceived behavioural control of the Gokwe community on the use of mobile phone technologies was found to be positive. The adoption and usage of mobile phones to undertake agricultural-related tasks is a crucial criterion to be met, according to perceived behavioural control. As a result, if a smallholder farmer or an agricultural extension officer is unable to exert control over their mobile phones while conducting agriculture-related chores, they might not adopt them. However, this research established that the smallholder farmers in Zimbabwe are capable of generally using these mobile phone technologies and most of them are 30 to 45 years old. The challenge was other factors like the technophobia of aged agricultural extension officers, perceived expenses, and the absence of network signals in some areas. It is based on these factors that the

researcher felt compelled to arrive at the point of proposing a mobile phone technology agriculture framework that if implemented, could result in the increased adoption and use of mobile phone technologies for agricultural purposes by smallholder farmers in Zimbabwe and possibly other SSA countries in similar circumstances.

Table 5.9: Perception themes around theoretical constructs.

Theme	Supporting extracts from pilot study, FGD and interviews	Literature	Pilot study	FGD	Interviews
Perceived enabling of the positive expressiveness of mobile phone technologies.	<i>Sometimes we engage with customers on Facebook or WhatsApp, where I sometimes ask customers to offer their buying prices. There can be a bidding war of some sort, which is beneficial to the farmer. [SHFAA] Sometimes I take pictures of my produce and share them on my WhatsApp status and receive messages from potential clients soliciting for my produce. [SHF2]</i>				x
The perceived costliness of mobile phone technologies.	<i>The cost of data is very high for a farmer. [SHF3] The cost of mobile phone agriculture applications and services is very high and is not affordable for many farmers. [FGDP3]</i>	x	x	x	x
Perceived lack of mobility of mobile phone technologies.	<i>... the major challenge is that of network availability although it is better than Telecel because when I was using it, I used to travel almost two kilometres to access the network. [SHFD]</i>	x	x		x
Perceived ease of use of mobile phone technologies.	<i>Many farmers are not digitally skilled; they are not prudent with the use of their mobile phones. [SHFZ]</i>	x	x	x	x
Perceived usefulness of mobile phone technologies in agriculture operational activities.	<i>Buddie is also a treasurable asset for the movement of money from customers through EcoCash [SHF4]. It is a clock, a radio, a bank, a payment facility, a communication device, a data storage device, and a photo and video camera all in one. [SHFAD]</i>	x	x	x	x
Perceived compatibility with agriculture information acquisition and dissemination	<i>I use my mobile phone to communicate with the officer and get knowledge of the optimal planting dates, good seed varieties, learn about diseases and agrochemicals to use to address the diseases and pests and this improved knowledge can have a greater impact on the productivity of my agricultural activities. [SHFO]</i>	x		x	x
Perceived lack of support for mobile phone technology applications and service providers	<i>I have only used EcoFarmer, but it was very erratic. I do not even know what its purpose is. It was just like reading a magazine because I was only getting updates sporadically. [SHFL]</i>			x	x
Perceived positive subjective norms of the Gokwe South community on the use of mobile phone technologies by all members of society, including women.	<i>My wife uses a smartphone, which I bought her, I use a basic phone because I usually lose them, but my wife is more careful. [SHFK]</i>				x
Perceived positive behavioural control of the Gokwe South community on the use of mobile phone technologies.	<i>A farmer may take a photo or video of a sick animal and share it with other farmers and the agricultural Extension Officer, and instant feedback may then be obtained from the agricultural extension officer and another farmer. [SHFY]</i>			x	x

While the research was inductive, the researcher entered the field with a conceptual framework because the research was guided by a progressive case study approach, as suggested by Thompson (2022). This approach enabled the researcher to approach the field with an open mind yet equipped with information because theoretical knowledge helped establish boundaries regarding what researchers were originally searching for. Such boundaries help prevent a finding of arbitrary and vague research outcomes that might be unrelated to the research problem.

The responses from the interview guide and focus group discussion reinforced the results from the literature analysis for six constructs. The research results also supported the proposed new constructs, i.e., Perceived Support of Service Provider (PSoSP), Perceived Expressiveness (PE) and Perceived Mobility (PM). Therefore, the constructed theoretical framework could be adopted and applied by other researchers in research on technology adoption in different domains. The reasons why smallholder farmers in Zimbabwe underutilised mobile phone technologies for agricultural needs, although these farmers productively used mobile phone technologies in their everyday lives, were unknown at the time of this research. As a result, this study contributes to the body of knowledge already available about sub-Saharan African literature in general and Zimbabwe in particular.

The theories and concepts from the present research could inform further mobile phone technology and innovation research in developing contexts. The research can claim comprehensiveness because, at the time of its execution, there was no literature on why many smallholder farmers in Zimbabwe were not using their mobile phones in agricultural activities while the same farmers were successfully using them (mobile phones) in their general, everyday lives. This research is also the first to propose a framework to improve the adoption and use of mobile phone technologies in smallholder agriculture by incorporating a conceptual framework with nine constructs derived from three multiattribute information systems adoption theories (TAM, TRA, TPB and UTAUT) integrated.

The constructed eclectic model has nine constructs, namely Perceived Expressiveness (PE) (New), Perceived Costs (PC), Perceived Mobility (PM), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Perceived Compatibility (PComp) (New), Perceived Support of Service Provider (PSoSP) (New), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC). The study established that these constructs explain the adoption of mobile phone technology and the usage variations thereof by smallholder farmers in Zimbabwe.

As a result, this research presents the resulting model for mobile phone adoption prediction and usage explanation, the mobile technology agriculture adoption model, as a significant contribution to the field of theoretical models for predicting the adoption of technologies and innovations research and explaining the usage patterns. This model is a first within the Zimbabwean setting where agricultural extension services play such a big part in educating smallholder farmers and assessing the usefulness of mobile phone technology applications in their area of supervision. This study might lead to a full appropriation of mobile phone technologies for agriculture by Zimbabwe's smallholder farmers and, to some extent, might also be true for other sub-Saharan African nations under comparable circumstances. Figure 5.12 presents the revised model.

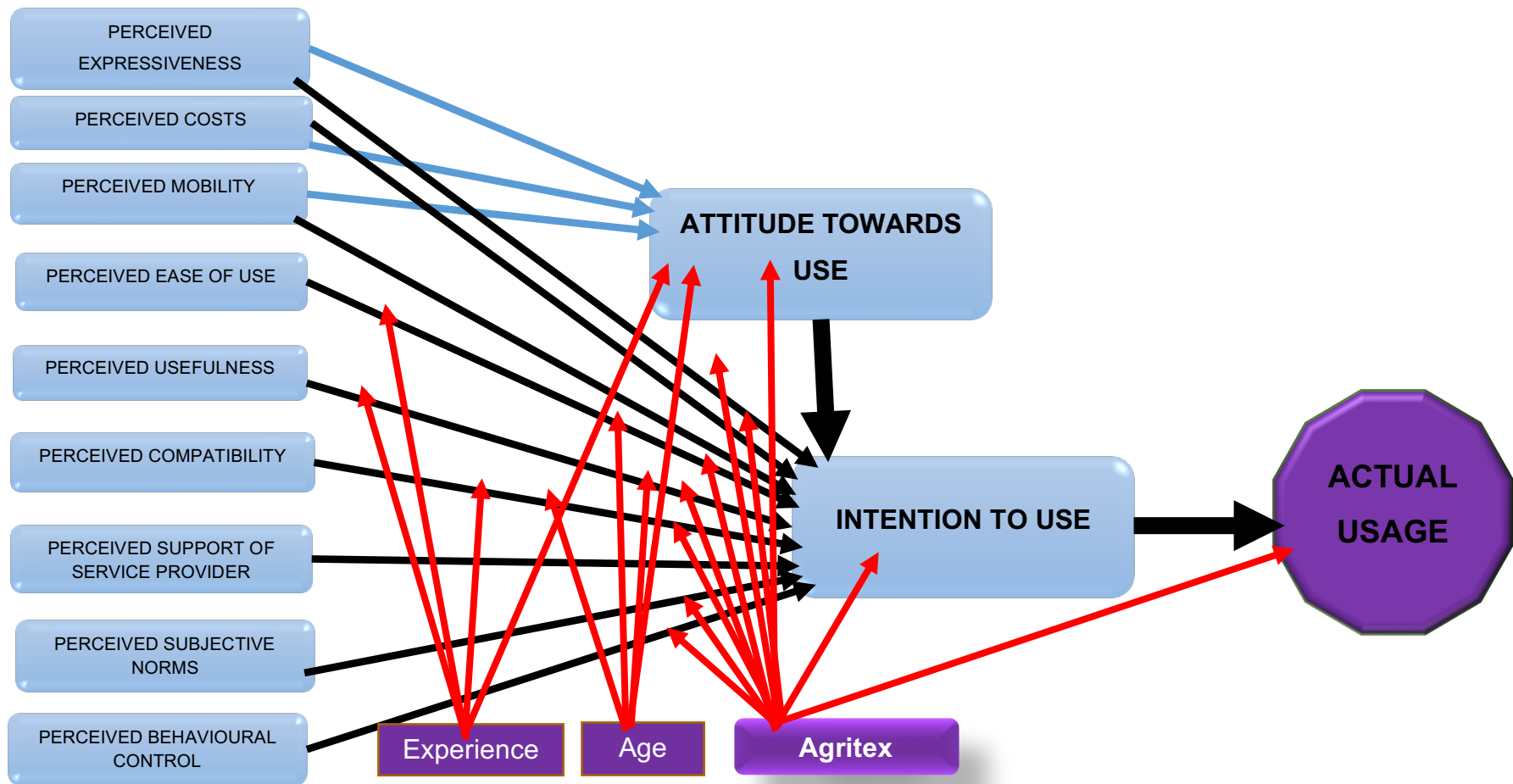


Figure 5.12: The modified conceptual model after incorporating the empirical data. (author's construction)

5.11 CHAPTER SUMMARY

The research findings presented in this chapter were analysed following the strategies for analysing multiple case studies (within-case and cross-case analysis) as prescribed by (Phondej & Neck, 2014; Stake, 1995; Woodside, 2010; Yin, 2010). The researcher contextualised the primary research question by utilising the data collection instruments. The chapter discussed the research findings based on the six research sub-questions. The research findings are summarised thus: The researcher conducted primary research with smallholder farmers at three farmers' markets and reported the findings at the beginning of the chapter. Subsequent to the pilot study, the chapter presented the data gathered from the focus group discussions. The study then provided the findings from the main data-collecting phase through a comparative study of the five (5) village locations. The data confirmed that the farmers across all research sites possessed mobile phones, although their usage of mobile phone technologies for agricultural purposes varied. As a result, the research findings reported in this chapter and the literature analysis described in Chapter Two enabled the emergence of the theory for understanding smallholder farmers' non-adoption of mobile phones in the Zimbabwean context. The next chapter concentrates on the framework's creation, description and discussion. The proposed framework was submitted for expert assessment; the reviewers' opinions and comments are included in the final framework provided in the next chapter.

CHAPTER SIX: DISCUSSION OF RESEARCH FINDINGS AND FRAMEWORK DEVELOPMENT.

EXAMINING THE NON-ADOPTION OF MOBILE PHONE TECHNOLOGIES FOR AGRICULTURAL ACTIVITIES BY SMALLHOLDER FARMERS IN ZIMBABWE



Figure 6.1: Thesis and Chapter Five navigation map (author's construction)

6.1 INTRODUCTION

This chapter summarises and discusses the research activity considering the study's background, research questions, literature review and conceptual model in connection with the produced constructs, themes and patterns. The main research question in this study is:

Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general, everyday lives?

The researcher addressed this question using thematic analysis and connected the generated themes and the conceptual model constructs, resulting in the presentation of the revised conceptual model at the end of Chapter Five in Figure 5.12.

The constructed and revised eclectic model contains nine constructs, three of which this research proposes: Perceived Expressiveness (PE) (a new construct) is a vital factor because it influences the smallholder farmers' attitudes towards usage and intention to use mobile phone technology. Perceived Support of Service Provider (PSoSP) (a new construct) is instrumental in predicting adoption and explaining the usage behaviour and variations among technology users, touching on such issues as the accessibility of services and supporting information about the services offered and how they are accessed. These issues encompass digital access to the network and physical access to devices. Perceived Mobility (PM) (a new construct) is essential to possibly explaining why most of the participants subscribed to Econet while very few subscribed to NetOne and Telecel yet only used them in a supplementary capacity.

The other constructs informed by the literature review are mainly the theoretical models Perceived Ease of Use (PEOU), Perceived Compatibility (PComp), Perceived Usefulness (PU) (Isaac et al., 2016), Perceived Costs (PC) (Masinge, 2010), Perceived Subjective Norms (PSN) (Trafimow, 2009) and Perceived Behavioural Control (PBC) (Altawallbeh et al., 2015; Horst et al., 2007; Kerlinger, 1973; Trafimow & Fishbein, 1995). These constructs were found helpful in Zimbabwe's adoption of mobile phone technologies per the available empirical data.

Based on the unique aspects discovered through the nuances generated in this research, the constructs of the proposed model could aid in understanding the adoption of mobile phone technologies and usage variations. The research's main contribution to the body of knowledge is the developed theoretical model for explaining mobile phone adoption prediction and usage as a significant contribution to the field of theoretical frameworks for predicting the adoption of mobile phone technologies and other innovations, as well as explaining their usage patterns for agricultural purposes. The proposed eclectic model incorporates agricultural extension services officers as an essential element that moderates eight constructs of the proposed model. The research established that agricultural extension services officers play an integral part in training smallholder farmers and determining the value of mobile phone technology applications as a complementary tool in their work processes areas of supervision in Zimbabwe.

6.2 MOBILE PHONE TECHNOLOGY AGRICULTURE FRAMEWORK DEVELOPMENT PROCESS

The research primarily aimed to understand why most smallholder farmers in Zimbabwe did not fully appropriate their mobile phone technologies in their agricultural activities while they successfully used them in their general everyday lives. Having addressed the primary aim of the research in Chapter Five (see Sections 5.8, 5.9 and 5.10), the researcher focuses on addressing the secondary aim in this section. The research secondarily aimed to propose a guiding framework for harnessing mobile phones to ensure sustainable development of agricultural outcomes. The proposed framework was developed and grounded on the results of the literature review analysis, pilot study, focus group discussion and case study. The researcher engaged smallholder farmers, mainly in Gokwe South, and other key stakeholders in the agricultural value chain. Verbrugge (2016) posits that a framework is an abstract structure or summarised system, which is developed for the specific purpose of realisation of a defined objective or goal. It should be developed in such a way that users have autonomy over the entire use of the framework, whether partially or wholly. Frameworks might subsequently constitute one or more models or enable the development of models. The proposed mobile phone

technology framework was developed for facilitating information flow to smallholder farmers in Zimbabwe. The information should be context-specific to the farmers' circumstances and be delivered in timely for it to be actionable.

Mobile phone adoption and usage, like any other technology, is a complicated nonlinear process that is influenced by numerous factors, as suggested by Kayanda et al., (2020). As a result, this study constructed a conceptual framework to guide the research, based on core canons from several theories, which allowed for a more complete picture of the elements influencing smallholder farmers' perceptions of mobile phone uptake and usage behaviour in Zimbabwe. The empirical data, together with a thorough literature review analysis, resulted in the development of a framework for harnessing mobile phone technology for the benefit of Zimbabwe's smallholder farmers. Many features and participants in mobile telecommunications, the agricultural value chain and government departments and agencies are all included in the framework. The development of the framework was informed by the data gathered from the literature review, the pilot study, FGD and the case studies findings. The proposed framework would comprise the following components or functions:

a) Identification, synchronisation and alignment of all agriculture information sources and processes in Zimbabwe

Zimbabwe has many agricultural players in the value chain. These include agricultural processing companies like seed companies, fertiliser companies and other agrichemical companies. These companies provide seed varieties for different farming regions and a variety of fertilisers, pest control chemicals as well as weed control chemicals. Thus, they generate information about these issues, which should be known to farmers for them to make informed choices about which seeds are most suitable for their areas and which chemicals to apply to realise optimal yields. The agricultural research council of Zimbabwe conducts a lot of research and produces cutting-edge and groundbreaking agricultural information, which should be communicated to farmers. There are also the agricultural extension services, which is the responsible branch that works together with smallholder farmers in Zimbabwe. In their daily operations, agricultural extension officers increasingly discover newly budding pests and diseases that have never been witnessed.

As a result, agricultural extension services have since become a critical source of agricultural information, which should be taped into the proposed framework.

The meteorological services provide weather information, which is related to the expected rainfall patterns for a given region and place every year as well as daily weather forecasts and this information is vital for farmers to make choices about what crops to plant and when to plant. In addition, The Agricultural Marketing Authority of Zimbabwe constitutes bodies such as the Grain Marketing Body (GMB), Cotton-Marketing Body (CMB) and Tobacco Marketing Body (TMB), as well as agricultural vending markets like Mbare Musika, Kombayi Musika, Renkini Musika and any other independent buyers. Farmers need this information to make knowledgeable choices as to where and to whom to sell their crops. All agricultural information sources and processes in Zimbabwe should be aggregated and stored in a national data repository. This information should be available to all stakeholders in the agricultural value chain, especially farmers.

b) The national agricultural information database

This repository should be created and utilised to store all agricultural information and make it available to all stakeholders. This national data repository should be accessible via multiple mobile phone technology application platforms. The data would be cumulative, and previous and present data would be combined to provide information for decision-making. All institutional databases where information is created for auto-updating should be properly connected to the repository. This is the division of the system where all the recognised sources of information are synchronised and processed. It processes information and prepares it for easy access on the information access and service platform. The database server should be used for the storage of this national database repository as a web application system.

c) The information service and access platform

This platform should provide access to agricultural data in the repository. The platform should be accessible through various mobile phone technology forms, which include a website, mobile phone technologies applications and USSD among others.

d) The mobile phone technology agriculture applications and services used in Zimbabwe

This identifies all the available mobile phone technology applications and services in Zimbabwe. As mentioned in Chapter Two, mobile phone handsets take three different forms: basic phones, feature phones and smartphones, as posited by Haque and Amir (2019). Either USSD, online browsers or smartphone native mobile applications, notably Google Android, Apple *iOS* and *Windows* phones, can access several mutually popular mobile agriculture apps. These smartphone native mobile applications run independently, flawlessly, and subtly quicker on the major operating systems platforms on which they are installed, in real time. The research established that most smallholder farmers have basic mobile phone handsets, so it would be prudent to ensure that the emphasis is placed on USSD applications and services while not shutting out smartphone mobile applications. All these applications should be granted access to all the data for availing on their platforms to their clients.

e) The evaluation of all mobile phone agricultural applications and services by the Ministry of Agriculture

Farmers in Zimbabwe have access to a variety of mobile phone agriculture applications and services. These applications are valuable in different ways, and some of them complement one another. The Ministry of Agriculture should analyse these applications for functionality and usefulness before recommending them to farmers for adoption via agricultural extension officials. The owners of these applications and services should ensure that their applications are commensurate with the positive perceptual concerns identified in this study. This is a significant component of the proposed framework in which all mobile phone agricultural application technologies are examined, and their benefits and drawbacks are highlighted. This will make it easier to propose the best programs to users.

f) The evaluation of farmers' intrinsic characteristics and training about mobile phone technologies by agricultural extension officers.

The agricultural extension officers are the ones who work daily with the smallholder farmers, and they know the endogenous factors characterising every farmer in their area of operation. Based on their assessment of an individual farmer, they could recommend the best mobile phone technology agricultural applications and services suitable for the circumstances of the farmer. This may result in steadily more smallholder farmers in Zimbabwe adopting and continually using mobile phone technologies sustainably in their agricultural activities. This may result in the rapid diffusion and upscaling of mobile phone technologies used in agriculture by smallholder farmers in Zimbabwe.

g) Smallholder farmers' access, effective and sustainable use of mobile phone technologies in agricultural activities

The mobile phone agricultural framework encompasses both exogenous and endogenous factors that determine technology acceptability and stresses their interaction in Zimbabwean decision-making on the deployment and use of mobile phone technologies in agriculture. Farmers might learn about the existence of a new technology, how to adopt it and what the effects and expenses would be. An individual's understanding of a new technology then serves as the foundation for the individual's thoughts and attitudes toward the technology. As a result, those smallholder farmers' views on mobile phone technology are merely a reflection of the information and expertise they have on the application and how to use it. It is vital to have a better understanding of how mobile phone technology applications work and how they might assist farmers to optimise their income while cutting expenditure. As a result, the involvement of agricultural extension officers in teaching and training farmers about agricultural mobile technology applications is key to the success of the proposed framework.

The data of the expert reviewers of the research are presented in Table 6.1. The research regarded four experts as adequate since any number between two (2) and five (5) reviewers have been deemed sufficient (Holbrook et al, 2008). The proposed framework encapsulates all agriculture information sources and processes combined into a national agriculture information repository and all this information should be availed on a platform which makes the information available in android, USSD, SMS and website form. The

framework has some of the most popular and useful mobile agriculture applications in Zimbabwe but is not limited to those identified since more applications could be identified and made operational. The most important part is the integration of agricultural extension services (Agritex) into the framework. The agricultural extension department is central to the development of smallholder farmers in Zimbabwe; hence, it has a dual role in the framework. Its first role is to evaluate the mobile phone technology agriculture applications and services available in Zimbabwe. Its second role is to evaluate the smallholder farmers' intrinsic characteristics, training requirements, mobile phone technology applications and their associated services in their areas of operation. The perceptions of smallholder farmers in Zimbabwe and the factors that affect their adoption and effective use of mobile phone technologies were discussed using the nine (9) constructs of the constructed model adapted for this research (see Section 5.8). All the above-stated information was applied in developing the proposed framework.

The agriculture extension officers deal closely with smallholder farmers daily; therefore, they are familiar with the endogenous characteristics that distinguish each farmer in their region. They could suggest the most appropriate mobile phone technology agricultural apps and services for the conditions of the farmer, based on their evaluation of the farmer. This might lead to a surge in the number of smallholder farmers in Zimbabwe who adopt and sustainably use mobile phone technology. If some smallholder farmers fully accept mobile phone technologies, additional farmers might follow suit and adopt and employ mobile phone technology in their agricultural activities.

6.3 EXPERT REVIEW

After the initial development of the framework, the framework needed to be submitted for expert review for evaluation. Four experts were chosen: One is an agricultural extension services officer; one is an agricultural informatics officer, and one holds a PhD degree in agricultural informatics and is a prominent researcher. These expert reviewers examined the significance, useability, and validity of the proposed framework, as well as any possible benefits or drawbacks. The four (4) experts provided their perspectives on the suggested framework for harnessing mobile phone technologies for the development of

smallholder agriculture in Zimbabwe. These suggestions played a crucial role in perfecting the proposed framework structure.

Table 6.1: Expert reviewers' data

Highest Qualification	Country	Present Role	Pseudonym
PhD	South Africa	Lecturer and consultant	EXPRT1
MSc	Zimbabwe	Agricultural Informatics Officer University of Zimbabwe	EXPRT2
MSc	Zimbabwe	Agricultural Extension Informatics Officer	EXPRT3
BSc	Zimbabwe	Agricultural Extension Officer	EXPRT4

Table 6.1 reveals that the four (4) expert framework reviewers possess rich backgrounds in academic work and the practice of agriculture informatics. The experts were given an assessment to guide them in the assessment process of the proposed framework. The assessment centred on the applicability of the framework in the Zimbabwean context, its strengths, and shortcomings as well as its validity in the context of agriculture informatics.

The agricultural informatics officer expert was given the pseudonym EXPRT2 and is based at the University of Zimbabwe. He has more than ten years of experience and is knowledgeable in irrigation, ICT4Ag, research, innovation, and development. He works with several organisations, including USAID, IFAD, FAO, and OXFAM (among others) in partnership with the Ministry of Agriculture in Zimbabwe on various projects providing consultation on research and development operations. Expert three (EXPRT3) is an agricultural services informatics officer stationed at the Gokwe centre. He has a wealth of experience in agricultural extension services and is well-informed about the difficulties faced by smallholder farmers in Zimbabwe concerning information seeking and access. He engages with several NGOs in the area like FAO, German Agro and OXFAM, among others, as well as *EcoFarmer*, in partnership with the Ministry of Agriculture to assist smallholder farmers and agricultural extension services officers in Gokwe.

Expert EXPRT4 is an agricultural services officer stationed at the Gokwe centre. He has a wealth of experience in agricultural extension services and is conversant with the challenges confronting smallholder farmers in Zimbabwe concerning information seeking

and access. He assists smallholder farmers and agricultural extension services officers in Gokwe on agricultural informatics issues. The issue of the evaluation sheet was muted to guarantee uniformity in replies as well as the lucidity of the proposed framework. The review sheet also includes summary comments on each component assessed. Table 6.2 presents the experts' review findings and discusses suggestions based on the research findings.

The expert opinions on the framework, provided insights into the simplicity, applicability, importance, and relevance of the framework that is suggested for utilising mobile phone technologies to advance smallholder agriculture in Zimbabwe. Officers from the department of agricultural extension services can use the framework to help them while working. The framework may increase smallholder farmers' adoption and efficient use of mobile phone technology in Zimbabwe. In summary, the implementation of the suggested framework may lead to the overall development of smallholder farmers in Zimbabwe since it would facilitate smallholder farmers informed and appropriate timely decisions. The framework's appropriateness and applicability can also be discussed with other specialists for ongoing development.

Table 6.2: Showing the summary of review experts opinions

FRAMEWORK REVIEW THEMES	SUMMARY OF THE REVIEW EXPERTS' OPINIONS	RECOMMENDATIONS
SIMPLICITY	<p><i>The experts pointed out that the framework is straightforward and that setting standards would require careful study, training and capacity-building is needed to ensure that smallholder farmers in Zimbabwe accept and make efficient use of mobile phone technology in their agricultural activities.</i></p> <p>EXPERT 1 observed: "There are clear linkages of the structural components of the framework and how they are linked to the problem and the suggested solutions."</p> <p>EXPERT 2 indicated: "The title implies an assessment hence it implies evaluating current status which is within feasible scope for the researchers' studies."</p> <p>EXPERT 3 noted: "The framework is simple to understand. Smallholder farmers are now well versed in the use of smartphones and are familiar with different ICT applications on phones. Different applications are also able to disclose relevant information on value chains and markets of different crops and livestock."</p> <p>EXPERT 4 remarked: "Some of the reasons for low usage of mobile phone technologies by smallholder farmers are already known. To that end, the research may add more value by examining circumstances under which smallholder farmers use or do not use mobile technology (barriers and enablers)."</p>	<p><i>The Ministry of Lands, Agriculture, Fisheries, Water, Climate and Rural Development, agricultural research institutions, ICT applications and software developers, Mobile Network Operators (MNOs) and other important stakeholders like Non-Governmental Organisations (NGOs) must work together to advance the agriculture value chain (NGOs). This will allow for synergies that will stimulate the development of the skills required for the creation of mobile applications and the high-quality implementation of novel solutions for the USSD, SMS and Android platforms. This includes creating or defining pertinent competencies and creating the system architecture (both front-end and back-end). The total solution makes it possible to manage data through the portal, which reduces the frequency of modifications to users' mobile applications and considerably speeds up the introduction of new functions.</i></p>
RATIONALITY	<p>The experts concurred that the framework is relevant; however, for successful application and operationalisation, there is a need to add the evaluation layer.</p> <p>EXPERT 1: "The framework elements are easy to understand and how they are linked to the problem and the suggested solutions. However, the feedback loops of information sharing and/ or product sharing are not very clear. The same with feedback loops of improving the process after evaluations at each stage."</p> <p>EXPERT 3: "Yes, it has the potential to improve the adoption of mobile phone technologies because mobile phone technologies provide all relevant information on good agricultural practices, information on all agronomy of all crops, post-harvest management for all crops including processing and value addition, value chain of all crops and livestock. So there is a rationality for the proposed framework."</p>	<p><i>Since it would enable continuous integration of various agricultural applications and stakeholders in the suggested framework parts, the evaluation layer ought to be provided as a basis for the deployment of the framework. Constant monitoring and analysis are crucial as a situation advances, for instance, throughout the framework operationalisation there is a need for the evaluation layer which encompasses the feedback loops. This enables the discovery of the required extra knowledge transfer and the identification of the operational development and solution aspects' priorities. As a result, mobile phone agricultural applications need to be put into place and evaluated at various higher levels of agriculture operational facilities and experts.</i></p>

<p style="text-align: center;">SIGNIFICANCE</p>	<p><i>The judgements of the specialists were quite reassuring in terms of relevance. According to them, the suggested framework has the potential to be put into practice and encourage the adoption and efficient use of mobile phone technology to facilitate information access and flow of agriculture among smallholder farmers while increasing their agricultural production.</i></p> <p>EXPERT 1: Asserted that they “Extremely agree. This framework uses a participatory approach from the relevant stakeholders, i.e., users and developers and it is informed on the needs of the farmer and hence, will be very relevant and will likely result in higher adoption.”</p> <p>EXPERT 2 “The framework requires modelling around accepted methodologies of assessing the usefulness and adoption of technologies. The researcher may benefit from exploring concepts such as the system usability scale to better shape the data gathering process.”</p> <p>EXPERT 3 “There are social groups formed on mobile phones with relevant information for all agricultural activities. These groups provide a platform for farmers and other stakeholders to share information. The proposed framework gels well with the evolution of mobile phones to enable smallholder farmers to have the current and latest information on the production of all crops and livestock. Always up to date on issues concerning agriculture.”</p>	<p><i>Because of how encouraging and uplifting the remarks were, they were adopted in their existing iteration. However, to increase the significance of the redesigned architecture, security and assessment layers have also been included.</i></p>
<p style="text-align: center;">STRENGTHS AND WEAKNESSES</p>	<p>The possible benefits and drawbacks of the suggested framework for using mobile devices to advance small-scale farming in Zimbabwe, as noted by the experts, might be summed up as listed below.</p> <p><i>The strengths are:</i></p> <ul style="list-style-type: none"> ❖ The features of the proposed framework are demonstrated in the literature and data gathering, and it integrates effectively with the conceptual and theoretical framework of the research. ❖ The proposed elements are relevant as they are somewhat all-encompassing. ❖ This framework employs a participatory approach from the essential players, such as users, developers, and practitioners and it is informed by the interests of the farmer hence will be pretty crucial and will probably lead to increased adoption. ❖ The framework is comprehensive and strives to address a pressing issue since data is essential to advancing and modernising agricultural research and development. ❖ The framework is logical and methodical. ❖ It is action-oriented, with a role for each shareholder and clearly defined results. <p><i>The weaknesses are:</i></p> <ul style="list-style-type: none"> ❖ There aren't any obvious feedback loops that spell out what will happen if the proposed action isn't carried out. ❖ It would be smart to engage the NGOs and the CGIAR as stakeholders since they have significant expertise in the development, deployment and testing of use case scenarios. 	<p><i>The proposed framework, according to the expert reviewers, can make it easier for Zimbabwe and the SSA, as well as other countries with comparable contextual contexts, to harness mobile phone technology for the growth of smallholder agricultural operations. The experts indicated that before deployment and integration into the framework, all current mobile phone technology agricultural systems, other apps and methods for disseminating agricultural information, as well as other functions, must be examined. However, the experts also suggested that there may be a need to categorise the various applications based on functionality as well as the evaluation of the most adopted application and the list of adopted applications and establish the reasons for the disparities. The framework's technological procedures and applications should all enable compatibility with the current ICT infrastructure. The researcher suggests the integration of NGOs as well as the evaluation layer into the framework.</i></p>

The expert opinions on the framework (summarised in Table 6.2) provided insights into the simplicity, applicability, importance, and relevance of the framework that is suggested for utilising mobile phone technologies to advance smallholder agriculture in Zimbabwe. The framework may increase smallholder farmers' adoption and efficient use of mobile phone technology in Zimbabwe. In summary, the implementation of the suggested framework may lead to the overall development of smallholder farmers in Zimbabwe since it would facilitate smallholder farmers informed and appropriate decision-making in real time. The framework's appropriateness and applicability can also be discussed with other specialists for ongoing development.

6.4 THE PROPOSED FRAMEWORK AFTER EXPERT RECOMMENDATIONS

The revised proposed framework after the expert review is hereby presented in Figure 6.2 The framework shows changes that were made to the framework under the recommendations made by the experts. The changes are:

- 1) The addition of USSD and SMS applications to the mobile phone technology agriculture applications and services layer.
- 2) The addition of the categorisation function to the evaluation of all mobile phone agricultural applications and services; the categorisation by the Ministry of Agriculture layer is highlighted in red text.
- 3) The addition of the adoption and use of mobile phone technologies by the smallholder farmers' layer.
- 4) The addition of the feedback layer for evaluation of the success and failure of adopted mobile phone technologies by smallholder farmers.

While the expert reviewers concurred on the significance of the framework to possibly facilitate the acceptance of mobile phone technologies leading to their adoption and effective usage by smallholder agriculture in Zimbabwe, they suggested that with the recommended changes, the soundness of the framework will be improved.

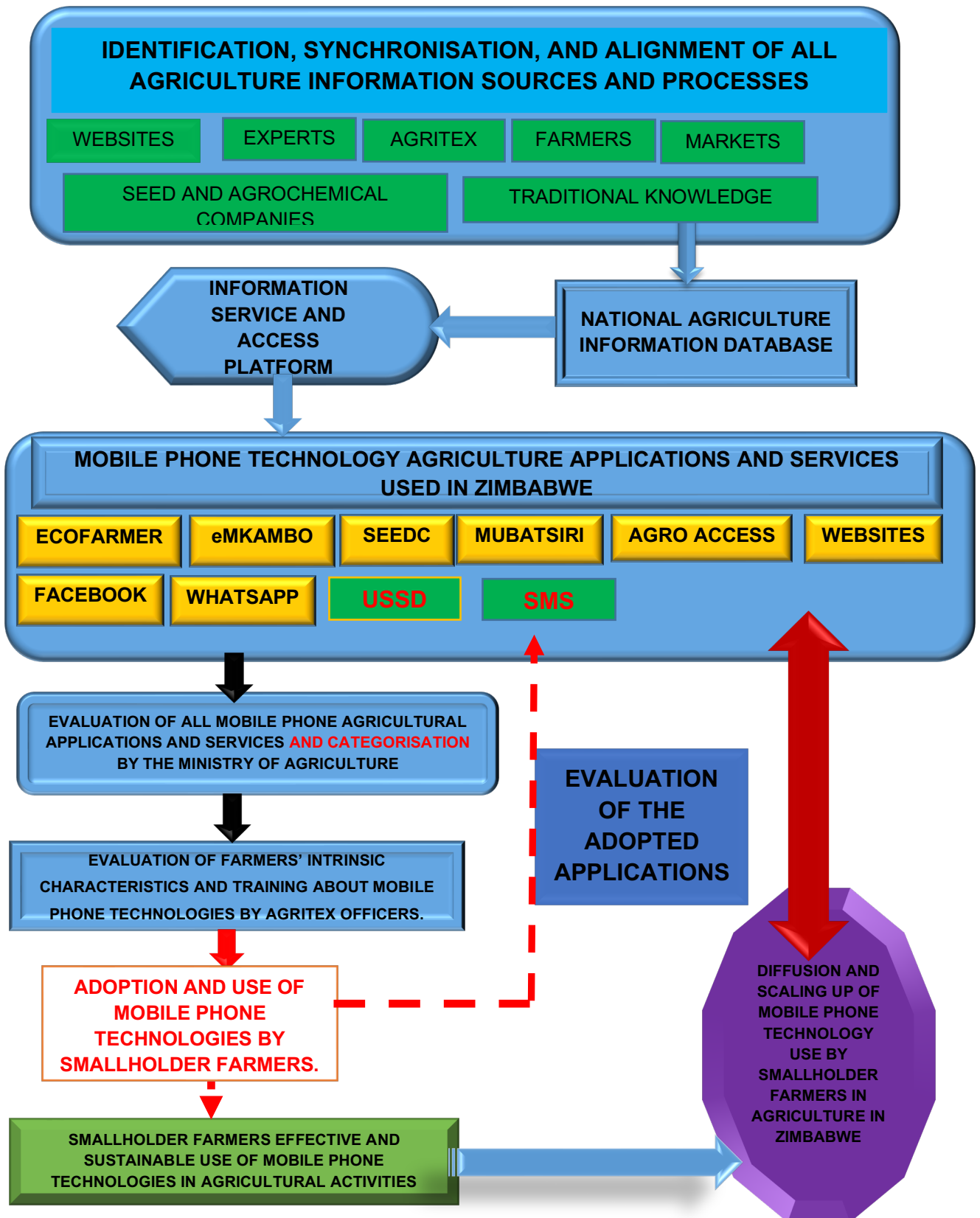


Figure 6.2: The proposed framework after reviewing by experts.

6.5 CHAPTER SUMMARY

Chapter Six summarised the research work by considering the study's key research question: **Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general, everyday lives?** The chapter briefly examined the usage of USSD services, mobile phone technology apps and services, agricultural applications and services, and non-agricultural applications and services by smallholder farmers in Zimbabwe. The chapter also examined factors influencing smallholder farmers' perceptions of the adoption and use of mobile phone technologies for agricultural purposes and explored the work responsibilities and functions of the agricultural extension officers, using the theoretical constructs from the conceptual model. The process resulted in the creation of a framework for using mobile phone technology for smallholder agriculture development in Zimbabwe. The framework could provide policymakers with information on what measures are needed to enable smallholder farmers to fully accept and use mobile phone technologies in their agricultural activities.

CHAPTER SEVEN: RESEARCH CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS AND FUTURE RESEARCH.



Figure 7.1: Thesis and Chapter Seven navigation map (author's construction)

7.1 INTRODUCTION

This chapter concludes the study by focusing on the researcher's reflections, making suggestions, detailing the research's contributions, and opening avenues for future researchers in the fields of ICT4D, Information systems, mobile phone technologies and mAgriculture. The study was based on the philosophy of interpretivism, which recognises multiple realities. The study was conducted in Gokwe South in the Midlands Province of Zimbabwe, using a multiple-case study approach. Although the study was premised on a qualitative research approach only, it was executed in three phases, with the first phase of interviews conducted at the farmers' markets (Mbare, Kombayi/Kudzanai and Gokwe). Subsequently, a focus group discussion was conducted at the Gokwe centre. The final phase of data collection then commenced using structured, in-depth interviews with smallholder farmers at their homesteads in Gokwe South at the five village sites (Mutanhaurwa, Mashove, Matoranhema, Nyamazana and Dzawanda). The research fused tenets from a grounded theory approach with case study approach canons to devise a progressive case study approach, as recommended by Steenhuis and De Bruijn (2006) and supported by such scholars as Colker (2008), O'Connor (2012) and Tibben (2013). The researcher applied within-case and cross-case analysis, triangulation and hermeneutics to the data analysis process to gain an in-depth understanding of the research occurrence, in line with the provisions suggested by Yin (2009).

This study used a qualitative technique to obtain a better understanding of the reasons for the variability in the usage of mobile phone technologies by smallholder farmers. The researcher used constant comparison analysis to construct the themes, hermeneutically interpreted the findings, and used descriptive coding systems. The researcher assessed the farmers' acquisition and ongoing usage of mobile phones for their agricultural operations. The research is philosophically validated by the interpretive paradigm, which acknowledges the existence of multiple realities and subjective knowledge-building. As a result, a qualitative technique based on observations, a focus group discussion and in-depth interviews were used. This chapter reflects on the new knowledge derived from the study, the contribution and limitations of the research project and further research emanating from the study for future development and improvement.

7.2 RESEARCH REFLECTIONS

The researcher's overall experience in smallholder agricultural practice, as well as a love and enthusiasm for mobile technology applications and their ability to aid development, particularly in smallholder agriculture, prompted the research. Mobile phones could provide context-specific agriculture information to smallholder farmers in real time. Agriculture extension staff in Zimbabwe could employ mobile phone technology to disseminate critical agriculture information to smallholder farmers since most Zimbabweans live in rural regions and rely on smallholder agriculture for their livelihoods. The researcher's zeal was encouraged and increased by the constant reports published in Zimbabwean local media on the issues that smallholder farmers face.

The SDGs framework is premised on leveraging ICTs to achieve a better world for everyone. Mobile phones are the ICT variant in the hands of many people in Zimbabwe, especially the marginalised, of whom smallholder farmers are among the most marginalised in Zimbabwe. Smallholder farmers are among the poorest people in Zimbabwe and poverty levels among these farmers have remained very high due to underproductivity, which has been exacerbated over the years by a lack of access to real, context-specific actionable agriculture information, such as where to find affordable optimally priced inputs and lucrative produce markets. Other vital information includes newly emerging and lethal agricultural and animal pests and illnesses that require immediate action to avoid catastrophic losses. Some NGOs, such as German Agro, have stepped in to attempt to avoid disaster, but their efforts have been constrained by their resources, and thus, they have been limited to certain locations.

As a result of revealing the smallholder farmers' opinions about employing mobile phone technology for agricultural reasons, the research generated new and vital constructs like Perceived Support of Service Provider (PSoSP) critical to predicting the adoption of mobile phones and explaining the variations in the usage levels of mobile phones among smallholder farmers. Further, the NGO German Agro seems to be succeeding in their localised areas of operation as the bulk of the smallholders in its (German Agro) sphere of influence reportedly use its mobile application. Such usage suggests the importance of PSoSP in predicting the acceptance and adoption of technology and explaining the variations in its usage. The other new constructs emerging from this research include Perceived Expressiveness (PE) and Perceived Mobility (PM). The research also

supported the existing six constructs derived from the literature review process. Therefore, the research submitted its primary contribution, the conceptual framework revised through empirical evidence as presented in Section 5.10 and the constructed model in Figure 5.12.

The research submitted its secondary and practical contribution to the body of knowledge, namely the framework for guiding the adoption and utilisation of mobile phone technology to assist smallholder farmers in Zimbabwe, a developing country, in improving their agricultural outcomes. The framework is intended to assist smallholder farmers, particularly in Zimbabwe, in adopting and fully using mobile phone technology. This framework, taken as a whole, aims to eliminate the barriers that smallholder farmers in Zimbabwe encounter pertaining to utilising mobile phone technology fully for agricultural reasons. Chapter Six (Section 6.2) presented the proposed framework for harnessing mobile phone technology for sustainable smallholder agricultural outcomes, and Figure 6.2 displays the actual structure of the framework.

The proposed mobile phone agricultural framework comprises the following components or elements: a) The identification, synchronisation and alignment of all agriculture information sources and processes in Zimbabwe. b) The national agricultural information database. c) The information service and access platform. d) The mobile phone technology agriculture applications and services used in Zimbabwe. e) The evaluation of all mobile phone agricultural applications and services by the ministry of agriculture. f) The evaluation of farmers' intrinsic characteristics and training on mobile phone technologies by agricultural extension officers. g) Smallholder farmers access effective and sustainable usage of mobile phone technologies in their agricultural activities. These elements need to be aligned and explicitly defined so that they might result in the usage of mobile phone technologies by smallholder farmers, which may result in the development of smallholder agricultural activities.

7.3 EVALUATION OF HOW THE RESEARCH ADDRESSED THE MAIN RESEARCH QUESTION

By performing a thorough literature analysis, conducting five individual interviews at three farmers' markets, a 12-member focus group discussion at Gokwe Centre and individual interviews with 30 smallholder farmers at their homesteads in Gokwe South, the research

was able to answer the main research question. The expert review comments were also integrated into the research, which aided in addressing the primary research issue as well as further exploring the research sub-questions. The interviews performed at the three farmers' markets were utilised to gain some insight into the reasons why these farmers are not employing mobile phone technology in their daily agricultural activities. These were purposively sampled while they went about their work of selling agricultural items to farmers' market merchants. Gokwe South is in the country's Midlands province, and it is one of the country's vibrant and productive agriculture districts and the best in the province.

The research analysed the findings from observations, focus group discussions and individual interviews on smallholder agricultural activities, the characteristics, information needs and challenges the farmers face, as well as an assessment of the usage of mobile phone technologies in agriculture by the smallholder farmers and agricultural extension officers in Zimbabwe. This enabled the emergence of the theory, which culminated in the development and refinement of the conceptual framework presented in Figure 5.12. The researcher conducted a literature review on ICT agricultural frameworks and models, which supported the research in making a secondary and practical contribution by developing and benchmarking the suggested framework for harnessing mobile phone technology for supporting smallholder agriculture in Zimbabwe. While there are other major difficulties confronting smallholder farmers in Zimbabwe, the lack of actionable and timely information to, from and among smallholder farmers along the agriculture value chain has been a key contributor. While data were acquired using several qualitative methodologies, necessitating separate analyses; nonetheless, the interpretations were later unified. Observations, a focus group discussion and in-depth interviews were employed during the study's validation process; the data analysis was done in an interpretative inquest, in line with recommendations by Creswell and Miller (2000). However, to attain sound credibility the researcher is required to answer the following questions posited by Eriksson and Kovalainen (2011):

- a) Is the researcher familiar with the topic?
- b) Are the data sufficient to merit the claims?
- c) Have links been made between categories and observations?

- d) Can any other researcher using their materials confirm their claims or be closer to their findings using the interpretations that the researcher has made?

Ensuring that the correct research questions were asked was critical.

To have an in-depth understanding of the reasons why most smallholder farmers in Zimbabwe were not using mobile phone technologies in their everyday agricultural activities, the following main research question was formulated:

Why are most smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general, everyday lives?

The primary research question was distilled into six sub-research questions, as presented in Chapter One (Section 1.4.1).

1. It is important to make sure that the researcher has chosen a particular research design suitable to the research question.

The main research question is a 'why' question and therefore, the research methodology is a qualitative approach, which is premised on the interpretivist philosophy. A multiple-case study design was used in this research and an inductive approach was applied. A mixed-methods strategy of data collection and analysis [observations, individual interviews, FGD and expert reviews] was employed. Empirical research results from the interviews in the five villages in Gokwe South were used as complementary to verify results from the pilot research at the farmer's markets and the FGD and were analysed inductively. Data collection and analysis were undertaken with 30 smallholder farmers distributed across five villages, which were the main research sites and the FGD at Gokwe centre as well as five smallholder farmers at the farmers' markets at Mbare Harare, Kombayi Gweru and Gokwe centre to guarantee a diverse source of responses. The research employed a multiple-case study technique because it allows for triangulating data during data processing, as well as the generation of relevant and trustworthy knowledge to enable theoretical generation, practical contribution and application, with primacy given to theoretical generation. This is essential in the field of emerging technological applications and ICT4D research. Within-case analysis, cross-case analysis, triangulation and hermeneutics were used in the data analysis process, in line with the recommendations by Klein and Myers (1999). This was done to ensure that

an in-depth analysis of the research phenomenon is obtained, as emphasised by Yin (2014). The nine (9) elements of the developed eclectic model modified for this research were used to discuss the perspectives of smallholder farmers and the factors influencing their adoption and efficient usage of mobile phone technologies in Zimbabwe (see Sections 5.8, 5.9 and 5.10).

The research conceptual model components developed to underlie the study assisted in the development of the interview guide and FGD questions. These were then utilised qualitatively to gain a clear image of smallholder farmers' underutilisation of mobile phone technologies in Zimbabwe, as well as their overall attitude toward the employment of mobile phone technologies in everyday agricultural activities. The qualitative technique was also favoured because it allowed for a comprehensive understanding of the social contexts of smallholder farmers in Gokwe South. Smallholder farmers' mobile phone ownership, their actual level of usage of mobile phone technologies in their everyday lives as well as in agricultural activities, the challenges they face in acquiring and using mobile phone technologies, and their readiness to use mobile phone technologies in their everyday agricultural activities are among the issues investigated. The study used a multi-method research methodology in which a broader range of methodologies was used in a strictly qualitative data gathering and analysis design. This allowed the researcher to determine the problems that smallholder farmers encounter while acquiring and using mobile phone technology and other agricultural application solutions, as well as the extent to which these challenges exist. The use of diverse tools for data collection and analysis resulted in rich data analysis; the researcher made informed decisions about which instruments to use to answer the main research question.

The research ensured that there was participant diversity and enrichment, which was achieved by observing and conducting in-depth interviews with thirty (30) individual smallholder farmers in five (5) villages in Gokwe South. The research also conducted an FGD with twelve (12) participants (see Section 5.4) at the Gokwe centre, which also helped to increase the number and diversity of participants. A pilot study was conducted at the farmers' markets (see Section 5.3). The pilot study and the FGD with 12 diverse participants who included smallholder farmers, mobile telecommunication experts, agricultural extension officers and representatives of organisations in the agricultural value chain helped to ensure instrument fidelity. This process is important as it ensures

that the data collection instruments address the main research question, as pointed out by Duke and Mallette (2011).

To ensure treatment integrity, comparisons and complementation of data collection methodologies were executed. The instruments were applied systematically across the thirty (30) smallholder farmers in the five (5) villages in Gokwe South and the research results were compared with the findings from the FGDs (Vuuren et al., 2016). However, the FGDs guide contained some additional concepts that were not in the interview guide. The research also applied the hermeneutic guidelines posited by Klein and Meyers (1999) to complement the data analysis process.

The researcher is aware of some criticism of the qualitative approach concerning its ontology, epistemology, methodology, paradigm, research design and ideology. As a result, some measures were put in place in every phase to make sure that the research approach allowed for probing to establish whether the primary research question was addressed. All the methods applied in the data collection process complemented each other well as observations at the farmers' markets at Mbare, Kombayi and Gokwe centre as well as at the five villages facilitated further enquiries through the interviews, in line with Thomas (2010).

The primary research question focused on why most smallholder farmers in Zimbabwe are not using mobile phone technologies for agriculture-related purposes, while they successfully utilise them in their everyday lives. The major challenges underlying the fact that most smallholder farmers in Zimbabwe are not using their mobile phone technologies in their agricultural activities while they successfully utilise them in their everyday lives were identified as:

- a) The Perceived Support of Service Provider (PSoSP) construct (new) generated in this research is a key factor in predicting the adoption and explaining the usage, or lack of it, of mobile phone technologies. This construct accounted for the reasons why all the sampled research participants were using Econet's telecommunications service since it is the only one of the three operators of which the network is accessible to most parts of Gokwe South. The participants were using Econet's other supplementary services (like mobile money transfers) quite adeptly. However, most of these same farmers were also not using *EcoFarmer*, an agriculture information dissemination application, and the research established

the reason as a lack of support from the service provider for the service compared to its supplementary services. The absence of infrastructure like base stations and electricity to support the operations and functioning of mobile phone services has resulted in the near or total absence of a network for NetOne and Telecel in most areas. That might explain why few research participants used these (NetOne and Telecel) organisations' telecommunication services in their areas and were only using them as supplements to Econet. This also supports the Perceived Mobility (PM) construct (new) since its absence also explains the adoption of Econet instead of NetOne and Telecel in the area.

- b) The Perceived Costliness (PC) construct was supported, and there is a convergence between this construct and the literature review, the pilot study, the focus group discussion, and all the research sites in this research. Most farmers have basic mobile phone handsets and cannot afford the associated telecommunication services in Zimbabwe.
- c) The Perceived Usefulness (PU) construct was supported by the empirical data since the research participants were actively involved in using their mobile phones in most of their general, everyday life activities like SMS messaging, voice calling, mobile money transfer and, to some extent, *WhatsApp* messaging. This construct might explain that smallholder farmers would adopt and use mobile phone technologies in agriculture if they perceive it to be useful to them in their agricultural activities. However, the variations in the usage levels of these general activities might account for the Perceived Ease of Use (PEOU) construct, as was the case with the agricultural extension officer at Mashove village.
- d) The Perceived Expressiveness (PE) construct (newly proposed in this research) was found useful in explaining the adoption and usage of mobile phones for agricultural purposes, with some smallholder farmers posting images of their produce on their *WhatsApp* statuses and finding it very beneficial.
- e) The Perceived Compatibility (PComp) construct was supported by empirical data since the participants adopted mobile phones in different areas of general everyday life, like mobile money transfer (*EcoCash*). For example, the agricultural extension officer for Dzawanda village employed a mobile phone to complement her supervisory responsibilities.

- f) Perceived Subjective Norms (PSN) were considered important as the women in the area used mobile phone technologies, and in some cases, the spouses were buying their wives better handsets than for themselves.
- g) The Perceived Behavioural Control (PBC) factor revealed a lack of digital skills among some smallholder farmers and the 'technophobia' of some agricultural extension officers. This lack was further compounded by the authorities at the agricultural extension services offices' bureaucratic tendencies. Such circumstances might contribute to the low ownership of mobile phone handsets because if someone does not own a mobile device, they would not know how to use such a device.

Generally, eight constructs were moderated by the agricultural extension officers; hence, their initiatives and competency levels in the usage of mobile phone technologies become vital to the acceptance, adoption and usage of mobile phone technologies. The latter could be complemented by governmental intervention and the encouragement of agricultural extension officers to use mobile phone technologies. Other moderators of the constructs include the age of the smallholder farmers and their experience using mobile phones, which might be accounted for by the timeframe in which they have owned the mobile phone. The research results and the insights from the literature review were merged to inform the development of the conceptual framework, which could be used by other researchers in future. This framework can provide a prediction about the potential adoption of mobile phones for agricultural purposes and explain the variations in usage behaviour levels by different smallholder farmers in Zimbabwe.

After addressing the first contribution of the research, the conceptual framework enabled the researcher to address the secondary aim, i.e., to propose a framework for guiding the adoption and utilisation of mobile phone technologies to advance Zimbabwean smallholder agriculture. Many mobile phone agricultural applications have been developed and deployed in Zimbabwe, but their use is very limited and confined to very few capable smallholder farmers in Gokwe South, as evidenced by the findings at Dzawanda village, where most of the interviewees did not know about such applications, let alone use them. This research argues that the adoption and full appropriation of mobile phone technologies by smallholder farmers in agriculture in Zimbabwe might successfully occur once farmers have been trained on how to use mobile phone technologies

effectively. This might enable smallholder farmers to appreciate the importance of these technologies in seeking, receiving and sharing information. Further, mobile phone technologies (mobile phone handsets and associated services) should be provided at discounted prices for the farmers so that most smallholder farmers can acquire and use mobile phone technologies.

The proposed framework encapsulates all agriculture information sources and processes into a national agriculture information repository. All this information should be availed on a platform, which makes the information available on Android, USSD, SMS and website forms. The framework is not limited to those identified applications only as more applications can be fashioned and made operational, hence there should be provision for integrated. The most important part is the integration of agricultural extension services (Agritex) into the framework. The agricultural extension department is central to the development of smallholder farmers in Zimbabwe; hence, it has a dual role in the framework. Its first role is to evaluate the mobile phone technology agriculture applications and services available in Zimbabwe. Its second role is to evaluate the smallholder farmers' intrinsic characteristics, training requirements, mobile phone technology applications and services in their areas.

The next sub-section focuses on illuminating how the research problem has been addressed in this research.

The primary research question was stated as follows:

Why are smallholder farmers in Zimbabwe not using mobile phone technologies for agriculture-related purposes while they successfully utilise them in their general, everyday lives?

The themes derived from focus group discussions, interviews and the researcher's observations offered a solution to the main research question. The challenges faced by smallholder farmers in their regular agricultural activities, their information needs, factors encouraging the adoption and continued use of mobile phone technologies in agricultural activities and factors impeding such adoption and continued use are among the themes that emerged. The literature review together with the expert reviews were incorporated into the data which answered the main research question.

To address the main research question, six (6) research sub-questions were used to make a deeper enquiry concerning the study.

What are the smallholder agricultural activities, characteristics, information needs and challenges farmers face in Zimbabwe?

To address research Sub-Question 1, ten (10) questions were used in the interview guide. This enabled the research to establish smallholder agriculture activities, characteristics, and information needs.

What are the mobile agricultural applications and services available in Zimbabwe?

To address research Sub-Question 2, six (6) questions were used on the interview guide to gather the requisite data. This facilitated the study to institute mobile phone technologies and their uses in agricultural activities by smallholder farmers in Zimbabwe. Sub-Question 3 reads: *What are the perceptions of smallholder farmers on the outcomes of their agricultural activities because of the use of mobile phones?* Eight (8) questions from the interview guide were utilised to elicit smallholder farmers' opinions on the utility of mobile phone technologies in their routine agricultural tasks to answer this sub-question. The empirical research results culminated in the emergence of the conceived conceptual model's nine (9) elements. These constructs provided insights into the mobile phone adoption prediction and explanation for the varying usage behaviour of Zimbabwe's smallholder farmers. The constructs explained the smallholder farmers' lack of adoption and usage of mobile phone technologies in their agricultural operations and the barriers to their successful acceptance and usage of mobile agriculture applications. Thus, the study's secondary aim was addressed by the creation of a framework for harnessing mobile phones and the alignment of aspects influencing smallholder farmers' adoption and usage of mobile phones, which could lead to a rise in the use of mobile phone technology.

Sub-Question 4 reads:

How do smallholder farmers in marginalised settings use their mobile phones for agriculture-related purposes?

To address this research question, the research framed six (6) questions in the interview guide. The research found that those smallholder farmers in Zimbabwe who were using their mobile phones for agricultural purposes were searching for information about

agricultural implements, markets for produce, paying for products and receiving money among other uses.

What are the factors affecting the adoption and use of mobile phone technology as sources of agricultural information, upscaling them and their sustainable use among smallholder farmers in Zimbabwe?

The interview guide's nine questions that focused on this research sub-question produced some intriguing, nuanced themes including the perception that smallholder farmers lack digital literacy, the high cost of purchasing mobile phone handsets, as well as ongoing costs like data, voice calls and subscriptions to mobile agricultural applications. There is also the issue of poor network signal strength or unreliable network coverage and in some cases total network blackout.

The last sub-research question is:

How to ensure that smallholder farmers in Zimbabwe adopt and optimise the use of mobile phones in their agricultural activities sustainably?

This question is more closely related to the main research question as the research intended to establish the reasons why most smallholder farmers are not using mobile phones in their everyday agricultural activities in Zimbabwe. The research also intended to suggest solutions hence the proposed framework.

The study proved that agriculture extension officers played a crucial part in the growth of smallholder agriculture in Zimbabwe. It was intriguing to observe how agricultural extension officers might influence smallholder farmers' adoption and use of mobile phones in their regular agricultural tasks. This was noted in those smallholder farmers interviewed in Dzawanda village as they claimed that they were using some of Zimbabwe's mobile agriculture application services, in contrast with smallholder farmers in the other four (4) villages. This was attributed to the agricultural extension officer of the area who had positively influenced the smallholder farmers of the area to consistently use their mobile phones in their agricultural information seeking, searching, receiving, and even sharing among themselves. The same agricultural extension officer was cited by smallholder farmers at Mutoranhema village as already beginning to have a positive influence on the farmers' adoption and use of the mobile phone in their agricultural

activities yet that officer had just been introduced to that village to replace the officer who had just retired due to old age.

7.4 DID THE RESEARCH CAPTURE AN UNDERSTANDING OF THE ISSUE?

This study examined the reasons why most Zimbabwean smallholder farmers do not regularly employ mobile phone technology in their farming operations. The study found that smallholder farmers and some agricultural extension officers lacked digital literacy, experienced technophobia, paid high prices for their mobile phones and paid high operating costs for data, voice calls and mobile agricultural app subscriptions. There is also the issue of poor network signal strength or unreliable network coverage and in some cases, total network blackout. The research then established that there is a need for capacity building of smallholder farmers as well as addressing the issues of mobile phone acquisition and running costs to make them affordable for smallholder farmers.

There is also a need to address infrastructure issues like insufficient telecommunications and electricity in the rural areas where most of the smallholder farmers are based. By addressing these problems, smallholder farmers may be more likely to accept and employ mobile phone technologies in their farming operations. Smallholder farmers may benefit from the facilitation of knowledge-sharing about climatic conditions, weather forecasts, agricultural input prices and the market price for products, diseases, and other disasters in real time, using the extensive adoption and intensive use of mobile phone technologies in seeking, searching, and even sharing agricultural information. This might help reduce information asymmetry and information searching costs and might result in a reduction in losses incurred by farmers, especially in situations involving perishable products which require efficient time to market. The next section focuses on the contribution made by the research.

7.5 THE CONTRIBUTION MADE BY THIS RESEARCH

Theoretical and practical advances in academic knowledge have emerged from this research. The conceptual model was created and modified by the research to help understand why smallholder farmers in Zimbabwe only sometimes use their mobile phones for agricultural purposes. This is a theoretical contribution, which helps to provide a better understanding of non adoption of mobile phones for agricultural purposes while

successfully using them in general everyday life activities which is abstracted from the empirical findings. This analysis contributes to a theoretical body of knowledge, which is cross-cutting, and hence, can be useful to other researchers outside the research settings in which the researcher conducted this research. The practical contributions of this research centre on the core ideas of the suggested framework and how smallholder farmers in Zimbabwe could use mobile phone technology as well as how their actual usage might lessen issues with their need for agricultural information. These concepts are expatiated in the next sub-sections.

7.5.1 The theoretical contribution of the research

The responses to the interview guide and focus group discussion reinforced the results from the literature analysis for six constructs. The research also proposed three new constructs, namely Perceived Expressiveness, Perceived Support of Service Provider and Perceived Mobility. The proposed mobile technology agriculture adoption model explained the adoption, patterns and variations of mobile phone technology usage by smallholder farmers in Zimbabwe in this research. The model emphasises the significance of the role of agricultural extension service officers in the adoption and usage processes. As such, the model incorporates agricultural extension services officers as an integral component, moderating eight constructs of the proposed model. The research findings show that agricultural extension service personnel in Zimbabwe play a crucial role in teaching smallholder farmers and assessing the utility of mobile phone technology applications as a supplemental tool in the agricultural extension service processes.

Therefore, the constructed conceptual framework could be adopted and applied by other researchers in different research areas. The reasons why smallholder farmers in Zimbabwe were underutilising mobile phone technologies for agricultural needs although these farmers productively used mobile phone technologies in their everyday life were unknown at the time this research was being conducted. As a result, this study contributes to the body of knowledge already available about sub-Saharan African literature in general and Zimbabwe in particular.

General discussions around mobile phone technology concepts suggest that they could complement the work of agricultural extension officers, thereby advancing smallholder agriculture information flows directly and indirectly boosting productivity and reducing

losses. In contrast, this study sought to identify the obstacles impeding the complete use of mobile phone technology in smallholder agriculture and to propose solutions. As a result, this research contributes to the United Nations Sustainable Development Goals (SDGs). The research is important in seeking to address two (2) of the core United Nations SDGs directly, concentrating on enhancing people's quality of life, particularly the marginalised. SDG1 (end all forms of poverty everywhere) and SDG2 (end hunger, achieve food security, enhance nutrition, and promote sustainable agriculture) are among them. Zimbabwe has several agricultural applications for mobile technology but there is an important need to educate, train and capacitate smallholder farmers to fully appropriate them in their agricultural activities. That is why this study recommends the augmentation of smallholder farmers' digital skills and competencies in using digital devices through agricultural extension services.

The theories and concepts from the research could inform further mobile phone technology and innovation research in developing contexts. This research is also the first to propose a framework to improve the adoption and use of mobile phone technologies in smallholder agriculture. The proposed eclectic model comprises nine constructs, namely Perceived Expressiveness (PE) (New), Perceived Costs (PC), Perceived Mobility (PM) (New), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Perceived Compatibility (PComp), Perceived Support of Service Provider (PSoSP) (New), Perceived Subjective Norms (PSN) and Perceived Behavioural Control (PBC). Based on the nuances obtained from the research these constructs were found to be useful in the adoption of mobile phone technologies in Zimbabwe.

The study found that smallholder farmers' perceptions of mobile phone technology are positively shaped by perceived compatibility which, in turn, influences their willingness to acquire mobile phones and use them for agricultural purposes. The apparent lack of support from the telecommunication service providers has a detrimental impact on smallholder farmers in Zimbabwe's plans to use mobile phone technologies. The perceived positive subjective norms of the Gokwe South community on the usage of mobile phone technologies by all members of society including women is a positive development as it may mean that all members of the community can use mobile phones without being judged by society. The perceived positive behavioural control of the Gokwe South community on the use of mobile phone technologies suggests that the people of

Gokwe South are confident about their capabilities to use mobile phones and this is a positive effect to the adoption and use of mobile phones in agriculture by smallholder farmers in Gokwe South. The adoption and use of mobile phones to undertake agriculture-related tasks are crucial criteria to be met, according to Perceived Behavioural Control.

Therefore, the research submits the developed conceptual model as a key contribution to the domain of theoretical frameworks for understanding the adoption of technologies and innovations research and evaluation and use by other researchers.

7.5.2 Practical contribution of this research

This section focuses on the framework that was developed in this research. Smallholder farmers may accept and fully appropriate mobile phone technology if the framework's components are well integrated. It is determined what causes the gaps in mobile phone technology adoption by Zimbabwe's smallholder farmers in their agricultural activities. The practical contribution this research makes to the body of knowledge is the proposed framework. The framework provides a general overview of how agricultural data from different sources should be populated into a national repository and how it should be made available to end users, especially smallholder farmers, through different mobile agricultural applications, USSD and SMS. The framework also supports the work processes of agricultural extension services and complements their roles of agriculture information dissemination to smallholder farmers. Data collection by agricultural extension service officers can be facilitated by using mobile phone technologies, whereby smallholder farmers could upload pest and disease agricultural information, which could easily be sent to a laboratory for analysis and solutions could be provided in real time.

The development and deployment of mobile phone technology application platforms and services would continue to evolve with new players freely coming on board but their integration into the framework could be done one at a time in the form of phases. The full integration of every platform should be done after a full evaluation of the technology's usefulness to the smallholder farmers by the agricultural extension services. There will also be a need for continuous monitoring and evaluation of the integrated mobile phone technologies on the framework as this ensures adherence to operational standards as well as continuous improvement of a solution that has been implemented. The researcher also proposes the need for establishing a national ICT agriculture policy of which the

focus would be the overall improvement of agriculture in Zimbabwe. The policy should go beyond focusing on access to information to also emphasise such things as the quality of agricultural data at all levels from ward to district and province to national.

The research identified mobile phone technology elements and platforms (USSD facility and mobile phone agriculture applications) that are supported by various mobile phone devices. These applications can smoothen information seeking, access and communication among smallholder farmers and between smallholder farmers and other stakeholders in the agricultural value chain. This might result in timely information seeking and response receiving. The agricultural extension services officers are currently underfunded; they are no longer provided with motorbikes as during the 1980s and 1990s; hence, the Ministry of Agriculture needs to motivate and empower them by providing them with training on new digital skills and methods, which could aid them in executing their duties.

7.6 THE RESEARCH STUDY'S LIMITATIONS AND RECOMMENDATIONS

The probable limitation of this research is that it is a case study, and the participants were mostly purposively sampled smallholder farmers in five villages (5) in Gokwe South District. The research also employed a qualitative approach, which emphasises the need for an understanding of deeper nuances ahead of sample representativeness, which, in turn, explains why most smallholder farmers were excluded. The research developed a conceptual model as a guide for framing the boundaries to ensure the researcher went into the field with an open mind yet with a general expectation of what might be discovered. The conceptual model included aspects from the main adoption models, but not all features of the adoption models were tested or validated in this research. However, three new constructs were proposed in this research, namely Perceived Support of Service Provider (PSoSP), Perceived Expressiveness (PE) and Perceived Mobility (PM). These constructs were validated by empirical data and found powerful in predicting the participants' adoption of mobile phone technology and providing a sound explanation for the variances in their usage levels of mobile phones. The research also affirmed and supported the other six constructs from the literature review, namely Perceived Costs (PC), Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived

Compatibility (PComp), Perceived Subjectivity Norms (PSN) and Perceived Behavioural Control (PBC).

The research did not develop and test a mobile application, which might also present a limitation. However, the ICT expert and agricultural extension services informatics officers' sentiments about the proposed framework confirmed its usefulness to the agricultural extension officers, smallholder farmers and the agricultural community at large. The expert reviewers suggested that the proposed framework could facilitate the harnessing of mobile phone technologies for the development of smallholder agricultural activities for Zimbabwe and SSA, as well as other nations with a similar contextual setting. The experts recommended that it is imperative to ensure that all the existing mobile phone technology agricultural systems and other applications and processes for agricultural information dissemination and other functions should be evaluated before they are deployed and integrated into the framework. All the technological applications and processes to be integrated into the framework should support interoperability with the existing ICT infrastructure. This research was conducted in Zimbabwe, a country in a developing context situated in SSA; hence, it is confined to these contextual settings. Therefore, the research outcome is relevant and applicable specifically to Zimbabwe and to a general extent, to other developing nations, especially in SSA. The next section focuses on future studies.

7.7 FUTURE RESEARCH

This sub-section highlights possible avenues for future research in ICT4D, Mobile phone technologies in many areas of applications and in particular, agriculture. The research suggests that if the proposed framework is adopted and implemented by policymakers in Zimbabwe, future researchers could conduct the same research using the quantitative or mixed method, which might bring forth some quantitative understanding of the issues affecting the adoption of mobile phone technologies in Gokwe South, Zimbabwe. Other researchers could adopt the eclectic theoretical model and evaluate the lucidity of the nine constructs and possibly, modify the model by either adjusting the constructs, modifying them, subtracting some or adding others if possible.

The research also proposes that future researchers could conduct the same research in a different case study and compare the findings with the findings of this research. Other

researchers could undertake multi-case study research in different locations and make comparisons of the research findings between the different cases. Finally, other researchers could develop mobile phone technology applications based on the recommendations of the developed framework for harnessing mobile phone technologies for the development of smallholder agriculture in Zimbabwe. These researchers could then evaluate the adoption and effective use of the developed mobile phone technology by smallholder farmers longitudinally over five (5), ten (10) or fifteen (15) years.

7.8 RESEARCH SUMMARY

This sub-section offers the research conclusions by comparing the results of the study to the research aim, obstacles and objectives. The study aimed to understand the reasons why smallholder farmers in Zimbabwe were not successfully using their mobile phones in their agricultural activities when they were using these devices (mobile phones) in other general, everyday areas of their lives like calling, SMS messaging and mobile money transfer. The major research question and six sub-research questions were formulated for the research to achieve its goal. The research was able to provide contributions made to the body of knowledge which included the theoretical contributions and practical contributions in Section 7.5.

The study's main goal was to make a theoretical contribution to the body of knowledge; hence, the research created a conceptual model and modified it to help understand why smallholder farmers in Zimbabwe only sometimes used their mobile phones for agricultural purposes. This model is a theoretical contribution, which helps provide a better understanding of the farmers' non-adoption and a lack of mobile technology use, which is abstracted from the empirical findings. The analysis contributes to a cross-cutting theoretical body of knowledge, which could thus be useful to researchers in other research settings.

The research's secondary aim was to create a framework for utilising mobile phone technologies to advance smallholder agriculture in Zimbabwe. To that end, the study analysed the literature on smallholder farmers and mobile phone use in agriculture and offered a detailed overview of the study's context. The factors influencing mobile phone uptake and use in agriculture as well as attitudes and views toward technology were then discussed. The research used a qualitative approach premised on the interpretivism

philosophy which acknowledges multiple realities. Based on the emerging theory above this second contribution was proposed.

The proposed framework integrates the key agricultural stakeholders in the layers and put the agricultural extension services officers at the epicentre of the operationalisation of the framework as they are a vital part of the smallholder agriculture information dissemination and agriculture development matrix. The framework is meant to support the integration of agricultural information sources into a centralised repository which should be accessible to all agricultural information dissemination platforms. All the developed mobile phone technology for agriculture platforms should be integrated into the framework after evaluation. The agricultural extension services officers who are the direct contact people working with smallholder farmers should evaluate the intrinsic conditions of the smallholder farmers under their jurisdiction and recommend to them the best mobile phone technology agricultural application suitable for each farmer's circumstances. The framework is presented in Section 6.2 and has been reviewed by four (4) experts. The proposed framework has been welcomed by the agricultural extension services department in Zimbabwe.

In conclusion, this study is a paradigm shift in the field of mobile agriculture, supporting smallholder farming specifically in Zimbabwe and in developing nations generally. The study has made recommendations for ways to increase the uptake and efficient use of mobile phone technologies by smallholder farmers in Zimbabwe. The framework for harnessing mobile phone technologies for the development of smallholder agriculture in Zimbabwe supports the proposed SDGs digital technology solutions applications to agriculture as posited by scholars like Nitturkar (2021) and Qin et al., (2022), which is confirmed by Zimbabwe's 2019 to 2030 National Agriculture Policy nine (9) Framework (Chitongo et al., 2020). The researcher endeavoured to improve the adoption and effective usage of mobile phone technologies by smallholder farmers in their agricultural activities and the proposed framework will complement that endeavour. The process of crafting this work enabled the researcher to accumulate a reservoir of skills in sections such as formulation of the theoretical and/ or conceptual framework and how to align research methodology with the object of enquiry.

REFERENCES

- Abraham, M., & Pingali, P. (2020). Transforming smallholder agriculture to achieve the SDGs. *The Role of Smallholder Farms in Food and Nutrition Security*, 173–209. https://doi.org/10.1007/978-3-030-42148-9_9
- Abu-Shanab, E. (2015). Moderators or predictors of gender and age: *International Journal of E-Adoption*, 7(1), 32–51. <https://doi.org/10.4018/IJEA.2015010103>
- Adams, S., & Akobeng, E. (2021). ICT, governance and inequality in Africa. *Telecommunications Policy*, 45(10), 102198. <https://doi.org/10.1016/j.telpol.2021.102198>
- Addom, B. K., & Baumüller, H. (2020). The enabling environments for the digitalization of African agriculture. https://doi.org/10.2499/9780896293946_13
- Agyekumhene, C., De Vries, J. R., Van Paassen, A., Macnaghten, P., Schut, M., & Bregt, A. (2018). Digital platforms for smallholder credit access: The mediation of trust for cooperation in maize value chain financing. *NJAS - Wageningen Journal of Life Sciences*, 86–87, 77–88. <https://doi.org/10.1016/j.njas.2018.06.001>
- Ahmed, I., & Ali, A. (2017). Determinants of continuance intention to use mobile money transfer: An integrated model. *Journal of Internet Banking and Commerce*, 22(S7), 1–24. <http://hdl.handle.net/10576/5620>
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control*, pp. 11–39. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69746-3_2
- Ajzen, I. (1991). The theory of planned behavior. *University of Massachusetts at Amherst*, 211(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Ajzen, I. (2010). Constructing a theory of planned behavior questionnaire. *Biofeedback and Selfregulation*, 17, 1–7. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84(5), 888–918. <https://doi.org/10.1037/0033-2909.84.5.888>
- Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Prentice-Hall, Englewood Cliffs, NJ. <https://cir.nii.ac.jp/crid/1572543024551612928>
- Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics*, 47(S1), 1–237 (United Kingdom). <https://doi.org/10.1111/agec.12301>
- Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *The Journal of Economic Perspectives*, 24(3), 207–232. <https://doi.org/10.1257/jep.24.3.207>
- Akinyemi, B. E., & Mushunje, A. (2020). Determinants of mobile money technology adoption in rural areas of Africa. *Cogent Social Sciences*, 6(1). <https://doi.org/10.1080/23311886.2020.1815963>

- Alam, M., D'Este, C., Banwell, C., & Lokuge, K. (2017). The impact of mobile phone based messages on maternal and child healthcare behaviour: A retrospective cross-sectional survey in Bangladesh. *BMC Health Services Research*, 17(1). <https://doi.org/10.1186/S12913-017-2361-6>
- Aldosari, F., Al Shunaifi, M. S., Ullah, M. A., Muddassir, M., & Noor, M. A. (2017). Farmers' perceptions regarding the use of information and communication technology (ICT) in Khyber Pakhtunkhwa, Northern Pakistan. *Journal of the Saudi Society of Agricultural Sciences*. <https://doi.org/10.1016/J.JSSAS.2017.05.004>
- Alhojailan, M. I., & Ibrahim, M. (2012). Thematic analysis: A critical review of its process and evaluation. *WEI International European Academic Conference Proceedings*, 1(2011), 8–21. <https://doi.org/10.1177/1525822X02239569>
- Alkire, S. (2010). OPHI Working Paper No. 36 human development: Definitions, critiques, and related concepts. *Background paper for the 2010 Human Development Report*. Available at SSRN: <https://ssrn.com/abstract=2351490>
- Allen, R. E. S., & Wiles, J. L. (2016). A rose by any other name: Participants choosing research pseudonyms. *Qualitative Research in Psychology*, 13(2), 149–165. <https://doi.org/10.1080/14780887.2015.1133746>
- Allport, G. W. (1935). Attitudes. In: C. Murchison (Ed.), *Handbook of social psychology* (pp. 798–844). Clark University Press, Worcester, MA.
- Almqvist, R., Bino, C., & Skoog, M. (2011). Towards the next generation of public management. *The International Journal of Public Sector Management*, 24(2), 122–145. <https://doi.org/10.1108/09513551111109035>
- Alrafi, A. (2008). Technology acceptance model. *Journal of Interactive Marketing*, 22(4), 1–12. <https://doi.org/10.1002/dir>
- Altamirano, M. A., & Beers, C. P. V. (2017). Frugal innovations in technological and institutional infrastructure: Impact of mobile phone technology on productivity, public service provision and inclusiveness. *The European Journal of Development Research* 2017, 30(1), 84–107. <https://doi.org/10.1057/S41287-017-0115-2>
- Altawallbeh, M., Soon, F., Thiam, W., & Alshourah, S. (2015). Mediating role of attitude, subjective norm and perceived behavioural control in the relationships between their respective salient beliefs and behavioural intention to adopt e-learning among instructors in Jordanian universities. *Journal of Education and Practice*, 6(11), 152–160. <http://iiste.org/Journals/index.php/JEP>
- Amunkete, K. N., Van Staden, C. J., & Schoeman, M. A. (2019). Perceptions on using e-learning in preserving knowledge on Namibia's indigenous medicinal plants. *IST-Africa Week Conference (IST-Africa)*, 1–10. [10.23919/ISTAFRICA.2019.8764841](https://doi.org/10.23919/ISTAFRICA.2019.8764841)
- Anadozie, C., Fonkam, M., Cleron, J. P., & Kah, M. M. O. (2019). The impact of mobile phone use on farmers' livelihoods in post-insurgency Northeast Nigeria. *Sage Journals*, 37(1) 6–20. <https://doi.org/10.1177/0266666919886904>
- Anney, V. N. (2014). Ensuring the quality of the findings of qualitative research: looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and*

Policy Studies, 5(2), 272–281.
<https://doi.org/10.3109/08941939.2012.723954>

Anseeuw, W., Kapuya, T., & Saruchera, D. (2012). Zimbabwe's agricultural reconstruction : Present state, ongoing projects and prospects for reinvestment. *Development Planning Division Working Paper series No. 32*. Midrand: DBSA.

Antonio, A., & Tuffley, D. (2014). The gender digital divide in developing countries. *Future Internet*, 6(4), 673–687. <https://doi.org/10.3390/fi6040673>

Anthony, D., & Mutalemwa, D. K. (2014). Factors influencing the use of mobile payments in Tanzania: Insights from Zantel's Z-pesa services. *Journal of Language, Technology & Entrepreneurship in Africa*, 5(2), 69-90
<https://www.ajol.info/index.php/jolte/article/view/113177>

Ardana, R. (2014). The influence of perceived usefulness, ease of use, compatibility and risk on mobile banking user attitude. *Jurnal Administrasi Bisnis S1 Universitas Brawijaya*, 17(2), 85134. administrasibisnis.studentjournal.ub.ac.id

Arsal, I. (2008). *The influence of electronic word of mouth in an online travel community on travel decisions: A case study* (August 2008) [Doctor of Philosophy, Clemson University]. https://tigerprints.clemson.edu/all_dissertations/273/

Asif, A. S., Uddin, M. N., Dev, D. S., & Miah, M. A. M. (2017). Factors affecting mobile phone usage by the farmers in receiving information on vegetable cultivation in Bangladesh. *Journal of Agricultural Informatics*, 8(2).
<https://doi.org/10.17700/jai.2017.8.2.376>

Asongu, S., & Nwachukwu, J. C. (2017). Mobile phones in the diffusion of knowledge and persistence in inclusive human development in Sub-Saharan Africa. *Information Development*, 33(3), 289-302. <https://doi.org/10.1177/0266666916655189>

Asongu, S. A., Orim, S. M. I., & Nting, R. T. (2019). Inequality, information technology and inclusive education in sub-Saharan Africa. *Technological Forecasting and Social Change*, 146(February), 380–389. <https://doi.org/10.1016/j.techfore.2019.06.006>

Astalin, P. K. (2013). Qualitative research designs: A conceptual framework. *International Journal of Social Science and Interdisciplinary Research*, 2(1), 118–124. indianresearchjournals.com

Athens, L. (2010). Naturalistic inquiry in theory and practice. *Journal of Contemporary Ethnography*, 39(1), 87–125. <https://doi.org/10.1177/0891241609343663>

Awuor, F., Raburu, G., Onditi, A., & Rambim, D. (2016). Building e-agriculture framework in Kenya. *Journal of Agricultural Informatics*, 7(1), 75–93.
<https://doi.org/10.17700/jai.2016.7.1.244>

Ayanso, A., Cho, D. I., & Lertwachara, K. (2014). Information and communications technology development and the digital divide: A global and regional assessment. *Information Technology for Development*, 20(1).
<https://doi.org/10.1080/02681102.2013.797378>

Baqir, M., & Palvia, P. (2009). A qualitative inquiry of ICT based socio-economic

development in developing countries: The case of Pakistan.
http://libres.uncg.edu/ir/uncg/f/Baqir_uncg_0154D_10238.pdf

- Barakabitze, A. A., Fue, K. G., & Sanga, C. A. (2017). The use of participatory approaches in developing ICT-based systems for disseminating agricultural knowledge and information for farmers in developing countries: The case of Tanzania. *Electronic Journal of Information Systems in Developing Countries*, 78(1). <https://doi.org/10.1002/J.1681-4835.2017.TB00576.X>
- Baskerville, R. L., & Myers, M. D. (2015). Design ethnography in information systems. *Information Systems Journal*, 25(1). <https://doi.org/10.1111/isj.12055>
- Bass, J. M., Nicholson, B., West, B. S., & Bass, J. M. (2013). A framework using institutional analysis and the capability approach in ICT4D. <https://itidjournal.org/index.php/itid/article/view/1028.html>
- Batchelor, S., Scott, N., Manfre, C., Lopez, A. V., & Edwards, D. (2014). Is there a role for mobiles to support sustainable agriculture in Africa? *ICT for Sustainability 2014*, 272–280. <https://doi.org/10.2991/ict4s-14.2014.33>
- Baumüller, H. (2015). Assessing the role of mobile phones in offering price information and market linkages: The case of M-Farm in Kenya. *EJISDC*, 1–16. <https://doi.org/10.1002/j.1681-4835.2015.tb00492.x>
- Baumüller, H. (2012). Facilitating agricultural technology adoption among the poor: The role of service delivery through mobile phones. *ZEF Working Paper Series*, 98, 35. <https://doi.org/10.1111/j.1467-629X.1980.tb00220.x>
- Baumüller, H. (2018a). The little we know: An exploratory literature review on the utility of mobile phone-enabled services for smallholder farmers. *Journal of International Development*, 30(1), 134–154. <https://doi.org/10.1002/jid.3314>
- Beaufort, M. (2018). Digital media, political polarization and challenges to democracy. *Information, Communication & Society*, 21(7), 915–920. <https://doi.org/10.1080/1369118X.2018.1451909>
- Bentler, P. M., & Speckart, G. (1979). Models of attitude-behavior relations. *Psychological Review*, 86(5), 452–464. <https://doi.org/10.1037/0033-295X.86.5.452>
- Beranek, L. L., & Mellow, T. J. (2012). Cellphone acoustics. *Acoustics: Sound Fields and Transducers*, 391–406. <https://doi.org/10.1016/B978-0-12-391421-7.00008-7>
- Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman & Littlefield. <https://ds.amu.edu.et/xmlui/bitstream/handle/123456789/11396/Russel-Research-Method-in-Anthropology.pdf?sequence=1&isAllowed=y>
- Boeije, H. . (2009). Research design. *Analysis in Qualitative Research*, 19–42.
- Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and Quantity*, 36(4), 391–409. <https://doi.org/10.1023/A:1020909529486>

- Bongomin, G. O. C., Ntayi, J. M., Munene, J. C., & Malinga, C. A. (2018). Mobile Money and Financial Inclusion in Sub-Saharan Africa: The Moderating Role of Social Networks. *Journal of African Business*, 19(3), 361–384. <https://doi.org/10.1080/15228916.2017.1416214>
- Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. *Information Systems Journal*, 31(6), 869-902. <https://doi.org/10.1111/isj.12326>
- Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Sage Publications. <https://uk.sagepub.com/en-gb/afr/transforming-qualitative-information/book7714>
- Brink, H. I. L. (1993). Validity and reliability in qualitative research. *Curationis*, 16(2), 35–38. <https://doi.org/10.4102/curationis.v16i2.1396>
- Brink, P. J. (1993). Reliability validity issues. *Western Journal of Nursing Research*, 15(4), 401–402. <https://doi.org/10.1177/019394599301500401>
- Bryman, A. (2009). Integrating quantitative and qualitative research: How is it done? *Qualitative Research*, 6(1), 97–113. <https://doi.org/10.1177/1468794106058877>
- Bryman, A. (2012). *Social research methods*. Oxford University Press.
- Butler, T. (1998). Towards a hermeneutic method for interpretive research in information systems. *Journal of Information Technology*, 13(4), 285–300. <https://doi.org/10.1057/jit.1998.7>
- Carroll, A., & Heiser, G. (2019). An analysis of power consumption in a smartphone. *Proceedings of the 2010 USENIX Annual Technical Conference, USENIX ATC 2010*, 271–284.
- Chandio, A. A., Jiang, Y., Wei, F., & Guangshun, X. (2018). Effects of agricultural credit on wheat productivity of small farms in Sindh, Pakistan: Are short-term loans better? *Agricultural Finance Review*, 78(5), 592–610. <https://doi.org/10.1108/AFR-02-2017-0010>
- Chang, J. (2011). An interpretive account of counsellor development. *Canadian Journal of Counselling and Psychotherapy*, 45(4). <https://cjc-rcc.ucalgary.ca/article/view/59314/44731>
- Chanyagorn, P., & Kungwannarongkun, B. (2011). ICT readiness assessment model for public and private organizations in developing country. *International Journal of Information and Education Technology*, 1(2), 99–106. <https://doi.org/10.7763/IJiet.2011.V1.17>
- Chaparadza A. (2018). Seedco's new app is probably the best app for agriculture in Zimbabwe right now - Techzim. <https://www.techzim.co.zw/2018/10/seedcos-new-app-is-probably-the-best-app-for-agriculture-in-zimbabwe-right-now/>
- Charmaz, K. (1996). The search for meanings-grounded theory. *Rethinking Methods in*

Psychology, 27–49. <https://doi.org/10.1016/B978-0-08-044894-7.01581-5>

Charmaz, K., & Henwood, K. L. (2007). Grounded theory. https://doi.org/10.1007/978-3-8349-9258-1_12

Cheek, J., & Hein, S. (2009). Congress of qualitative inquiry. *Fifth International Congress of Qualitative Inquiry*.

Chepken, C., Mugwanya, R., Blake, E., & Marsden, G. (2012). ICTD interventions: Trends over the last decade. *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development - ICTD '12*, 241. <https://doi.org/10.1145/2160673.2160704>

Chhachhar, A. R., Chen, C., & Jin, J. (2016). Mobile phone impact on agriculture and price information among farmers. *Indian Journal of Science and Technology*, 9(39). <https://doi.org/10.17485/ijst/2016/v9i39/98432>

Chiparausha, B., & Chigwada, J. P. (2021). Promoting library services in a digital environment in Zimbabwe. *Research Anthology on Collaboration, Digital Services, and Resource Management for the Sustainability of Libraries*, 373–385. <https://doi.org/10.4018/978-1-7998-8051-6.ch021>

Chipidza, W., & Leidner, D. (2019). A review of the ICT-enabled development literature: Towards a power parity theory of ICT4D. *Journal of Strategic Information Systems*. <https://doi.org/10.1016/j.jsis.2019.01.002>

Chisita, C. T., & Malapela, T. (2014). Towards mobile agricultural informations systems in Zimbabwean libraries: Challenges and opportunities for small scale farmers in utilizing ICTs for sustainable food production. *Agriculture Information Worldwide*, 6, 58–65. <http://journals.sfu.ca>

Chitongo, L., Chikunya, P., & Marango, T. (2020). Do economic blueprints work? Evaluating the prospects and challenges of Zimbabwe's transitional stabilisation programme. *African Journal of Governance and Development*, 9(1), 7-20. <https://hdl.handle.net/10520/EJC-1ef237d9bb>

Chitungo, S., & Munongo, S. (2013). Extending the technology acceptance model to mobile banking adoption in rural Zimbabwe. *Journal of Business Administration and Education*, 3(1), 51–79.

Choudhury, D., Mishra, S., & Savitskie, K. (2014). Study on cell phone feature perception and usage behavior among students. *Parikalpana - KIIT Journal of Management*, 10(II), 1–12. <https://www.indianjournals.com/ijor.aspx?target=ijor:pkjm&volume=10&issue=2&article=001>

Churi, A. J., Mlozi, M. R. S., Tumbo, S. D., & Casmir, R. (2012). Understanding farmers information communication strategies for managing climate risks in rural semi- arid areas, Tanzania. *International Journal of Information and Communication Technology Research*, 2(November), 838–845.

Cliffe, L. (2011). Agricultural land redistribution: toward greater consensus. In *Review of African Political Economy* (Vol. 38, Issue 127).

<https://doi.org/10.1080/03056244.2011.552784>

Cliffe, L., Alexander, J., Cousins, B., & Gaidzanwa, R. (2011). An overview of Fast Track Land Reform in Zimbabwe: Editorial introduction. *Journal of Peasant Studies*, 38(5), 907–938. <https://doi.org/10.1080/03066150.2011.643387>

Cliffe, L., Alexander, J., Cousins, B., Gaidzanwa, R., Cliffe, L., Alexander, J., Cousins, B., & An, R. G. (2017). An overview of Fast Track Land Reform in Zimbabwe : Editorial introduction.6150(June). <https://doi.org/10.1080/03066150.2011.643387>

Cobbett, M. (1984). Agricultural extension in Zimbabwe: The basis for rural development. (pp. 16–20). https://disa.ukzn.ac.za/sites/default/files/pdf_files/rejan85.8.pdf

Coff, C., De Jong, W., Galloway, G., Katila, P., Pacheco, P., Gu, J., Zhang, C., Vaz, A., Mukwereza, L., Developments, R., Titeca, K., Flynn, R., Mohmand, S., Verhoeven, H., Wang, Y., Zadek, S., Halle, M., Ortiz, S., ... Schwartz, B. (2015). Benchmarking the policies and practices of international hydropower companies. *World Development*, 28(5), 26. <https://doi.org/10.1016/j.jwb.2008.11.004>

Cohen, L., Manion, L., & Morrison, K. (2017). Research Methods in Education. In *Research Methods in Education*. <https://doi.org/10.4324/9781315456539>

Colker, J. O. (2008). *A grounded theory approach to developing a theory of leadership through a case study of shorebank* (Issue August) [University of Phoenix]. <https://www.proquest.com/openview/9fecb09743c94622e1add112c7ec4af2/1?pq-origsite=gscholar&cbl=18750>

Compeau, D., Marcolin, B., Kelley, H., & Higgins, C. (2012). Research commentary--generalizability of information systems research using student subjects--A reflection on our practices and recommendations for future research. In *Information Systems Research*. <https://doi.org/10.1287/isre.1120.0423>

Council, I. (2012). Responsible conduct in the global research enterprise. *A policy report*. Amsterdam: InterAcademy Council. <https://www.interacademies.org/sites/default/files/publication/file.pdf>

Creswell, J. W. (2003a). *Research design* (2nd ed.). Sage.

Creswell, J. W. (2003b). Research design qualitative quantitative and mixed methods approaches. *Research design qualitative quantitative and mixed methods approaches*, 3–26. <https://doi.org/10.3109/08941939.2012.723954>

Creswell, J. W. (2007). Qualitative inquiry and research Design: Choosing among five approaches. In Book: Vol. 2nd ed. <https://doi.org/10.1016/j.aenj.2008.02.005>

Creswell, J. W. (2008). Three components involved in a design. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5–21. http://www.sagepub.com/upm-data/22780_Chapter_1.pdf

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods Approaches* (4th ed.). SAGE Publications, Inc. <http://www.ceil-conicet.gov.ar/wp-content/uploads/2015/10/Creswell-Cap-10.pdf>

- Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory Into Practice*, 39(3), 124–130. https://doi.org/10.1207/s15430421tip3903_2
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed). SAGE Publications. <https://uk.sagepub.com/en-gb/afr/designing-and-conducting-mixed-methods-research/book241842>
- Cresswell, J. W., Wolcot, H. F., Leech, N., Onwuegbuzie, A., Yunos, Z., Ahmad, R., & Lynch, T. (2014). Writing up your PhD (qualitative research). *School Psychology Quarterly*, 22(4), 96. <https://doi.org/10.4090/juee.2008.v2n2.033040>
- Cropanzano, R., Anthony, E., Daniels, S., & Hall, A. (2017). Social exchange theory: A critical review with theoretical remedies. *The Academy of Management Annals*, 11, 1–38. 10.5465/annals.2015.0099.
- Crow, G., & Wiles, R. (2008). Managing anonymity and confidentiality in social research: The case of visual data in Community research. *Economic & Social Research Council*, 8(8), 1–14. https://eprints.ncrm.ac.uk/id/eprint/459/1/0808_managing%20anonymity%20and%20confidentiality.pdf
- Crul, S. (2014). The mHealth opportunity in sub-Saharan Africa: The path towards practical application. *Deloitte*.
- CTA. (2019). Digitalising extension: Smart advisory services for farmers. *Spore* No. 194, June-August, 1–48. https://www.researchgate.net/profile/Petros-Chavula/publication/363738585_Description_of_Agricultural_Extension_and_Advisory_Service_System_in_Zambia/links/632c09a870cc936cd32889e2/Description-of-Agricultural-Extension-and-Advisory-Service-System-in-Zambia.pdf
- Cypress, B. S. (2017). Rigor or reliability and validity in qualitative research. *Dimensions of Critical Care Nursing*, 36(4), 253–263. <https://doi.org/10.1097/DCC.0000000000000253>
- Dahms, M. (2010). Shifting Focus from Access to Impact: Can Computers Alleviate Poverty? *Handbook of Research on Overcoming Digital Divides: Constructing an Equitable and Competitive Information Society*, 439–466. <https://doi.org/10.4018/978-1-60566-699-0.ch024>
- Dasuki, S. I., & Zamani, E. D. (2019). Assessing mobile phone use by pregnant women in Nigeria: A capability perspective. *The Electronic Journal of Information Systems in Developing Countries*, 85(5), e12092. <https://doi.org/10.1002/ISD2.12092>
- Davidson, A. S. (2013). Phenomenological approaches in psychology and health sciences. *Qualitative Research in Psychology*, 10(3), 318–339. <https://doi.org/10.1080/14780887.2011.608466>
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models *. *Management Science*, 35(8), 982–1003. <https://pubsonline.informs.org/doi/abs/10.1287/mnsc.35.8.982>
- Davis, F.D. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, 22(14), 1111–1132.

<https://doi.org/10.1111/j.1559-1816.1992.tb00945.x>

- De', R., Pal, A., Sethi, R., Reddy, S. K., & Chitre, C. (2018). ICT4D research: A call for a strong critical approach. *Information Technology for Development, 24*(1), 63–94. <https://doi.org/10.1080/02681102.2017.1286284>
- Denzin, N. K. & Lincoln, Y. (2011). *Interpretive frameworks*. Sage.
- Denzin, N. K. (1971). The logic of naturalistic inquiry. *Social Forces, 50*(2), 166. <https://doi.org/10.2307/2576935>
- Denzin, N., & Lincoln, Y. (2005). *The Sage handbook of qualitative research*. In Sage Publications.
- Dethier, J. J., & Effenberger, A. (2012). Agriculture and development: A brief review of the literature. *Economic Systems, 36*(2), 175–205. <https://doi.org/10.1016/j.ecosys.2011.09.003>
- Deutsche Forschungsgemeinschaft., B. B. G. (2000). Forum, qualitative social research. In *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*. Deutsche Forschungsgemeinschaft. <http://www.qualitative-research.net/index.php/fqs/article/view/466/996L>
- Dhaka, B. L., & Chayal, K. (2010). Farmers' experience with ICTs on transfer of technology in changing agri-rural environment. *Indian Res. J. Ext. Edu, 10*(3), 114–118. <https://seea.org.in/uploads/pdf/v10321.pdf>
- Diercks, G., Larsen, H., & Steward, F. (2019). Transformative innovation policy: Addressing variety in an emerging policy paradigm. *Research Policy, 48*(4), 880–894. <https://doi.org/10.1016/j.respol.2018.10.028>
- Dishaw, M., Strong, D., Bandy, D. B., & Strong, D. M. (2002). Extending the task-technology fit model with self-efficacy constructs with self-efficacy constructs. *Information Systems Journal, 1021–1027*. MCIS 2002 Proceedings. 143. <http://aisel.aisnet.org/amcis2002/143>
- Dix, K. L. (2007). DBRIEF: A research paradigm for ICT adoption. *International Education Journal, 8*(2), 113–124. <https://eric.ed.gov/?id=EJ834152>
- Dixon, E. (2012). Building a model for online distance courses through social media and networks. *International Journal of Virtual and Personal Learning Environments, 3*(3), 81–94. <https://doi.org/10.4018/jvple.2012070105>
- Donadeu, M., Nwankpa, N., Abela-Ridder, B., & Dungu, B. (2019). Strategies to increase adoption of animal vaccines by smallholder farmers with focus on neglected diseases and marginalized populations. In *PLoS Neglected Tropical Diseases* (Vol. 13, Issue 2). <https://doi.org/10.1371/journal.pntd.0006989>
- Dooly, M., Moore, E., & Vallejo, C. (2017). Reserch ethics. *Qualitative Approaches to Research on Plurilingual Education, 2017, 351–362*. <https://doi.org/10.14705/rpnet.2017.emmd2016.634>
- Dube, L. M. (2020). Command agriculture and food security: An interrogation of state

- intervention in the post-fast track land redistribution era in Zimbabwe: 56(7), 1626–1643. <https://doi.org/10.1177/0021909620979330>
- Duke, N. K., & Mallette, M. H. (2011). *Literacy research methodologies* (2nd ed.). The Guilford Press. https://www.literacycookbook.com/uploaded_files/free-download-zone/2366239945bdc9f635c48c10_things_to_know_about_research_duke_trtr1002.pdf
- Dul, J., & Hak, T. (2008). Case study methodology in business research. In *New York* (Vol. 129). <https://doi.org/10.1007/s13398-014-0173-7.2>
- Duncombe, R. (2012). Mobile phones for agricultural and rural development: A literature review and future research directions. In *Africa*. Nature Publishing Group. <https://doi.org/10.1057/ejdr.2014.60>
- Dunjana, N., Zengeni, R., Muchaonyerwa, P., & Wuta, M. (2018). Typological characterisation of farms in a smallholder food-cash crop production system in Zimbabwe – opportunities for livelihood sustainability. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 119(2), 11–22.
- Eagle, D., & Saleh, N. (2021). The economics of smallholder farming. *The Sustainable Intensification of Smallholder Farming Systems*, 33–64. <https://doi.org/10.1201/9781003048053-3/Economics-smallholder-farming- David-Eagle-Nadira-Saleh>
- Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review*, 14(4), 532–550. <http://www.jstor.org/stable/258557>.
- Elliott, R., & Timulak, L. (2005). Descriptive and interpretive approaches to qualitative research. *A Handbook of Research Methods for Clinical and Health Psychology*, 147–157. <https://doi.org/10.1093/med:psych/9780198527565.001.0001>
- Emeana, E. M., Trenchard, L., & Dehnen-Schmutz, K. (2020). The revolution of mobile phone-enabled services for agricultural development (m-Agri services) in Africa: The challenges for sustainability. *Sustainability (Switzerland)*, 12(2), 485. <https://doi.org/10.3390/su12020485>
- Eriksson, P., & Kovalainen, A. (2011). 19 Qualitative research evaluation. *Qualitative Methods in Business Research*, 290–297.
- Escobar, A. (1994). Encountering development. *The Making and Unmaking of the Third World*, 320. <http://www.amazon.com/dp/0691001022>
- Esteban, J., & Schneider, G. (2017). Polarization and conflict: Theoretical and empirical Issues. *Introduction Intro duction Polarization and Conflict : Theoretical and Empirical Issues **. 45(2), 131–141. <https://doi.org/10.1177/0022343307087168>
- Esteves, J., & Pastor, J. (2003). Using a multimethod approach enterprise systems implementations to?. *The Electronic Journal of Business Research Methods*, 2(2), 69–82. <https://academic-publishing.org/index.php/ejbrm/article/view/1187>
- Etwire, P. M., Buah, S., Ouédraogo, M., Zougmoré, R., Partey, S. T., Martey, E., Dayamba, S. D., & Bayala, J. (2017). An assessment of mobile phone - based

- dissemination of weather and market information in the upper west region of Ghana. *Agriculture & Food Security*, 6(8), 1–9. <https://doi.org/10.1186/s40066-016-0088-y>
- Evans, O. (2018). Digital agriculture: Mobile phones, internet & agricultural development in Africa. *Actual Problems of Economics*, 7–8(205–206), 76–90.
- Ezeomah, B., & Duncombe, R. (2019). *The role of digital platforms in disrupting agricultural value chains in developing countries BT - Information and communication technologies for development. Strengthening southern-driven cooperation as a catalyst for ICT4D*. 231–247.
- FAO. (2009). The special challenge for sub-Saharan Africa. In *The high-level expert forum on how to feed the world in 2050*. http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Africa.pdf
- FAO. (2016). All messages from the 2016 FAO e-conference on small farms and food security and nutrition. *Exploring the Contribution of Small Farms to Achieving Food Security and Improved Nutrition*, October, 1–87.
- Fernández, W. D. (2004). The grounded theory method and case study data in IS research: Issues and design. *Information Systems Foundations: Constructing and Criticising Workshop at The Australian National University 2*, July 16–17, 43– 59.
- Flick, U. (2014). *An introduction to qualitative research*. Sage
- Food and Agriculture Organisation. (n.d.). The agricultural extension system in Zimbabwe. Retrieved July 17, 2018, from <http://www.fao.org/docrep/005/ac913e/ac913e05.htm>
- Food and Agriculture Organisation. (2018). *How AgriFin Mobile is assisting smallholder farmers in Zimbabwe*. <https://www.fao.org/e-agriculture/blog/how-agrifin-mobile-assisting-smallholder-farmers-zimbabwe>
- Food and Agriculture Organization of the United Nations (FAO). (2014). Understanding smallholder farmer attitudes to commercialization – The case of maize in Kenya. In *Rome*.
- Formoso, B. (2021). The agroecological sustainability of petty farmers in Thailand: A challenge for the future. *Current Research in Environmental Sustainability*, 3, 100078. <https://doi.org/10.1016/j.crsust.2021.100078>
- Fortus, D. (2009). The importance of learning to make assumptions. In *Science Education* (Vol. 93, Issue 1, pp. 86–108). <https://doi.org/10.1002/sce.20295>
- Fouka, G., & Mantzorou, M. (2011). What are the major ethical issues in conducting research? Is there a conflict between the research ethics and the nature of nursing? *Health Science Journal*, 5(1), 3–14.
- Fram, S. M. (2013). The constant comparative analysis method outside of grounded theory. *Qualitative Report*, 18(1), 1–25. <https://doi.org/10.46743/2160-3715/2013.1569>
- Future People. (2014). The Research Onion. *Future Ideas*, 1–10.

<https://doi.org/10.1007/s13398-014-0173-7.2>

- Gabagambi, D. M. (2013). Barriers to trade for smallholder farmers in Tanzania a review and analysis of agricultural related market policies in Tanzania. *PELUM Tanzania and ESAFF* 2013, 40. <http://hdl.handle.net/20.500.12018/2723>
- Gann, P. (2017). An explication and application of Max Weber's theoretical construct of Verstehen. *14*(2), 30–34.
- Gatero, G. (2011). Utilization of ICTs for accessing health information by medical professionals in Kenya: A case study of Kenyatta National Hospital. *Journal of Health Informatics in Developing Countries*, *5*(1), 60–88. <http://www.jhidc.org/index.php/jhidc/article/view/55>
- Geldof, M., Grimshaw, D. J., Kleine, D., & Unwin, T. (2011). What are the key lessons of ICT4D partnerships for poverty reduction? *Systematic Review Report, February*, 1–89. http://r4d.dfid.gov.uk/pdf/outputs/systematicreviews/dfid_ict_sr_final_report_r5.pdf
- Given, L. M. (2008a). Naturalistic inquiry. In *Encyclopedia of Research Design*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412961288.n262>
- Given, L. M. (2008b). *The Sage encyclopedia of qualitative research methods*. Sage Publications. <https://doi.org/10.4135/9781412963909>
- Glaser, B. (2013). Grounded theory methodology. *Introducing Qualitative Research in Psychology*, 69–82.
- Glaser, B. G. (2016). The grounded theory perspective: Its origins and growth | Grounded Theory Review. *Grounded Theory Review*, *15*(1), 4–9. <http://groundedtheoryreview.com/2016/06/19/the-grounded-theory-perspective-its-origins-and-growth/>
- Glaser, B. G., & Strauss, A. L. (1967). The discovery of grounded theory: Strategies for qualitative research. In *Observations* (Vol. 1, Issue 4). <https://doi.org/10.2307/2575405>
- Golafshani, N. (2003). *Understanding reliability and validity in qualitative research*.*8*(4), 597–606. <http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf>
- Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*, *21*(2), 135–146. <https://doi.org/10.1057/ejis.2011.54>
- Gomez, R., Baron, L. F., & Fiore-Silfvast, B. (2012). The changing field of ICTD: Content analysis of research published in selected journals and conferences, 2000-2010. *ACM International Conference Proceeding Series*, 65–74. <https://doi.org/10.1145/2160673.2160682>
- Government of Zimbabwe. (2014). *Zimbabwe country analysis working document* (Issue October). <https://www.imf.org/external/pubs/ft/scr/2014/cr14202.pdf>
- Gray, D. E. (2012). Theoretical perspectives and research methodologies. In *Doing*

Research in the Real World (Third Edit, pp. 16–38).
<https://doi.org/10.1017/CBO9781107415324.004>

Gregor, S. (2002). A theory of theories in information systems. *Information Systems Foundations*, 1–18. <https://www.semanticscholar.org/paper/A-Theory-of-Theories-in-Information-Systems-Gregor/2541e6f50e7055c58d0e92267330929fb1608f75>

Gregory, I. (2003). *Ethics in research*. Continuum.
https://books.google.co.zw/books/about/Ethics_in_Research.html?id=oOW_eV_apwYC&source=kp_cover&redir_esc=y

Grunert, K. G. (1992). The concept of key success factors : Theory and method Charlotte Ellegaard Project no 15 Executive Summary. In *October* (Issue 4).
<https://pure.au.dk/portal/files/32299581/wp04.pdf> (12

Grunfeld, H. (2007). Framework for evaluating contributions of ICT to capabilities, empowerment and sustainability in disadvantaged communities. *CPRsouth2 Conference, Chennai, India—December 15-17, 2007 Empowering Rural Communities through ICT Policy and Research*, 1–21. http://www.cprsouth.org/wp-content/uploads/drupal/Helena_Grunfeld.pdf

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication & Technology*, 29(2), 75–91.
<https://doi.org/10.1007/BF02766777>

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). Applied thematic analysis validity and reliability (credibility and dependability) in qualitative research and data analysis. In *Applied Thematic analysis*. <https://doi.org/10.4135/9781483384436.n4>

Guha, R. (2005). Methods to improve the reliability, validity and interpretability of Qsar Models [The Pennsylvania State University]. In *Methods* (Issue August).
<https://www.proquest.com/openview/eb12e4ecd16550df9cb7f89b2cd0d4c6/1?pq-origsite=gscholar&cbl=18750&diss=y>

GUIDE, F. (2005). *Qualitative Research Methods*.
https://pdf.usaid.gov/pdf_docs/PNADK310.pdf

Gukurume, S., & Mahiya, I. T. (2020). Mobile money and the (un)making of social relations in Chivi, Zimbabwe. <https://doi.org/10.1080/03057070.2020.1823682>, 46(6), 1203–1217. <https://doi.org/10.1080/03057070.2020.1823682>

Hailu, G., Khan, Z. R., Pittchar, J. O., & Ochatum, N. (2017). Radio and mobile phone ownership or access by smallholder farmers of eastern Uganda and its potential use for push-pull technology dissemination. *International Journal of Agricultural Extension*, 5(2), 19–28. <http://www.escijournals.net/IJAE>

Halabia, A. (2013). Using comparison for qualitative data analysis in ICT4D-A case study from Syria. Diuf.Unifr.Ch.
http://diuf.unifr.ch/main/pai/sites/diuf.unifr.ch.main.pai/files/publications/2013_Halabi_Comparison_ICT4D.pdf

Ham, M., Jeger, M., Ivković, A. F., & Frajman Ivković, A. (2015). The role of subjective

norms in forming the intention to purchase green food. *Economic Research-Ekonomiska Istrazivanja*, 28(1), 738–748.
<https://doi.org/10.1080/1331677X.2015.1083875>

Hammersley, M., & Traianou, A. (2012). *Ethics in qualitative research: Controversies and contexts*. SAGE Publications.
<https://www.torrossa.com/en/resources/an/4913580>

Hannibal, C., & Kauppi, K. (2019). Third party social sustainability assessment: Is it a multi-tier supply chain solution? *International Journal of Production Economics*, 217, 78–87. <https://doi.org/10.1016/j.ijpe.2018.08.030>

Harden, G., Boakye, K. G., & Ryan, S. (2018). Turnover intention of technology professionals: A social exchange theory Perspective. *Journal of Computer Information Systems*, 58(4), 291–300.
<https://doi.org/10.1080/08874417.2016.1236356>

Haug, R., Nchimbi-Msolla, S., Murage, A., Moeletsi, M., Magalasi, M., Mutimura, M., Hundessa, F., Cacchiarelli, L., & Westengen, O. T. (2021). From policy promises to result through innovation in African agriculture? *World*, 2(2), 253–266.
<https://doi.org/10.3390/world2020016>

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2006). *The future of small farms: synthesis paper. version 1*.
<https://www.weltagrarbericht.de/fileadmin/files/weltagrarbericht/future-small-farms%202006.pdf>

Heeks, R. (2008). Current analysis and future research agenda on “Gold Farming”: Real-world production in developing countries for the virtual economies of online games. *Development Informatics Working Paper Series*, 32, 1–87.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3477387

Heeks, R. (2008b). ICT4D 2.0: The next phase of applying ICT for international development. *Computer*, 41(6), 26–31. <https://doi.org/10.1109/MC.2008.192>

Heeks, R. (2014a). *Future priorities for development informatics research from the post-2015 development agenda: Development informatics working paper no.57*.
<papers2://publication/uuid/E62B26A8-CEBC-4A60-A869-94B02AB6E969>

Heeks, R. (2014b). *ICTs and poverty eradication: Comparing economic, livelihoods and capabilities models*.
http://www.seed.manchester.ac.uk/medialibrary/IDPM/working_papers/di/diwp_58.pdf

Heeks, R. (2015). *ICT4D 2016: New priorities for ICT4D policy, practice and WSIS in a Post-2015 World*. <http://dx.doi.org/10.2139/ssrn.3438433>

Heeks, R., & Ospina, A. V. (2019). Conceptualising the link between information systems and resilience: A developing country field study. *Information Systems Journal*, 29(1).
<https://doi.org/10.1111/isj.12177>

Hikwa, L., & M. E. (2014). Enabling instruments for digital access and e. *Digital access and e-government: Perspectives from Developing and Emerging Countries*, 271–283.
<https://doi.org/doi:10.4018/978-1-4666-5868-4.ch017>

- Hill, R. J., Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention and behavior: An introduction to theory and research. *Contemporary Sociology*, 6(2), 244. <https://doi.org/10.2307/2065853>
- Ho, J. K. (2014). Information systems projects for sustainable development and social change. *10(1)*, 68–82.
- Holbrook, A. L., Krosnick, J. A., Pfent, A., Lepkowski, J. M., Tucker, C., Brick, J. M., De Leeuw, E., Japac, L., Lavrakas, P. J., Link, M. W., & Sangster, R. L. (2008). The causes and consequences of response rates in surveys by the news media and government contractor survey research firms 1. *Advances in telephone survey methodology*, 499-528. <https://doi.org/10.1002/9780470173404.ch23>
- Holton, J. A. (2018). From grounded theory to grounded theorizing in qualitative. *SAGE Research Methods*, 233–250. <https://methods.sagepub.com/book/handbook-of-qualitative-business-management-research-methods-v1/i1692.xml>
- Hong, W., & Lang, K. R. (1988). A philosophical foundation of qualitative modeling methodologies based on the Yin-Yang Principle. *Capra*. https://www.qrg.northwestern.edu/papers/files/qr-workshops/qr99/Hong_1999_Philosophical_Foundation_Yin-Yang_Principle.pdf
- Horst, M., Kuttschreuter, M., & Gutteling, J. M. (2007). Perceived usefulness, personal experiences, risk perception and trust as determinants of adoption of e-government services in The Netherlands. *Computers in Human Behavior*, 23(4), 1838–1852. <https://doi.org/10.1016/j.chb.2005.11.003>
- Houensou, D. A., Goudjo, G. G., & Senou, M. M. (2021). Access to finance and difference in family farm productivity in Benin: Evidence from small farms. *Scientific African*, 13, e00940. <https://doi.org/10.1016/j.sciaf.2021.e00940>
- Hunt, S. D. (1989). Naturalistic, humanistic, and interpretive inquiry: Challenges and ultimate potential. *ACR Special Volumes*, SV-07. <http://www.acrwebsite.org/volumes/12184/volumes/sv07/SV-07>
- Hussain, S. A. (2016). ICT4 Agriculture lessons learned from developing countries. A systematic review protocol. *ACM International Conference Proceeding Series*, 03-06-June. <https://doi.org/10.1145/2909609.2909636>
- International Telecommunication Union. (2018). *ICT price basket methodology*. <https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/pricemethodology.aspx>
- International Telecommunication Union, O. E. C.(2011). *M-Government: Mobile technologies for responsive governments and connected societies*. <https://doi.org/10.1787/9789264118706-en>
- ITU. (2013). International telecom union annual report 2013: Measuring the information society. <https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-ES-E.pdf>
- Isaac, O., Abdullah, Z., Ramayah, T., Mutahar, A. M., & Alrajawy, I. (2016). Perceived

- usefulness, perceived ease of use, perceived compatibility, and net benefits. An empirical study of internet usage among employees in Yemen. *The 7th International Conference on Postgraduate Education, Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia, December*, 899–919.
- Ismail, H. A. (2016). Intention to use smartphone through perceived compatibility, perceived usefulness, and perceived ease of use. *Jurnal Dinamika Manajemen*, 7(1), 1. <https://doi.org/10.15294/jdm.v7i1.5748>
- ITU. (2013). International Telecom Union Annual Report 2013: Measuring the information society. https://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2013/MIS2013_without_Annex_4.pdf
- Jadhav, A., & Weis, J. (2020). Mobile phone ownership, text messages, and contraceptive use: Is there a digital revolution in family planning? *Contraception*, 101(2), 97–105. <https://doi.org/10.1016/j.contraception.2019.10.004>
- Jahangir, N., & Begum, N. (2008). The role of perceived usefulness, perceived ease of use, security and privacy, and customer attitude to engender customer adaptation in the context of electronic banking. *African Journal of Business Management*, 2(2), 032–040. <https://academicjournals.org/journal/AJBM/article-full-text-pdf/1FD799E16398.pdf>
- Jani, K., Chaudhuri, M., Patel, H., & Shah, M. (2020). Machine learning in films: An approach towards automation in film censoring. *Journal of Data, Information and Management*, 2(1), 55–64. <https://doi.org/10.1007/s42488-019-00016-9>
- Jennings, L., Omoni, A., Akerele, A., Ibrahim, Y., & Ekanem, E. (2015). Disparities in mobile phone access and maternal health service utilization in Nigeria: A population-based survey. *International Journal of Medical Informatics*, 84(5), 341–348. <https://doi.org/10.1016/J.IJMEDINF.2015.01.016>
- Kabbiri, R., Dora, M., Kumar, V., Elepu, G., & Gellynck, X. (2018). Mobile phone adoption in agri-food sector: Are farmers in sub-Saharan Africa connected? *Technological Forecasting and Social Change*, 131(October), 253–261. <https://doi.org/10.1016/j.techfore.2017.12.010>
- Kacharo, D. K., Mvena, Z. S. K., & Sife, A. S. (2019). Factors constraining rural households' use of mobile phones in accessing agricultural information in Southern Ethiopia. *African Journal of Science, Technology, Innovation and Development*, 11(1), 37–44. <https://doi.org/10.1080/20421338.2018.1541336>
- Kahwili, R. M. (2020). *Role of agro-dealers in inputs distribution and the counterfeit challenges to smallholder farmers in Tanzania*. <http://www.suaire.sua.ac.tz/handle/123456789/3651>
- Kamat, P. V. (2006). Research ethics. In *The Symposium on Scientific Publishing, ACS National Meeting, March*, 49. <https://doi.org/10.1016/j.mpmmed.2016.07.007>
- Kanis, H. (2014). Reliability and validity of findings in ergonomics research. *Theoretical Issues in Ergonomics Science*, 15(1), 1–46. <https://doi.org/10.1080/1463922X.2013.802058>

- Kassem, H. S., Alotaibi, B. A., Ghoneim, Y. A., & Diab, A. M. (2021). Mobile-based advisory services for sustainable agriculture: Assessing farmers' information behavior. *Information Development*, 37(3), 483–495. <https://doi.org/10.1177/0266666920967979>
- Kavoi, J. M., Mwangi, J. G., & Kamau, G. M. (2014). Challenges faced by small land holder farmer regarding decision making in innovative agricultural development: An empirical analysis from Kenya. *International Journal of Agricultural Extension*, 02(02), 101–108. <https://esciencepress.net/journals/index.php/IJAE/article/view/705>
- Kayanda, A., Busagala, L., & Tedre, M. (2020). User perceptions on the use of academic information systems for decision making support in the context of Tanzanian higher education. *International Journal of Education and Development Using Information and Communication Technology*, 16(1), 72–87. <https://eric.ed.gov/?id=EJ1254826>
- Kemp, S. (2020). Digital 2020: July global statshot — Datareportal – Global digital insights. DataReportal. <https://datareportal.com/reports/digital-2020-july-global-statshot>
- Kemp, S. (2021). Digital in Zimbabwe: All the statistics you need in 2021 — DataReportal – *Global Digital Insights*. <https://datareportal.com/reports/digital-2021-Zimbabwe>
- Kerlinger, F. N. (1973). *The foundation of behavioural research. In The Foundation of Behavioral Research*. <https://doi.org/10.3102/0013189X006008005>
- Kesavan, P. C., & Swaminathan, M. S. (2014). 2014 International year of family farming: A boost to evergreen revolution. *Current Science*, 107(12), 1970–1974. https://doi.org/10.1142/9789813200074_0028
- Khan, N. A., Qijie, G., Ali, S., Shahbaz, B., & Shah, A. A. (2019). Farmers' use of mobile phone for accessing agricultural information in Pakistan: A case of Punjab province. *Ciencia Rural*, 49(10), 1–12. <https://doi.org/10.1590/0103-8478cr20181016>
- Khan, S. N. (2014). Qualitative research method: Grounded theory. *International Journal of Business and Management*, 9(11), 224. <https://doi.org/10.5539/ijbm.v9n11p224>
- Khayyat, N. T., & Heshmati, A. (2012). Determinants of mobile phone customer satisfaction in the Kurdistan region. *Journal of Knowledge Management, Economics and Information Technology*, 2(3), 91–121. <http://temep-repec.my-groups.de/DP-90.pdf>
- Kiaka, R., Chikulo, S., Slootheer, S., & Hebinck, P. (2021). “The street is ours”. A comparative analysis of street trading, Covid-19 and new street geographies in Harare, Zimbabwe and Kisumu, Kenya. *Food Security*, 13(5), 1263–1281. <https://doi.org/10.1007/s12571-021-01162-y>
- Kiforo, E. (2013). Teachers attitudes and perceptions on the use of ICT in teaching and learning as observed by ICT champions. *X World Conference on Computers in Education*, 2007.
- Kihn, L.A., & Ihantola, E.M. (2015). Approaches to validation and evaluation in qualitative

- studies of management accounting 1. *Qualitative Research in Accounting and Management*, 12(3), 230–255.
https://tampub.uta.fi/bitstream/handle/10024/100655/approaches_to_validation_and_evaluation.pdf?sequence=1
- Kiiza, B., & Pederson, G. (2012). ICT-based market information and adoption of agricultural seed technologies: Insights from Uganda. *Telecommunications Policy*, 36(4), 253–259. <https://doi.org/10.1016/j.telpol.2012.01.001>
- Kilimo, A. (2014). *mAgri*. May. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/09/mAgri_airtelkilimo_caststudy_sept4.pdf
- Kim, S. Y., & Kim, M. R. (2013). Comparison of perception toward the adoption and intention to use smart education between elementary and secondary school teachers. *Turkish Online Journal of Educational Technology*, 12(2), 63–76. <https://eric.ed.gov/?id=EJ1015402>
- Kinsey, B. H. (1999). Land reform, growth and equity: Emerging evidence from Zimbabwe's resettlement programme. *Journal of Southern African Studies*, 25(2), 173–196. <https://doi.org/10.1080/030570799108650>
- Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1), 67. <https://doi.org/10.2307/249410>
- Komunte, M., Rwashana, A. S., & Nabukenya, J. (2012). Comparative analysis of mobile phone usage among women entrepreneurs in Uganda and Kenya. *African Journal of Computing & ICT*, 5(5), 74–86.
- Korstjens, I., & Moser, A. (2017). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*, 0(0), 1–5. <https://doi.org/10.1080/13814788.2017.1375092>
- Kothari, C., Kumar, R., & Uusitalo, O. (2014). Research Methodology. In *New Age International*. <https://doi.org/http://196.29.172.66:8080/jspui/bitstream/123456789/2574/1/Research%20Methodology.pdf>
- Krauss, K., & Turpin, M. (2010). Towards the emancipation of the ICT4D researcher: Reflecting on a case study in deep rural South Africa 1 Introduction 2 Critical social theory in ICT4D. *Processing*, March, 1–10.
- Krell, N. T., Giroux, S. A., Guido, Z., Hannah, C., Lopus, S. E., Caylor, K. K., & Evans, T. P. (2021). Smallholder farmers' use of mobile phone services in central Kenya. *Climate and Development*, 13(3), 215–227. <https://doi.org/10.1080/17565529.2020.1748847>
- Kroeze, J. H. (2012). *Postmodernism, interpretivism, and formal ontologies*. 43–45. <https://doi.org/10.4018/978-1-4666-0179-6.ch003>
- Kroeze, J. H., & Van Zyl, I. (2014). Transdisciplinarity in information systems : Extended reflections. *Twentieth Americas Conferences on Information Systems*, 1–10.

- Krueger, R. A., & Casey, M. A. (2002). *Designing and conducting focus group interviews* (Vol. 18).
- Kumar, R. (2011). *Research methodology : A step-by-step guide for beginners*. SAGE.
- Kumar, U., Werners, S., Paparrizos, S., Datta, D. K., & Ludwig, F. (2020). Hydroclimatic information needs of smallholder farmers in the lower Bengal delta, Bangladesh. *Atmosphere*, 11(9). <https://doi.org/10.3390/atmos11091009>
- Kupfer, A., Schöb, S., Ableitner, L., & Tiefenbeck, V. (2016). Technology adoption vs. continuous usage intention : Do decision criteria change when using a technology ? *Aisel*, 2, 1–10. <https://core.ac.uk/download/pdf/301368723.pdf>
- Kwapong, N. A., Ankrah, D. A., Boateng-Gyambiby, D., Asenso-Agyemang, J., & Fening, L. O. (2020). Assessment of agricultural advisory messages from farmer-to-farmer in making a case for scaling up production: A qualitative study. *Qualitative Report*, 25(8), 2011–2025. <https://doi.org/10.46743/2160-3715/2020.4241>
- Lai, P. C. (2017). The literature review of technology adoption models and theories for novelty technology. 14(1), 21–38. <https://doi.org/10.4301/S1807-17752017000100002>
- LaRossa, R. (2005). Grounded theory methods and qualitative family research. *Journal of Marriage and Family*, 67(November), 837–857. <https://doi.org/10.1111/j.1741-3737.2005.00179.x>
- Lavrakas, P. J. (2008). Anonymity. In *Encyclopedia of survey research methods*. Sage Publications, Inc. <https://doi.org/10.4135/9781412963947.n19>
- Leedy, P. D., & Ormrod, J. E. (2010). *Practical research: Planning and design*. <http://dissertationrecipes.com/wp-content/uploads/2011/04/AssumptionslimitationsdelimitationsX.pdf>
- Leon, N., Schneider, H., & Daviaud, E. (2012). Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC medical Informatics and Decision Making* (Vol. 12, p.123). <https://doi.org/10.1186/1472-6947-12-123>
- Leong, T. K., Meng, T. P., Eng, T. K., Hooi, P. H. R., & Lim, C. W. (2021). A Modified UTAUT Model M-Payment Use Intention: A Comparative Analysis Between Malaysians and Foreigners in Malaysia. 8(June), 77–110.
- Leung, L. (2015). Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, 4(3), 324–327. <https://doi.org/10.4103/2249-4863.161306>
- Levin, P. (2013). Big ambition meets effective execution: How EcoCash is altering Zimbabwe's financial landscape. *Mobile Money for the Unbanked*. <http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/07/EcoCash-Zimbabwe.pdf>
- Lewin, C., & Somekh, B. (2011). *Theory and methods in social research*. SAGE.

- Lincoln, Y. S. & E. G. G. (1985). Naturalistic inquiry. In *The SAGE Encyclopedia of Qualitative Research Methods*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412963909.n280>
- Lincoln, Y. S., & Guba, E. G. (1988a). Criteria for assessing naturalistic inquiries as reports. *Annual Meeting of the American Educational Research Association*, 26. <http://eric.ed.gov/?id=ED297007>
- Lincoln, Y. S., & Guba, E. G. (1988b). Ethics: The failure of positivist Science. In *Review of Higher Education* (Vol. 12, Issue 3, pp. 221–240). <http://eric.ed.gov/?id=EJ387434>
- Lincoln Y.S., Lynham S.A., & Guba G. E. (2011). Vol. 4. Sage publications; 2011. paradigmatic controversies, contradictions, and emerging confluences, revisited. In Patricia Leavy (Ed.), *The Sage Handbook of Qualitative Research* (4th ed.). https://sabinemendesmoura.files.wordpress.com/2014/11/gubaelincoln_novo.pdf
- Liu, J. (2021). Bridging digital divide amidst educational change for socially inclusive learning during the COVID-19 pandemic. *SAGE Open*, 11(4). <https://doi.org/10.1177/21582440211060810>
- Livingston, G., Schonberger, S., & Delaney, S. (2011). Sub-Saharan Africa: The state of smallholders in agriculture. *IFAD Conference on New Directions for Smallholder Agriculture*, 1–36. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=f2cbd3f72cb333c1cc6fd3eba6d5bc8bb8c89469>
- Loh, J. (2013). Inquiry into issues of trustworthiness and quality in narrative studies: A perspective. *Qualitative Report*, 18(33), 1–15. <http://ezproxy.asburyseminary.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edb&AN=89867872&site=eds-live>
- Lokeswari, K. (2016). A study of the use of ICT among rural farmers. *International Journal of Communication Research*, 6(3), 232–238. http://ijcr.eu/articole/325_03_K_Lokeswari.pdf
- Long, T., & Johnson, M. (2000). Rigour, reliability and validity in qualitative research. *Clinical Effectiveness in Nursing*, 4(1), 30–37. <https://doi.org/10.1054/CEIN.2000.0106>
- Lucic, D., Caric, A., & Lovrek, I. (2015, July). Standardisation and regulatory context of machine-to-machine communication. In *2015 13th International Conference on Telecommunications (ConTEL)* (pp. 1-7). IEEE. DOI: [10.1109/ConTEL.2015.7231216](https://doi.org/10.1109/ConTEL.2015.7231216)
- Lwoga, E., Ngulube, P., & Stilwell, P. (2010). Information needs and information seeking behaviour of small-scale farmers in Tanzania. *Innovation*, 40(1). <https://doi.org/10.4314/innovation.v40i1.60088>
- MacFarlane, B. (2009). *Researching with integrity: The ethics of academic enquiry*. Routledge. https://books.google.co.zw/books?id=oWZi6bBTS7EC&source=gbs_citations_module_r&cad=6

- Mack, N., Woodsong, K., MacQueen, K., Namey, E., & Guest, G. (2005). *Qualitative research methods: A data collector's field guide* (Vol. 36, Issue 1). <https://doi.org/10.1108/eb020723>
- MacVaugh, J., & Schiavone, F. (2010). Limits to the diffusion of innovation: A literature review and integrative model. *European Journal of Innovation Management*, 13(2), 197–221. <https://doi.org/10.1108/14601061011040258>
- Madon, S. (2000). The Internet and socio-economic development: exploring the interaction. *Information technology & people*, 13(2), 85-101. <https://doi.org/10.1108/09593840010339835>
- Madzivhandila, T., Sibanda, S., & Gwelo, F. A. (2016). Africa agriculture status report 2016. *Africa Agriculture Status Report 2016*, 19. <https://agra.org/wp-content/uploads/2017/09/aasr-report-2016-press0409201601.pdf>
- Magesa, M. M., Michael, K., & Ko, J. (2015). Towards a framework for accessing agricultural market information. *The Electronic Journal of Information Systems in Developing Countries*, 66(1), 1–16. <https://doi.org/10.1002/j.1681-4835.2015.tb00473.x>
- Magnusson, L., & Hanson, E. J. (2003). Ethical issues arising from a research, technology and development project to support frail older people and their family carers at home. *Health & Social Care in the Community*, 11(5), 431–439. <https://doi.org/10.1046/j.1365-2524.2003.00446.x>
- Maiyaki, A. A. (2010). Zimbabwes agricultural industry. *African Journal of Business Management*, 4(19), 4159–4166. <https://academicjournals.org/journal/AJBM/article-full-text-pdf/B1B917618089.pdf>
- Mambo, W. N. (2020). Designing per-poor system of innovation proverbs. *Inkanyiso: Journal of Humanities and Social Sciences*, 12(2), 212–229. <https://www.ajol.info/index.php/ijhss/article/view/203831>
- Mansingh, P., & Erena, F. A. (2016). Impact of mobile phone technology on agriculture and rural development : An analysis. *International Journal of Current Research*, 8(05), 31311–31317.
- Marais, M. (2011). Analysis of the factors affecting the sustainability of ICT4D initiatives. *IDIA2011 Conference Proceedings*, 100–120. <http://researchspace.csir.co.za/dspace/handle/10204/5374>
- Marshall, C., & Rossman, G. B. (1989). *Designing qualitative research* sage publications. Newbury Park, California
- Marshall, A., & Walras, L. (1924). *Neoclassical economics* (1890s–1930s).
- Martin, B. L., & Abbott, E. (2011). Mobile phones and rural livelihoods: Diffusion, uses, and perceived impacts among farmers in rural uganda. *Information Technologies & International Development*, 7(4), 17–34. <https://doi.org/10.1016/j.ijhcs.2008.08.007>
- Mashamaite, K. A. (2014). *The contributions of smallholder subsistence agriculture*

towards rural household food security in Maroteng village, Limpopo Province [University of Limpopo Supervisor:]. <http://hdl.handle.net/10386/1167>

- Masimba, F., Appiah, M., & Zuva, T. (2019). Influencing factors of mobile technology adoption by small holder farmers in Zimbabwe. *Advances in Intelligent Systems and Computing*, 1046(125–134). https://doi.org/10.1007/978-3-030-30329-7_12
- Masinge, K. (2010). *Factors influencing the adoption of mobile banking services at the Bottom of the Pyramid in South Africa* (Doctoral dissertation, University of Pretoria).
- Masuka, B., Matenda, T., Chipomho, J., Mapope, N., Mupeti, S., Tatsvarei, S., & Ngezimana, W. (2016). Mobile phone use by small-scale farmers: A potential to transform production and marketing in Zimbabwe. *South African Journal of Agricultural Extension (SAJAE)*, 44(2), 121–135. <https://doi.org/10.17159/2413-3221/2016/v44n2a406>
- Mazhambe, A. (2017). Assessment of the contribution of street vending to the Zimbabwe economy. A case of street vendors in Harare CBD. *IOSR Journal of Business and Management Ver. I*, 19(9), 91–100. <https://doi.org/10.9790/487X-19090191100>
- Mbele-Sibotshiwe, T. (2014). A study of the perceptions and adoption of mobile payment platforms by entrepreneurs in Zimbabwe's informal economy. <http://146.141.12.21/handle/10539/13787>
- Mbiti, I., & Weil, D. N. (2016). Mobile banking the impact of M- Pesa in Kenya. In and D. N. W. Sebastian Edwards, Simon Johnson (Ed.), *African Successes, Volume III: Modernization and Development: Vol. III* (Issue September, pp. 247–293). University of Chicago Press. <http://www.nber.org/books/afri14-3>
- McQuarrie, E. F., Marshall, C., & Rossman, G. B. (1990). Designing qualitative research. *Journal of Marketing Research*, 27(3), 370. <https://doi.org/10.2307/3172595>
- Mehtap, Ö., Erzenjin, E., & Pinar, I. (2012). The effect of end user perceptions of information technologies on the information sharing. *Journal of Global Strategic Management*, 1(6), 32–32. <https://doi.org/10.20460/jgsm.2012615784>
- Meihami, H., & Razmjoo, S. A. (2016). An emic perspective toward challenges and solutions of self- and peer-assessment in writing courses. *Asian-Pacific Journal of Second and Foreign Language Education*, 1(1), 1–20. <https://doi.org/10.1186/s40862-016-0014-7>
- Meredith, J. (1993). Theory building through conceptual methods. *International Journal of Operations & Production Management*, 13(5), 3–11. <https://doi.org/10.1108/01443579310028120>
- Merriam, S. (2002). *Introduction to qualitative research.pdf*. https://stu.westga.edu/~bthibau1/MEDT8484Baylen/introduction_to_qualitative_research/introduction_to_qualitative_research.pdf
- Miles, M., Huberman, A., & Saldaña, J. (2014). Designing matrix and network displays. In *Qualitative data analysis: A methods sourcebook* (3rd ed., pp. 107–119). SAGE

Publications. <https://doi.org/10.1136/ebnurs.2011.100352>

Millward, L. (2012). Focus groups. In *Research Methods in Psychology* (pp. 411–438). https://www.sagepub.com/sites/default/files/upm-binaries/46878_Breakwell_Ch17.pdf

Ministry of Agriculture. (n.d.). *Agritex*. Retrieved July 17, 2018, from <http://www.moa.gov.zw/index.php/agritex/>

Misaki, E., Apiola, M., Gaiani, S., & Tedre, M. (2018). Challenges facing sub-Saharan small-scale farmers in accessing farming information through mobile phones: A systematic literature review. *Electronic Journal of Information Systems in Developing Countries*, *84*(4), 1–12. <https://doi.org/10.1002/isd2.12034>

Mislove, A., Marcon, M., Gummadi, K. P., Druschel, P., & Bhattacharjee, B. (2007). Measurement and analysis of online social networks. *Proceedings of the 7th ACM SIGCOMM Conference on Internet Measurement - IMC '07*, 29–42. <https://doi.org/10.1145/1298306.1298311>

Mishra, V., Walsh, I., & Srivastava, A. (2022). Merchants' adoption of mobile payment in emerging economies: The case of unorganised retailers in India. *European Journal of Information Systems*, *31*(1), 74–90. <https://doi.org/10.1080/0960085X.2021.1978338>

Mitchell, J. D. (2014). Advancing grounded theory: using theoretical frameworks within grounded theory studies. *Qualitative Report*, *19*(36), 1–11. <http://search.ebscohost.com/login.aspx?direct=true&db=sih&AN=98028392&site=eds-live>

Mittal, S. (2012). Modern ICT for agricultural development and risk management in smallholder agriculture in India (No. 3; Socioeconomics, Issue April). CIMMYT. <http://repository.cimmyt.org/>

Mittal, S. (2016). Role of mobile phone-enabled climate information services in gender-inclusive agriculture. *Gender, Technology and Development*, *20*(2), 200–217. <https://doi.org/10.1177/0971852416639772>

Mittal, S., & Hariharan, V. K. (2018). Mobile-based climate services impact on farmers risk management ability in India. *Climate Risk Management*. <https://doi.org/10.1016/j.crm.2018.08.003>

Mittal, S., & Mehar, M. (2016). Socio-economic factors affecting adoption of modern information and communication technology by farmers in India: Analysis using multivariate probit model. *Journal of Agricultural Education and Extension*, *22*(2), 199–212. <https://doi.org/10.1080/1389224X.2014.997255>

Mitullah, W. V. (2003). Street vending in African cities: A synthesis of empirical findings from Kenya, Cote D'Ivoire, Ghana, Zimbabwe, Uganda and South Africa. <http://erepository.uonbi.ac.ke/handle/11295/38735>

Mkodzongi, G., & Lawrence, P. (2019). The fast-track land reform and agrarian change in Zimbabwe. *Review of African Political Economy*, *46*(159), 1–13. <https://doi.org/10.1080/03056244.2019.1622210>

- Mlambo, B. T. H. (2000). Re-framing Zimbabwe's public agricultural extension services: Institutional analysis and stakeholders views. *Agrekon*, 39(4), 665–672. <https://doi.org/https://doi.org/10.1080/03031853.2000.9523682>
- Mohamad, A. G. M. M., Idrus, S. S., & Ibrahim, A. A. E. A. (2018). Model of behavioral attention towards using ICT in universities in libya. *Jurnal Komunikasi: Malaysian Journal of Communication*, 34(2), 89–104. <https://doi.org/10.17576/JKMJC-2018-3402-06>
- Mokaya, S. O., & Njuguna, E. W. (2010). Adoption and use of information and communication technology (ICT) by small enterprises in Thika Town, Kenya. *Scientific Conference Proceedings*, 498–504. <http://elearning.jkuat.ac.ke/journals/ojs/index.php/jscp/article/view/730>
- Monette, D. R., Sullivan, T. J., & DeJong, C. R. (2013). *Applied social research: A tool for the human services*. Cengage Learning.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192–222. <https://doi.org/10.1287/isre.2.3.192>
- Morrill, T. (2009). Cell phone use and psychosocial development among emerging adults all graduate theses and dissertations. <http://digitalcommons.usu.edu/etd/748>
- Mothobi, O. (2019). *Visualisation and mapping does not compensate for poor data*. July, 1–7. https://africaportal.org/wp-content/uploads/2023/06/2019_Policy-Brief-Pricing-No-1_Africa-Data-Prices-.pdf
- Moyi, E. D. (2019). The effect of mobile technology on self-employment in Kenya. *Journal of Global Entrepreneurship Research* 2019 9:1, 9(1), 1–13. <https://doi.org/10.1186/S40497-019-0180-4>
- Moyo, S. (2000). The political economy of land acquisition and redistribution in Zimbabwe, 1990-1999. *Journal of Southern African Studies*, 26(1), 5–28. <https://doi.org/10.1080/030570700108351>
- Moyo, S. (2004). A review of Zimbabwean agricultural sector following the implementation of the land reform overall impacts of Fast Track Land Reform Programme. *Sam Moyo Agricultural Department of Technical Extension Convention for the Elimination of all forms of Discrimination* (Issue May).
- Moyo, S. (2011a). Land concentration and accumulation after redistributive reform in post-settler Zimbabwe. *Review of African Political Economy*, 38(128), 257–276. <https://doi.org/10.1080/03056244.2011.582763>
- Moyo, S. (2011b). Three decades of agrarian reform in Zimbabwe. *Journal of Peasant Studies*, 38(3), 493–531. <https://doi.org/10.1080/03066150.2011.583642>
- Moyo, S. (2011c) Changing agrarian relations after redistributive land reform in Zimbabwe. *Journal of Peasant Studies*, 38(3), 939–966. <https://doi.org/10.1080/03066150.2011.634971>

- Mramba, N. R. (2015). The conception of street vending business (SVB) in Income ooverty reduction in Tanzania. 8(5), 120–129. <https://doi.org/10.5539/ibr.v8n5p120>
- Muench, S., Bavorova, M., & Pradhan, P. (2021). Climate change adaptation by smallholder tea farmers: A case study of Nepal. *Environmental Science & Policy*, 116, 136–146. <https://doi.org/10.1016/J.ENVSCI.2020.10.012>
- Mugandani, R., Wuta, M., Makarau, A., & Chipindu, B. (2012). Re-classification of the agro-ecological regions of Zimbabwe in conformity with climate variability and change. *African Crop Science Journal*, 20(S2), 361–369. <https://doi.org/10.4314/acsj.v20i2>.
- Mugova, S. (2017). Corporate social responsibility in times of crisis: Practices and cases. In A. S. B. Samuel O. Idowu, Stephen Vertigans (Ed.), *Corporate Social Responsibility in Challenging Times in Developing Countries* (pp. 207–228). Springer. https://doi.org/https://doi.org/10.1007/978-3-319-52839-7_11
- Mugwisi, T., Mostert, J., & Ocholla, D. N. (2015). Access to and utilization of information and communication technologies by agricultural researchers and extension workers in Zimbabwe. *Information Technology for Development*, 21(1). <https://doi.org/10.1080/02681102.2013.874317>
- Mukeredzi, T. (2019). Mobile app automates agricultural contracting in Zimbabwe. <https://spore.cta.int/en/innovation/all/article/mobile-app-automates-agricultural-contracting-in-zimbabwe-sid0eb9cd1f3-69cc-4917-bb31-80871bf90cbb>
- Mukeredzi, T. (2020). Digital agriculture benefits Zimbabwe's farmers but mobile money is costly. <http://www.ipsnews.net/2020/05/digital-agriculture-benefits-zimbabwes-farmers-but-mobile-money-is-costly/>
- Munasirei, D. O.I., Manyanhaire, T., & Murenje, S. E. (2007). Investigating gender dimensions in vending activities in the city of Mutare, Zimbabwe. *Journal of Sustainable Development in Africa*, 9(4), 169–186.
- Murray, U., Gebremedhin, Z., Brychkova, G., & Spillane, C. (2016). Smallholder farmers and climate smart agriculture: Technology and labor-productivity constraints amongst women smallholders in Malawi. *Gender, Technology and Development*, 20(2), 117–148. <https://doi.org/10.1177/0971852416640639>
- Mushroor, S., Haque, S., & Amir, R. A. (2019). The impact of smart phones and mobile devices on human health and life. *International Journal Of Community Medicine And Public Health*, 7(1), 9. <https://doi.org/10.18203/2394-6040.ijcmph20195825>
- Musungwini, S. (2018). Mobile phone use by Zimbabwean smallholder Farmers: A baseline study. *The African Journal of Information and Communication*, 22, 29–52. <http://dx.doi.org/10.23962/10539/26171>
- Musungwini, S., & Van Zyl, I. (2017). 'Mobile technology for development' experiences from Zimbabwe vending markets a naturalistic enquiry. *International Journal of Business and Management Studies*, 06(01), 101–111.
- Mutami, C. (2015). Smallholder agriculture production in Zimbabwe: A survey.

Consilience: The Journal of Sustainable Development, 14(2), 140–157.
<https://doi.org/10.7916/D8F47NV5>

- Mutize, P. (2014). The sustainability of street vending as a livelihood strategy of women operating from Harare central business district. (Issue May) [Midlands State University]. <https://cris.library.msu.ac.zw//handle/11408/2036>
- Mutula, S. M. (2015). Factors influencing perceptions and attitudes of nurses towards the use of ICT in patient care in KwaZulu Natal Province, South Africa. *The African Journal of Information Systems*, 8(1). <http://digitalcommons.kennesaw.edu/ajis>
- Mwalukasa, N., Mlozi, M. R. S., & Sanga, C. A. (2018). Influence of socio-demographic factors on the use of mobile phones in accessing rice information on climate change adaptation in Tanzania. *Global Knowledge, Memory and Communication*, 67(8–9), 566–584. <https://doi.org/10.1108/GKMC-01-2018-0006>
- Mwantimwa, K. (2019). Use of mobile phones among agro-pastoralist communities in Tanzania. *Information Development*, 35(2), 230–244. <https://doi.org/10.1177/0266666917739952>
- Mwim, E. N., & Kritzinger, P. E. (2016). Views of Digital Divide: A Literature Review Keywords. 1–18. http://uir.unisa.ac.za/bitstream/handle/10500/21076/Views_of_DigitalDivideAliteraturereview_accepted_with_corrected_reviewers_comments.pdf?sequence=1
- Myers, M. D. (2013). *Qualitative research in business and management* (2nd ed.). Sage. https://www.ebooks.com/en-zw/book/1191101/qualitative-research-in-business-and-management/michael-david-myers/?_c=1
- Nabavi, A., Taghavi-Fard, M. T., Hanafizadeh, P., & Taghva, M. R. (2016). Information technology continuance intention: A systematic literature review. *International Journal of E-Business Research*, 12(1), 58–95. <https://doi.org/10.4018/IJEER.2016010104>
- Nani, G. V. (2016). A synthesis of changing patterns in the demographic profiles of urban street vendors in Botswana, South Africa and Zimbabwe. [https://doi.org/10.21511/ppm.14\(3-2\).2016.11](https://doi.org/10.21511/ppm.14(3-2).2016.11)
- Naz, F. (2006). Arturo Escobar and the development discourse: An overview. *Asian Affairs*, 28(3). <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=4fc657bd5dce1d2941bccc63c3756e75a7d50f16>
- Nelson, E. S. (2012). Heidegger, Misch, and the origins of philosophy. *Journal of Chinese philosophy*, 39(5), 10-30. https://brill.com/view/journals/jcph/39/5/article-p10_3.xml
- Neuman, W. L., & William, L. (2003). *Social research methods: Qualitative and quantitative approaches*. Allyn and Bacon. https://books.google.co.zw/books/about/Social_Research_Methods.html?id=q6ymQgAACAAJ&redir_esc=y
- Nitturkar, H. (2021). A practical tool to enhance the chances of success of digital

- agriculture interventions for sustainable development in Africa and India. *Journal of Crop Improvement*, 35(6), 890–914. <https://doi.org/10.1080/15427528.2021.1879335>
- Ngoma, H., Lupiya, P., Kabisa, M., & Hartley, F. (2021). Impacts of climate change on agriculture and household welfare in Zambia: an economy-wide analysis. *Climatic Change*, 167(3–4), 1–20. <https://doi.org/10.1007/s10584-021-03168-z>
- Nguyen, C. T. (2015). The interconnection between interpretivist paradigm and qualitative methods in education. *American Journal of Educational Science*, 1(2), 4399–4403.
- Nguyen, Q. A., Hens, L., Macalister, C., Johnson, L., Lebel, B., Tan, S. B., Nguyen, H. M., Nguyen, T. N., & Id, L. L. (2019). Theory of reasoned action as a framework for communicating climate risk: A case study of schoolchildren in the Mekong Delta in Vietnam. *MDPI Journal of Sustainability*, 1–14. <https://doi.org/10.3390/su10062019>
- Nijhawan, L. P., Janodia, M. D., Muddukrishna, B. S., Bhat, K. M., Bairy, K. L., Udupa, N., & Musmade, P. B. (2013). Informed consent: Issues and challenges. *Journal of Advanced Pharmaceutical Technology & Research*, 4(3), 134–140. <https://doi.org/10.4103/2231-4040.116779>
- Nikou, S. A., & Economides, A. A. (2015). The effects of perceived mobility and satisfaction on the adoption of mobile-based assessment. *Proceedings of 2015 International Conference on Interactive Mobile Communication Technologies and Learning, IMCL 2015, November*, 167–171. <https://doi.org/10.1109/IMCTL.2015.7359579>
- Nilsson, C. (2012). Information and communication technology as a tool for support in home care [Lulea University of Technology]. <http://ltu.diva-portal.org/smash/get/diva2:990344/FULLTEXT01.pdf>
- Nkomoki, W., Bavorová, M., & Banout, J. (2019). Factors associated with household food security in Zambia. *Sustainability (Switzerland)*, 11(9), 1–18. <https://doi.org/10.3390/su11092715>
- Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing*, 18(2), 34–35. <https://doi.org/10.1136/eb-2015-102054>
- Norris, N. (1997). Error, bias and validity in qualitative research. *Educational Action Research*, 5(1), 172–176. <https://doi.org/10.1080/09650799700200020>
- Nunkoo, R. (2016). Toward a more comprehensive use of social exchange theory to study residents' attitudes to tourism. *Procedia Economics and Finance*, 39(November 2015), 588–596. [https://doi.org/10.1016/S2212-5671\(16\)30303-3](https://doi.org/10.1016/S2212-5671(16)30303-3)
- Nyaga, K. M. (2014). The impact of mobile money services on the performance of small and medium enterprises in an urban town in Kenya. <http://41.89.49.13:8080/xmlui/handle/123456789/689>
- Nyamba, S. Y. (2017). Information in Tanzania: The roles of different Stakeholders [Sokoine University]. http://www.suaire.sua.ac.tz/bitstream/handle/123456789/2071/SIWEL_YOHAKIM

NYAMBA.pdf?sequence=1&isAllowed=y

- Nyambara, P., Hosted, W., & History, E. (2002). New agrarian contracts in Zimbabwe innovations in production and leisure. *Proceedings of Workshop Hosted by the Department of Economic History, University of Zimbabwe Harare, 13 September 2002* <https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/10225>
- Nysveen, H., & Pedersen, P. (2003). Usefulness and self-expressiveness: Extending TAM to explain the adoption of a mobile parking service. *BLED 2003 Proceedings*. <https://aisel.aisnet.org/bled2003/64>
- Nysveen, H., Pedersen, P. E., & Thorbjørnsen, H. (2005). Intentions to use mobile services: Antecedents and cross-service comparisons. *Journal of the Academy of Marketing Science*. <https://doi.org/10.1177/0092070305276149>
- Oberschall, A. (1972). Lusaka market vendors then and now. *JSTOR*, 1(1), 107–123. <http://www.jstor.org/stable/40552859>
- O'Connor, R. V. (2012). Using grounded theory coding mechanisms to analyze case study and focus group data in the context of software process research. *Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems*, 256–270. <https://doi.org/10.4018/978-1-4666-0179-6.ch013>
- Ooyo, C., Maina, J., Kimeli, V., & Awuor, F. (2019). *A qualitative approach to understanding the determinants of mobile phone users' intention to use mobile payment services*. 1–8. DOI: [10.23919/ISTAFRICA.2019.8764847](https://doi.org/10.23919/ISTAFRICA.2019.8764847)
- OECD/FAO (2016). Agriculture in sub-Saharan Africa. Prospects and challenges for the next decade. *Agricultural Outlook 2016-2025*, 181(November 1947), 59–93. https://doi.org/10.1787/agr_outlook-2016-en
- OECD. (2001). Understanding the digital divide. *Industrial Law Journal*, 6(1), 52–54. <https://doi.org/10.1093/ilj/6.1.52>
- Ogbeide, O. A., & Ele, I. (2015). Smallholder farmers and mobile phone technology in sub-Saharan agriculture. *Mayfair Journal of Information and Technology Management in Agriculture*, 1(1), 1–19. <http://mayfairjournals.com/wp-content/uploads/2015/05/smallholder-farmers-and-mobile-phone-technology-in-sub-sahara-agriculture.pdf>
- Ogbeide, O. A., & Ele, I. (2019). An analysis of mobile phone use in Nigerian agricultural development. *Environmental and Agricultural Informatics*, 2005, 1358–1377. <https://doi.org/10.4018/978-1-5225-9621-9.ch061>
- Ogunleye, O. S. (2010). Explosion of mobile and wireless technologies—An opportunities for mobile government to speed up service deliveries: A South African perspective. *Proceedings of MLife 2010 Conferences. October 27-29, Brighton UK*. <http://researchspace.csir.co.za/dspace/handle/10204/4774>
- Ogunniyi, M. D., & Ojebuyi, B. R. (2016). Mobile phone use for agribusiness by farmers in southwest Nigeria. *Journal of Agricultural Extension*, 20(2), 172–187. <https://doi.org/10.4314/jae.v20i2.13>

- Okello, C. B. G., Munene, J. C., Mpeera Ntayi, J., & Akol Malinga, C. (2018). Financial intermediation and financial inclusion of the poor: Testing the moderating role of institutional pillars in rural Uganda. *International Journal of Ethics and Systems*, 34(2), 146-165. <https://doi.org/10.1108/IJOES-07-2017-0101>
- Okunade, K. S., Salako, O., Adejimi, A. A., Akinsola, O. J., Fatiregun, O., Adenekan, M. A., ... & Berek, J. S. (2020). Impact of mobile technologies on cervical cancer screening practices in Lagos, Nigeria (mHealth-Cervix): Protocol for a randomised controlled trial. *F1000Research*, 9. <https://doi.org/10.12688/F1000RESEARCH.22991.1>
- Olarinde, L. O., & Oladunni, O. A. (2013). Enhancing smallholder farmers income and food security through agricultural research and development in West Africa: *International Conference of the African Association of Agricultural Economist*, 25. aaae-africa.org
- Olomu, M. O., Ekperiware, M. C., & Akinlo, T. (2020). Agricultural sector value chain and government policy in Nigeria: Issues, challenges and prospects. *African Journal of Economic and Management Studies*, 11(3), 525–538. <https://doi.org/10.1108/AJEMS-03-2019-0103/FULL/XML>
- Ommani, A.R., & Chizari, M. (2005). An educational needs assessment of low input sustainable agriculture (LISA) practices for wheat farmers in Khouzestan province of Iran. *Proceedings of the 21st Annual Association for International Agricultural and Extension Education Conference*. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=OfdkOQ8AAAAJ&citation_for_view=OfdkOQ8AAAAJ:UeHWp8X0CEIC
- Ondiege, P. (2016). *Regulatory impact on mobile money and financial inclusion in African countries - Kenya, Nigeria, Tanzania and Uganda*. <http://www.cnbc africa.com/news/financial/2014/07/04/breaking->
- Onwuegbuzie, A. J. (2009). *A qualitative framework for collecting and analyzing data in focus group research*. 1–21. <https://doi.org/10.1177/160940690900800301>
- Oteri, O. M., Kibet, L. P., & Edward, N. (2015). Mobile subscription, penetration and coverage trends in Kenya's telecommunication Sector. *International Journal of Advanced Research in Artificial Intelligence*, 4(1), 1–7. www.ijarai.thesai.org
- Patel, D. J., & Shukla, K. K. (2014). *Oriental Journal of Challenges and Opportunities for ICT Initiatives in Agricultural Marketing in India*. 9–13. Available from: <http://www.computerscijournal.org/?p=1505>
- Patton, M. Q., & Cochran, M. (2002). A guide to using qualitative research methodology. In *A guide to using qualitative research methodology*. <https://fieldresearch.msf.org/handle/10144/84230>
- Perkins, B. R. (2010). Book review: ICT4D, information and communication technology for development. general editor, Tim Unwin. *TechTrends*, 54(5), 15–17. <https://doi.org/10.1007/s11528-010-0429-9>
- Phellas, C. N., Bloch, A., & Seale, C. (2011). Structured methods: Interviews , questionnaires and observation. *Researching Society and Culture*, 181–205.

- Phiri, A., Chipeta, G. T., & Chawinga, W. D. (2019). Information needs and barriers of rural smallholder farmers in developing countries: A case study of rural smallholder farmers in Malawi. *Information Development*, 35(3), 421–434. <https://doi.org/10.1177/0266666918755222>
- Phondej, W., & Neck, P. A. (2014). *The seven steps of case study development: A strategic qualitative research methodology in female leadership field*. (Issue March 2010). <https://ideas.repec.org/a/rom/rmcimn/v12y2011i1p123-134.html>
- Pickens, J. (2005). Attitudes and perceptions. *Organizational Behavior in Health Care*, 43–75.
- Pikirayi, T. (2017). Internet penetration increases along with the Mobile Internet Data usage according to Potraz reports. *Techzim*. <https://www.techzim.co.zw/2017/12/internet-penetration-increases-along-with-the-mobile-internet-data-usage-according-to-potraz-report/>
- Pini, B. (2012). Qualitative data analysis. *Evidence-Based Nursing*, 15(1), 2. <https://doi.org/10.1136/ebnurs.2011.100352>
- Ponce, B. L., Juanes-Méndez, J. A., & García-Peñalvo, F. J. (2016). Handbook of research on mobile devices and applications in higher education settings. In *Handbook of Research on Mobile Devices and Applications in Higher Education Settings*. IGI Global. <https://doi.org/10.4018/978-1-5225-0256-2>
- Ponelis, S. R. (2015). Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of information systems research in small and medium enterprises. *International Journal of Doctoral Studies*, 10, 535–550.
- Porter, G., Hampshire, K., Abane, A., Munthali, A., Robson, E., De Lannoy, A., Tanle, A., & Owusu, S. (2020). Mobile phones, gender, and female empowerment in sub-Saharan Africa: studies with African youth. *Information Technology for Development*, 26(1), 180–193. <https://doi.org/10.1080/02681102.2019.1622500>
- Portulans Institute. (2019). Network readiness index Zimbabwe 2019(Figure 2), 1–6. <https://networkreadinessindex.org/2019/countries/cameroon/>
- Poshai, L., Chilunjika, A., & Intauno, K. (2023). Examining the institutional and legislative frameworks for enforcing cybersecurity in Zimbabwe. *International Cybersecurity Law Review*, 1-19. <https://doi.org/10.1365/s43439-023-00093-y>
- Postal and Telecommunications Regulatory Authority of Abridged Postal and Telecommunications. (2020) <https://t3n9sm.c2.acecdn.net/wp-content/uploads/2020/07/Abridged-Sector-Performance-report-1st-Q-2020.pdf>
- Potnis, D. D. (2014a). Beyond access to information: Understanding the use of information by poor female mobile users in rural India. *The Information Society*, 31(1), 83–93. <https://doi.org/10.1080/01972243.2014.976687>
- Potnis, D. D. (2014). Managing gender-related challenges in ICT4D field research.

- POTRAZ. (2020). Postal and telecommunications regulatory authority of abridged postal and telecommunications. <https://www.potraz.gov.zw/wp-content/uploads/2020/10/2020-Second-Quarter-Abridged-Sector-Performance-Report.pdf>
- POTRAZ. (2021). Covid sees rise in internet usage: <https://www.newzimbabwe.com/covid-sees-rise-in-internet-usage-potraz/>
- Poveda, S., & Roberts, T. (2018). Critical agency and development: Applying Freire and Sen to ICT4D in Zambia and Brazil. *Information Technology for Development*, 24(1). <https://doi.org/10.1080/02681102.2017.1328656>
- Press, C. (2011). The operation called verstehen author(s): Theodore Abel Source: *American Journal of Sociology*, Vol. 54 , No . 3 (Nov., 1948), pp. 211-218 Published by: The University of Chicago Press Stable URL: <http://www.jstor.org/stable/2770547>. 54(3), 211–218.
- Pronyk, P. M., Muniz, M., Nemser, B., Somers, M. A., McClellan, L., Palm, C. A., ... & Sachs, J. D. (2012). The effect of an integrated multisector model for achieving the Millennium Development Goals and improving child survival in rural sub-Saharan Africa: a non-randomised controlled assessment. *The Lancet*, 379(9832), 2179-2188. [https://doi.org/10.1016/S0140-6736\(12\)60207-4](https://doi.org/10.1016/S0140-6736(12)60207-4)
- Provazza, A. (2020). What is a Smartphone. <https://searchmobilecomputing.techtarget.com/definition/smartphone>
- Qin, T., Wang, L., Zhou, Y., Guo, L., Jiang, G., & Zhang, L. (2022). Digital technology-and-services-driven sustainable transformation of agriculture: Cases of China and the EU. *Agriculture (Switzerland)*, 12(2), 1–16. <https://doi.org/10.3390/agriculture12020297>
- Quandt, A., Salerno, J. D., Neff, J. C., Baird, T. D., Herrick, J. E., McCabe, J. T., Xu, E., & Hartter, J. (2020). Mobile phone use is associated with higher smallholder agricultural productivity in Tanzania, East Africa. *PLOS ONE*, 15(8), e0237337. <https://doi.org/10.1371/JOURNAL.PONE.0237337>
- Qureshi, S., & Najjar, L. (2017). Information and communications technology use and income growth: evidence of the multiplier effect in very small island states. *Information Technology for Development*, 23(2), 212–234. <https://doi.org/10.1080/02681102.2016.1173634>
- Rabiee, F. (2004). Focus-group interview and data analysis. *Proceedings of the Nutrition Society*, 63(04), 655–660. <https://doi.org/10.1079/PNS2004399>
- Radi, S.A., & Shokouhyar, S. (2021). Toward consumer perception of cellphones sustainability: A social media analytics. *Sustainable Production and Consumption*, 25, 217–233. <https://doi.org/10.1016/j.spc.2020.08.012>
- Rahmann, G., Azim, K., Brányiková, I., Chander, M., David, W., Erisman, J. W., Grimm,

- D., Hammermeister, A., Ji, L., Kuenz, A., Løes, A. K., Wan-Mohtar, W. A. A. Q. I., Neuhoﬀ, D., Niassy, S., Olowe, V., Schoeber, M., Shade, J., Ullmann, J., & van Huis, A. (2021). Innovative, sustainable, and circular agricultural systems for the future. *Organic Agriculture*, 11(2), 179–185. <https://doi.org/10.1007/s13165-021-00356-0>
- Rai, S., Chatterjee, S., & Sarker, S. (2010). Stories, Tales and Narrative all hint at the same idea... Department of Informatics INF, Copenhagen Business School. Working Paper / Institut for Informatik. Handelshøjskolen i København No. 04-2010
- Rapsomanikis, G. (2015). The economic lives of smallholder farmers. *Fao*, 39. <https://doi.org/10.5296/rae.v6i4.6320>
- Rashid, A. T. (2016). Digital inclusion and social inequality: Gender differences in ICT access and use in five developing countries. *Gender, Technology and Development*, 20(3). <https://doi.org/10.1177/0971852416660651>
- Redmond, M. V. (2015). Social exchange theory (p. 36)[English Technical Reports and White Papers]. *Iowa State University*. https://works.bepress.com/mark_redmond/2/
- Resnik, D. B. (2005). The ethics of science: An introduction. In *The Ethics of Science: An Introduction*. Routledge. <https://doi.org/10.4324/9780203979068>
- Richard, E. & Mandari, E. (2019). Factors influencing usage of mobile banking services: the case of Ilala district in Tanzania. *Orsea Journal*, 7(1)(1), 42–54. <http://www.journals.udsm.ac.tz/index.php/orsea/article/viewFile/1355/1247>
- Richards, L., & Morse, J. M. (2006). Qualitative research design. *A User's Guide to Qualitative Methods*, 73–104. <https://doi.org/10.1186/1472-6963-11-23>
- Rodon, J., & Sesé, F. (2008). Towards a framework for the transferability of results in IS qualitative research. *Sprouts: Working Papers on Information Systems*, 8(17). https://aisel.aisnet.org/sprouts_all/223
- Rogers, R. H. (2016). Using lenses to make sense of research: A review of Sharon M. Ravitch and Matthew Riggan's reason & rigor: How conceptual frameworks guide research. *The Qualitative Report*, 21(9), 1708-1712.
- RSB. (2013). Defining smallholders suggestions for a roundtable on sustainable biomaterials (RSB) smallholder definitions; Ecole Polytechnique Fédérale de Lausanne Energy Center - Lausanne, Switzerland. *Ecole Polytechnique Federale De Lausanne*, 31(October), 31. http://energycenter.epfl.ch/files/content/sites/energy-center/files/projets/Bioenergy Team/Defining smallholders_v30102013.pdf
- Sahin, I. (2006). Detailed review of Roger's Diffusion of innovations theory and educational technology. *The Turkish Online Journal of Educational Technology*, 5(2), 14–23. <https://files.eric.ed.gov/fulltext/ED501453.pdf>
- Salkind, N. J. (2018). In: *Encyclopedia of Research Design*. 1585–1586. <https://doi.org/10.4135/9781412961288>
- Samukange, T. & Mutomba, V. (2014, February 21). Zimbabwe records 75 company closures, over 9 000 job losses. *The Newsday*.

<https://www.newsday.co.zw/2014/02/zimbabwe-records-75-company-closures-9000-job-losses/>

- Sanou, B. (2014). ICT facts and figures. *The World in 2014: ICT Facts and Figures*, 1–8. <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf>
- Saunders, M., Lewis, P., & Thornhill, A. (2009a). *Chapter 5 Formulating the research design: The process of research design, research choices, research strategies*. 1–24.
- Saunders, M., Lewis, P., & Thornhill, A. (2009b). *For business students (5th ed.)*. Pearson Education Limited.
- Saunders, M., Lewis, P., & Thornhill, A. (2019). Understanding research philosophy and approaches to theory development. In *Research methods. Business Students 4th edition Pearson Education Limited, England*.
- Scaife, J. (2004a). Doing educational research: A guide to first-time researchers. In *Doing educational research: A guide to first-time researchers* (p. 272). SAGE Publications Ltd. <https://doi.org/10.4135/9781446280485>
- Scaife, J. (2004b). Reliability, validity and credibility. In *Doing educational Research: A guide to first-time researchers* (pp. 58–72). SAGE Publications Ltd. <https://doi.org/10.4135/9781446280485.n4>
- Scoones, I. (2009). The politics of global assessments: the case of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). *The Journal of Peasant Studies*, 36(3), 547-571. <https://doi.org/10.1080/03066150903155008>
- Schultze, U., & Avital, M. (2011). Designing interviews to generate rich data for information systems research. *Information and Organization*, 21(1), 1–16. <https://doi.org/10.1016/j.infoandorg.2010.11.001>
- Seddon, P. B., & Scheepers, R. (2012). Towards the improved treatment of generalization of knowledge claims in IS research: Drawing general conclusions from samples. *European Journal of Information Systems*, 21(1), 6–21. <https://doi.org/10.1057/ejis.2011.9>
- Seddon, P., & Scheepers, R. (2006). Other-settings generalizability in IS research. *ICIS 2006 Proceedings*. <https://aisel.aisnet.org/icis2006/70>
- Sedgwick, P. (2014). Unit of observation versus unit of analysis. *BMJ*, 348. doi: <https://doi.org/10.1136/bmj.g3840>
- Sendecka, L. (2006). Adoption of mobile services [Norges Handelshøyskolen Bergen]. In *Business*. <https://openaccess.nhh.no/nhh-xmlui/handle/11250/167783>
- Sharma, A. (2022). Other Interpretive Frameworks. *Mandala Urbanism, Landscape, and Ecology*, 27–34. https://doi.org/10.1007/978-3-030-87285-4_3
- Shemmings, C. D., & Ellingsen, I. T. (2015). *The SAGE handbook of interview*

research: *The complexity of the craft using q methodology*. SAGE

- Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22(2), 63–75. <http://www.lhemoodle.ch/course/view.php?id=3229>
- Simon, M. K. (2011). Assumptions, limitations and delimitations. <http://dissertationrecipes.com/wp-content/uploads/2011/04/AssumptionslimitationsdelimitationsX.pdf>
- Simpson, J., Ohri, L., & Lobaugh, K. (2016). The new digital divide - The future of digital influence in retail. *Deloitte University Press*, 20. https://dupress.deloitte.com/content/dam/dup-us-en/articles/3325_New-digital-divide/DUP_NewDigitalDivide.pdf
- Siraj, M. (2010). A model for ICT based services for agriculture extension in Pakistan. *Www.Cabi.Org*, 85. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=9c90709031e171560d2749b8b03f73165c28e900>
- Smetana, J. G., & Adler, N. E. (1980). Fishbein's value expectancy model. *Personality and Social Psychology Bulletin*, 6(1), 89–96. <https://doi.org/10.1177/014616728061013>
- Smith, D. (2003). Five principles for research ethics. *American Psychological Association*, 34(1). <http://www.apa.org/monitor/jan03/principles.aspx>
- Smyth, M. (2016). Reconceptualizing qualitative Research: Methodologies without methodology, by Mirka Koro-Ljungberg. *Qualitative Research in Psychology*, 13(3), 264–266. <https://doi.org/10.1080/14780887.2016.1149396>
- Smyth, R. (2011). New approaches to qualitative research. *British Journal of Educational Technology* (Vol. 42, Issue 1). https://doi.org/10.1111/j.1467-8535.2010.01154_12.x
- Society, I. (2012). Chapter 3. The ICT Price Basket (IPB). *The ITU website*. <http://conference.management.ase.ro/archives/2014/pdf/75.pdf>
- Spencer, L., Ritchie, J. & O'Connor, W. (2003). Qualitative research: A guide for social science students and researchers. *Qualitative Research Practice - A Guide for Social Science Students and Researchers*, 199–218.
- Spinoza, B. (1911). *Wilhelm dilthey - 1833 – 1911. October*.
- Stainton, K., Hughson, J., Funnell, R., Koutoukidis, G., & Lawrence, K. (2009). *Tabbner's nursing care: Theory and practice* (Google eBook) (5th ed., Vol. 2011). Elsevier Health Sciences.
- Stake, R. E. (1995). The art of case study research. <https://uk.sagepub.com/en-gb/afr/the-art-of-case-study-research/book4954>
- Stalker, P. (2008). Millennium Development Goals. 1–42. <https://doi.org/10.4337/9781847202864.00088>
- Statista. (2020). Number of mobile devices worldwide 2020-2025.

<https://www.statista.com/statistics/245501/multiple-mobile-device-ownership-worldwide/>

- Steenhuis, H. J., & De Bruijn, E. J. (2006). Building theories from case study research: the progressive case study. In *OM in the New World Uncertainties. Proceedings (CD-ROM) of the 17th Annual Conference of POMS, 28 April–1 May 2006, Boston, USA* (pp.-). Production and Operations Management Society (POMS).
<https://www.pomsmeetings.org/ConfProceedings/004/PAPERS/004-0204.pdf>
- Stellmacher, T., & Kelboro, G. (2019). Family farms, agricultural productivity, and the terrain of food (in)security in Ethiopia. *Sustainability* (Switzerland), *11*(18).
<https://doi.org/10.3390/SU11184981>
- Stoneman, C. (1992). The World Bank demands its pound of Zimbabwe's flesh. *Review of African Political Economy*, *19*(53), 94–96.
<https://doi.org/10.1080/03056249208703943>
- Strauss, A. L. (1987). Qualitative analysis for social scientists. *World*, *1*, 319.
<https://doi.org/10.1017/CBO9780511557842>
- Sullivan, R. (2006). The global, the local and population policy in sub Saharan Africa. University of California Berkely.
- Tahar, A., Alden RIYADH, H., Sofyani, H., & Eko Purnomo, W. (2020). Perceived Ease of Use, Perceived Usefulness, Perceived Security and Intention to Use E-Filing: The role of technology readiness. *Journal of Asian Finance*, *7*(9), 537–547.
<https://doi.org/10.13106/jafeb.2020.vol7.no9.537>
- Takavarasha, S., Hapanyengwi, G., & Kabanda, G. (2017). Using livelihood profiles for assessing context in ICT4D research: A case study of Zimbabwe's highveld prime communal. *Electronic Journal of Information Systems in Developing Countries*, *79*(1), 1–22. <https://doi.org/10.1002/j.1681-4835.2017.tb00582.x>
- Tamoutsidou, M. (2013). A review of the role of ICT in agriculture sector. *Scientific Works Volume*, LX (figure 1), 330–334. https://uftplovdiv.bg/site_files/file/scienwork/scienworks_2013/docs/auitmlad/18_M_Tamucidu.pdf
- Tata, J. S., & Mcnamara, P. E. (2016). Social factors that influence use of ICT in agricultural extension in Southern Africa. <https://doi.org/10.3390/agriculture6020015>
- Taylor-Powell, E., & Renner, M. (2003). Analyzing qualitative data. *Screen* (Vol. 25, Issue 3). <https://doi.org/10.1207/s15430421tip3903>
- Tekere, J. H. (2001). *Zimbabwe* [114].
<http://www.fao.org/docrep/005/y4632e/y4632e0y.htm>
- Tetteh Anang, B., Alhassan, H., & Danso-Abbeam, G. (2020). Estimating technology adoption and technical efficiency in smallholder maize production: A double bootstrap DEA approach. *Cogent Food and Agriculture*, *6*(1).
<https://doi.org/10.1080/23311932.2020.1833421>

- The World Bank. (2010). Trends in maternal mortality: 1990 to 2010. *Organization*, 32(5), 1–55. <https://doi.org/ISBN 978 92 4 150363 1>
- Thomas, D. R. (2003). A general inductive approach for qualitative data analysis. *Population English Edition*, 27(2), 237–246. <https://doi.org/10.1177/1098214005283748>
- Thomas, D. R. (2017). Feedback from research participants: Are member checks useful in qualitative research? *Qualitative Research in Psychology*, 14(1), 23–41. <https://doi.org/10.1080/14780887.2016.1219435>
- Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2011). Research methods in physical activity. *Human Kinetics*.
- Thomas, N. H. (2003). Land reform in Zimbabwe. *JSTOR*, 24, 691–712. <https://doi.org/10.2307/3993432>
- Thomas, P. (2010). *Research methodology and design*. 291–334. <https://doi.org/10.1515/9783110215519.82>
- Thompson, J. (2022). *A guide to abductive thematic analysis A Guide to Abductive Thematic Analysis*. 27(5), 1410–1421.
- Tibben, W. (2013). Theory building for ICT4D: The use of theory triangulation in case study research. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 4256–4265. <https://doi.org/10.1109/HICSS.2013.548>
- Tobbin, P., & Kuwornu, J. K. M. (2011). Adoption of mobile money transfer technology: Structural equation modeling approach. *European Journal of Business and Management*, 3(7), 59–78. <http://www.iiste.org/Journals/index.php/EJBM/article/view/593>
- Toma, J. D. (2016). Approaching rigor in applied qualitative research. *The SAGE Handbook for Research in Education*, 405– 23. <https://doi.org/10.4135/9781412976039.n23>
- Trafimow, D. (2009). The theory of reasoned action: A case study of falsification in psychology. *Theory & Psychology*, 19(4), 501–518. <https://doi.org/10.1177/0959354309336319>
- Trafimow, D., & Fishbein, M. (1995). Do people really distinguish between behavioural and normative beliefs? *British Journal of Social Psychology*, 34(3), 257–266. <https://doi.org/10.1111/j.2044-8309.1995.tb01062.x>
- Tsokota, T., Von Solms, R., & Van Greunen, D. (2017). An ICT strategy for the sustainable development of the tourism sector in a developing country: a case study of Zimbabwe. *The Electronic Journal of Information Systems in Developing Countries*, 78(1), 1-20.
- Turnbull, J., & Lathlean, J. (2015). Mixed methods research. *The Research Process in Nursing*, July, 371–383. <https://doi.org/10.1080/17439760.2016.1262619>

- Twinomurinzi, H., Schofield, A., Hagen, L., Ditsoane-Molefe, S., & Tshidzumba, N. A. (2017). Towards a shared worldview on e-skills: A discourse between government, industry and academia on the ICT skills paradox. *South African Computer Journal*, 29(3), 215–237. <https://doi.org/10.18489/sacj.v29i3.408>
- Ugochukwu, N. C., Carlu, W., & Abiodun, O. (2020). Rural smallholder farmers' awareness and use of ICT-based market information sources in South Africa. May. <https://doi.org/10.20944/preprints202005.0159.v1>
- UIT. (2020). Measuring digital development. Facts and figures 2020. *ITU Publications*, 1–15. [https://www.itu.int/en/mediacentre/Documents/MediaRelations/ITU Facts and Figures 2019 - Embargoed 5 November 1200 CET.pdf](https://www.itu.int/en/mediacentre/Documents/MediaRelations/ITU_Facts_and_Figures_2019_-_Embargoed_5_November_1200_CET.pdf)
- Umar, B. B., & Nyanga, P. H. (2014). Women smallholder farmers and sustainable agricultural intensification: A case of conservation agriculture in Zambia. *International Proceedings of Chemical, Biological and Environmental Engineering (IPCBE)*. <https://doi.org/10.7763/IPCBE>.
- UNDP. (2016). Overview: Human Development Report 2016 Human Development for Everyone. 1–40. <http://hdr.undp.org>
- UNDP. (2020). Human Development Report 2020: The Next Frontier Human Development and the Anthropocene. UNDP: New York, NY, USA, 1–7. 130–158. <http://hdr.undp.org/en/2020-report>
- United Nations. (2015). The Millennium Development Goals Report. *United Nations*, 72. <https://doi.org/978-92-1-101320-7>
- United Nations Development Programme. (2016). Human Development Report 2016. In *United Nations Development Programme*. [https://doi.org/eISBN: 978-92-1- 060036-1](https://doi.org/eISBN:978-92-1-060036-1)
- Valenzuela, D., & Shrivastava, P. (2002). Interview as a method for qualitative research. *Asu. Edu/~Kroel/Www500/Interview%*, 1–20. <https://doi.org/0018726708094863>
- Van Baardewijk, M. (2017). The impact of mobile phone use and IKSL's audio messages on the asset base of poor farmers in Lucknow, India. *The Electronic Journal of Information Systems in Developing Countries*, 79(1), 1–17. <https://doi.org/10.1002/j.1681-4835.2017.tb00584.x>
- Van Reijswoud, V. (2009). Appropriate ICT as a tool to increase effectiveness in ICT4D: theoretical considerations and illustrating cases. *Electronic Journal of Information Systems in Developing Countries*, 38(9), 1–18. <https://doi.org/10.1002/j.1681-4835.2009.tb00272.x>
- Van Zyl, I. (2013). Technology encounters and the symbolic narrative: Localising the 'technology for development' experience in South African education settings (Doctoral dissertation, Università della Svizzera italiana).
- Zyl, O. V., Alexander, T., Graaf, L. D., & Mukherjee, K. (2014). ICTs for agriculture in Africa. <https://documents1.worldbank.org/curated/en/802551468204543390/pdf/882230W>

- Valentine, J. C., Cooper, H., Patall, E. A., Tyson, D., & Robinson, J. C. (2010). A method for evaluating research syntheses: The quality, conclusions, and consensus of 12 syntheses of the effects of after-school programs. *Research Synthesis Methods*, 1(1), 20–38. <https://doi.org/10.1002/jrsm.3>
- Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a. In Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User Acceptance of Information Technology: Toward a Unified View. *Management Information Systems Quarterly*, 27(3). <https://aisel.aisnet.org/misq/vol27/iss3/5>
- Venkatesh, V., Thong, J. Y. L., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, 17(5), 328–376. <https://ssrn.com/abstract=2800121>
- Verbrugge, B. (2016). *Best practice, model, framework, method, guidance, standard: Towards a consistent use of terminology*. Revised. [Online], Available: <https://www.vanharen.net/blog/best-practice-model-framework-method-guidance-standard-towards-consistent-use-terminology/> [2021, July 22].
- Vishwatej, R., Angadi, J. G., & Maji, S. (2016). Knowledge of Karnataka farmers about information and communication technology (ICT) projects. *International Journal of Farm Sciences*, 6(1), 231–235. <https://www.indianjournals.com/ijor.aspx?target=ijor:ijfs&volume=6&issue=1&article=033>
- Vosough, A., Eghtedari, N., & Binaian, A. (2015). Factors affecting ICT adoption in rural area: A case study of rural users in Iran. *Research Journal of Fisheries and Hydrobiology*, 10(10), 611–616. <https://www.aensiweb.net/AENSIWEB/rjfh/rjfh/2015/June/611-616.pdf>
- Vuuren, J. J. van, Leenen, L., Grobler, M. M., Chan, K. F. P., & Khan, Z. C. (2016). Mixed methods research for improved scientific study. In *Advances in Knowledge Acquisition, Transfer, and Management: Vol. i*. IGI Global.
- Wahid, F. I. U. of I. (2007). Using the technology adoption model to analyze internet adoption and use among men and women in Indonesia. *Electronic Journal of Information Systems in Developing Countries*, 32(6), 1–8. <https://doi.org/https://doi.org/10.1002/j.1681-4835.2007.tb00225.x>
- Walford, G. (2005). Research ethical guidelines and anonymity1. *International Journal of Research & Method in Education*, 28(1), 83–93. <https://doi.org/10.1080/01406720500036786>
- Walsham, G. (1995). The emergence of interpretivism in IS research. *Information systems research*, 6(4), 376-394.
- Walsham, G. (1995b). Interpretive case studies in IS research: Nature and method. *European Journal of Information Systems*, 4(2), 74–81. <https://doi.org/10.1057/ejis.1995.9>

- Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, 15(3), 320–330. <https://doi.org/10.1057/palgrave.ejis.3000589>
- Walters, C. H. (2001). Assumptions of qualitative research methods. *Perspectives In Learning*, 2(1), 60–62. <http://csuepress.columbusstate.edu/pilhttp://csuepress.columbusstate.edu/pil/vol2/iss1/14>
- Walton, O. (2015). *New ICTs for Development* (Vol. 1, Issue 2009). <https://doi.org/10.1017/CBO9781107415324.004>
- Warschauer, M. (2003). Dissecting the "digital divide": A case study in Egypt. *The Information Society: An International Journal*, 19(4), 297–304. <https://doi.org/10.1080/01972240390227877>
- Wei, N. T., Baharudin, A. S., Hussein, L. A., & Hilmi, M. F. (2019). *Factors Affecting User 's Intention to Adopt Smart Home in Malaysia*. 13(12), 39–54. Retrieved October 18, 2023 from <https://www.learntechlib.org/p/216411/>.
- Whyte, G., Bytheway, A., & Edwards, C. (1997). Understanding user perceptions of information systems success. *Journal of Strategic Information Systems*, 6(1), 35–68. [https://doi.org/10.1016/S0963-8687\(96\)01054-2](https://doi.org/10.1016/S0963-8687(96)01054-2)
- Wiggins, S. (2021). The challenges of smallholder farming. *The Sustainable Intensification of Smallholder Farming Systems*, 3–31. <https://doi.org/10.1201/9781003048053-2/Challenges-smallholder-farming- steve-wiggins>
- Wiles, R., Crow, G., Heath, S., & Charles, V. (2008). The management of confidentiality and anonymity in social research. *International Journal of Social Research Methodology*, 11(5), 417–428. <https://doi.org/10.1080/13645570701622231>
- Williams, M. (2000). Interpretivism and generalisation. *The Journal of the British Sociological Association*, 34(2), 209–224. <https://www.cambridge.org/core/journals/sociology/article/interpretivism-and-generalisation/B77F9B4133790AEB0F96C162BB0CC763>
- Willies, J. W. (2007). *Foundations of qualitative research: Interpretive and critical approaches*. K. G. Shaw, & L. Cuevas (Eds.). Sage Publications Inc.
- Wimmer, R., & Dominick, J. (1997). Mass media research: an introduction. *Marketing Research: State-of-the-Art Perspectives, 2000*.
- Wolcott, H. F. (1995.). *The art of fieldwork*. Retrieved August 5, 2018, from https://books.google.co.zw/books/about/The_Art_of_Fieldwork.html?id=AFloAQ AAMAAJ&redir_esc=y
- Woods, M. (2011). Interviewing for research and analysing qualitative data : An overview Interview methods – for what purpose? Types of interviews for research The semi-structured interview: benefits and disadvantages Limitations of in-depth interviews Pre-interview prep. 1–8.

- Woodside, A. G. (2010). *Case study research: Theory, methods and practice* (First). Emerald Group Publishing Limited.
- World Bank. (2011). ICT in agriculture: Connecting smallholders to knowledge, networks, and institutions. *World*, 64605, 424. <https://doi.org/64605>
- World Bank. (2017). Gross national income per capita 2016, Atlas method and PPP. December, 3. <http://databank.worldbank.org/data/download/GNIPC.pdf>
- World Bank Report. (2019). *The digital economy in Southeast Asia : Strengthening the foundations for future growth*. 128. <http://hdl.handle.net/10986/31803>
- World Economic Forum. (2012). The Global Information Technology Report 2012 Living in a Hyperconnected World. In *Forum American Bar Association*.
- World Economic Forum. (2018). This is what happens in an internet minute in 2018 | *World Economic Forum*. Report. <https://www.weforum.org/agenda/2018/05/what-happens-in-an-internet-minute-in-2018>
- Wyche, S., & Steinfield, C. (2016). Why don't farmers use cell phones to access market prices? Technology affordances and barriers to market information services adoption in rural Kenya. *Information Technology for Development*, 22(2), 320–333. <https://doi.org/10.1080/02681102.2015.1048184>
- Wyckoff, A. D., & Colecchia, A. (1999). *Economic and social impact of electronic commerce: Preliminary findings and research agenda*. Organization for Economic Cooperation and Development (OECD). <https://dl.acm.org/doi/abs/10.5555/553117>
- Xiao, M. (2019). Factors influencing eSports viewership: An approach based on the theory of reasoned action. *Communication and Sport*. <https://doi.org/10.1177/2167479518819482>
- Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, 39(1), 93–112. <https://doi.org/10.1177/0739456X17723971>
- Yan, L. (2016). *Expatriate manager's adaption and knowledge acquisition: Personal development in multi-national companies in China*. Google Books. Springer Science + Business Media.
- Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The qualitative report*, 20(2), 134-152.
- Yean, T. F., Johari, J., & Sukery, A. F. M. (2015). The influence of attitude, subjective norms, and perceived behavioural control on intention to return to work: A case of socso's insured employees. *Kajian Malaysia*, 33, 141–154.
- Yin, R. K. (1987). Naturalistic Inquiry. Yvonna S. Lincoln , Egon G. Guba. *American Journal of Education*, 95(4), 614–618. <https://doi.org/10.1086/444329>
- Yin, R. K., Bateman, P. G., Vaughan, R., Lande, S., Cantor, J. A., & Dain, D. D. (1989). Interorganizational partnerships in local job creation and job training efforts: Six case studies. (Issue Cml). ERIC. <https://files.eric.ed.gov/fulltext/ED313578.pdf>

- Yin, R. K. (2003). Case study methodology (2003, 3rd edition). *Case Study Research design and methods*. Sage, Thousand Oaks (CA, 19–39; 96–106. https://books.google.com/books/about/Case_Study_Research.html?id=BWea_9ZGQMwC
- Yin, R. K. (2006). *Case study research - Design and methods*. *Clinical Research*, 2, 8–13. <https://doi.org/10.1016/j.jada.2010.09.005>
- Yin, R. K. (2009). *Case study research design and methods fourth edition*. In *Applied Social Research Methods Series* (Vol. 5). [http://cemusstudent.se/wp-content/uploads/2012/02/YIN_K_ROBERT-1.pdf%5CnISBN 978-1-412296099-1](http://cemusstudent.se/wp-content/uploads/2012/02/YIN_K_ROBERT-1.pdf%5CnISBN%20978-1-412296099-1)
- Yin, R. K. (2011). *Qualitative research from start to finish*. The Guilford Press.
- Yin, R. K. (2013). Validity and generalization in future case study evaluations. *Evaluation*, 19(3), 321–332. <https://doi.org/10.1177/1356389013497081>
- Yin, R. K. (2014a). *Applications of case study research*. SAGE Publications. https://books.google.co.zw/books/about/Applications_of_Case_Study_Research.html?id=-1Y2J0sFaWgC&redir_esc=y
- Yin, R. K. (2014b). *Case study research: Design and methods*. https://books.google.co.zw/books/about/Case_Study_Research.html?id=OgyqBAAAQBAJ&redir_esc=y
- Zhang, K. (2018). Theory of planned behavior: Origins, development and future direction. *International Journal of Humanities and Social Science Invention (IJHSSI)*, 7(05), 76–83. [https://www.ijhssi.org/papers/vol7\(5\)/Version-4/K0705047683.pdf](https://www.ijhssi.org/papers/vol7(5)/Version-4/K0705047683.pdf)
- Zheng, Y., Hatakka, M., Sahay, S., & Andersson, A. (2018). Conceptualizing development in information and communication technology for development (ICT4D). *Information Technology for Development*, 24(1), 1–14. <https://doi.org/10.1080/02681102.2017.1396020>
- Zimbabwe National Statistics, A. (2012). Zimbabwe population census 2012. http://www.zimstat.co.zw/dmdocuments/Census/CensusResults2012/National_Report.pdf
- Zimstat. (2019). Zimbabwe smallholder agricultural productivity survey 2017 Report. *September*, 1–50. <https://www.zimstat.co.zw/wp-content/uploads/publications/Economic/Agriculture/APM/APM-2017-Report.pdf>
- Zhou, M., Herselman, M., & Coleman, A. (2015). USSD technology a low cost asset in complementing public health workers' work processes. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 9044, 57–64. https://doi.org/10.1007/978-3-319-16480-9_6
- Zinnbauer, D. (2007). What can Social Capital and ICT do for Inclusion. *Institute for Prospective Technological Studies (IPTS)–JRC–European Commission EUR*, 22673, 1-40.
- Zohrabi, M. (2013). Mixed method research: Instruments, validity, reliability and reporting

findings. *Theory and Practice in Language Studies*, 3(2), 254–262.
<https://doi.org/10.4304/tpls.3.2.254-262>

Zuberi, T., & Thomas, K. (2012). Demographic projections, the environment and food security in sub-Saharan Africa. In *United Nations Development Programme* (Issue 1).
<http://ideas.repec.org/p/rac/wpaper/2012-001.html>

APPENDICES

A: ETHICAL CLEARANCE.



UNISA COLLEGE OF SCIENCE, ENGINEERING AND TECHNOLOGY'S (CSET) RESEARCH AND ETHICS COMMITTEE

20 June 2019

Ref #: 032/SM/2019/CSET_SOC

Name: Mr Samuel Musungwini

Staff #:

Student #: 50879944

Dear Mr Samuel Musungwini

**Decision: Ethics Approval for 5 years
(Humans involved)**

Researchers: Mr Samuel Musungwini, 14 Crali Road South Downs, Gweru, Zimbabwe, Zimbabwe, 50879944@mylife.unisa.ac.za, +263 77 211 7443

Project Leader(s): Prof Izak van Zyl, VanZyliz@cput.ac.za, +27 21 469 1115
Prof Jan Kroeze, kroezej@unisa.ac.za, +27 11 670 9117

Working Title of Research:

Harnessing Mobile Phone Technology for Development of Smallholder Agriculture in Zimbabwe

Qualification: PhD Information Systems

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee for the above mentioned research. Ethics approval is granted for a period of five years, from 20 June 2019 to 20 June 2024.

1. The researcher will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.



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B: ETHICAL CLEARANCE ACCEPTANCE LETTER

All communications should be addressed to
"The District Administrator"
Gokwe South
Telephone: 059- 2440



The District Administrator's
Office
P.O. Box 100
GOKWE SOUTH

ZIMBABWE

REF: ACCEPTANCE LETTER

22 FEBRUARY 2019

RE: ACCEPTANCE LETTER FOR SAMUEL MUSUNGWINI (STUDENT NUMBER: 50879944) TO CARRYOUT A SURVEY ON "HARNESSING MOBILE PHONES FOR DEVELOPMENT OF SMALLHOLDER AGRICULTURE IN ZIMBABWE."

The above matter refers;

Following the request from the University of South Africa to carryout a research on: **"HARNESSING MOBILE PHONES FOR DEVELOPMENT OF SMALLHOLDER AGRICULTURE IN ZIMBABWE"**: the case of Gokwe South District. Please be advised that you cleared and free to carry out the survey as intended. However, be reminded to stick to your topic as you do your research. You will be held responsible if ever you deviate from your primary clearance which is to research in line with your topic.

Thank you



S.GWATRINDA

DISTRICT ADMINISTRATOR-GOKWE SOUTH



APPENDIX C: INTERVIEW GUIDE

Interview Guide for Smallholder farmers

Dear respondent,

This interview guide is prepared to collect data regarding the current state of mobile phone availability, accessibility, adoption level and mobile phone user ability of Smallholder farmers in Zimbabwe. The study is being conducted for academic purposes for a PhD in Information Systems thesis. You are free to provide your responses to the questions. Your responses will be confidential.

General Information

District: Gokwe South

Ward Village.....

Part A: Respondents' characteristics

DEMOGRAPHIC CHARACTERISTICS		STATUS
A1	Sex of respondent.	
A2	What is your age?	
A3	What's your marital status?	
A4	How many family members do you have in your family?	
A5	Are you able to read and write?	
A6	What level of education did you acquire?	

Section B Interview Questions Regarding Agricultural activities.

B1. Do you own the land you are farming?

B2. How big is your farming land?

B3. Is your farming land adequate for you?

B4. How did you acquire your farming knowledge?

B5. Which crops are you producing on your farmland? State the crops in order of importance.

B6. Do you have livestock? State the livestock you have in order of importance.

B7. What are the major challenges that you face in your agricultural activities? Please state in order of importance.

B8. What do you think should be done to overcome these challenges?

B9. Do you depend on agriculture only for income for your family?

B10. How much money do you get from your agricultural activities per month/year?

Section C Interview Questions regarding mobile phone availability, accessibility, level of adoption and user ability of Smallholder Farmers.

C1. Do you own a mobile phone?

C2. How long have you had a mobile phone?

C3. Which type of phone do you use? Justify

C4. Which mobile network do you subscribe to? Justify

C5. How much did you spend on acquiring your mobile phone?

C6. How much money do you usually spend on your mobile phone for airtime top up and data per month?

C7. Are there any challenges that you face regarding acquisition of mobile phones and airtime and their prices?

C8. Is the mobile phone generally acceptable for general use by all people including women in Gokwe?

C9. Do you think you are capable of effectively and efficiently using the mobile phone?

C10. Do you by any chance use your mobile phone to showcase your agricultural products or concerns?

C11. Can you state the agricultural activities you use your mobile phone for? State in order of priority.

C12. What are the agriculture related mobile applications available in Zimbabwe? Which mobile applications have you used on your mobile phone?

C13. In your opinion, do you think the mobile phone and its agricultural applications and services are affordable by farmers? Explain?

C14. Is the mobile phone useful for your agriculture information accessibility and other people? Explain?

C15. Is the mobile phone compatible with many everyday agricultural activities of farmers?

C16. Is the mobile phone valuable for your agriculture information accessibility and other people?

C17. Is the mobile phone credible for your agriculture information accessibility and other people?

C19. Do you think the adoption of mobile phones can help farmers overcome challenges of accessing agriculture related information? Explain?

C20. In your opinion, what role should be played by mobile telecommunication companies and other agricultural mobile application companies to assist farmers for them [farmers] to realise their full potential?

C21. What role should the government officials play to enable more farmers to use their mobile phones when communicating agriculture related information?

C22. What are the advantages that prevail in Gokwe South, which gives hope that the use of mobile phones in communicating agriculture information may improve?

C23. What challenges do you face regarding the use of the mobile phone to access agriculture information?

C24. What are the other means of accessing agriculture information that you currently use and how do you compare them to the mobile phone? State in order of priority?

C25. Can you state in order of priority the benefits you have realised because of using the mobile phone in your agricultural activities?

APPENDIX D: FOCUS GROUP DISCUSSION GUIDE

FOCUS GROUP DISCUSSION: QUESTION GUIDE.

SECTION A

- 1) What are the agricultural practices that farmers in Gokwe area are involved in?
- 2) What are the challenges faced by farmers in carrying out their agricultural activities in Gokwe?
- 3) In your own opinion, how can these challenges be addressed?
- 4) What are the sources of agricultural information for farmers in Gokwe?

SECTION B

- 1) What is the general level of mobile phone ownership in Gokwe?
- 2) What do farmers use their mobile phones for?
- 3) Do farmers by any chance use mobile phones in carrying out their agricultural activities?
- 4) How useful is the mobile phone in the everyday life of a farmer?
- 5) What challenges do farmers in Gokwe face as far as using the mobile phone for agricultural activities is concerned?
- 6) What do you think should be done to address the challenges of using the mobile phone for agricultural purposes faced by farmers in Gokwe?

APPENDIX E: THE EXPERT REVIEWERS' EVALUATION SHEET

Expert reviewers' questionnaire

The Mobile Agriculture framework for harnessing mobile phone technology for the development of smallholder agriculture in Zimbabwe.

Evaluation Sheet

Primary Investigator: Samuel Musungwini, PhD Student at UNISA

Study Supervisors: Prof Izak Van Zyl and Prof Jan Kroeze

Dear Participant,

You have been selected as an expert in the field of Agriculture Informatics to help with the evaluation of the relevance and validity of the proposed framework. This framework was developed to facilitate and speed up the mobile phone technology adoption, sustainability, and continual use by smallholder farmers in Zimbabwe in their agriculture activities, with the ultimate objective of improving the delivery of context-specific and relevant agriculture information to smallholder farmers in real-time mobile phone technologies. Mainly, the evaluation and validation exercise are carried out to determine the value and relevance of the framework to farmers (smallholder) in Zimbabwe and to get your valuable feedback to help refine and improve the framework.

May you kindly assess and evaluate the framework by addressing the following questions:

a) Simplicity

1. Is the proposed framework practically usable, and simple enough to be easily understood by stakeholders in the agricultural value chain and those responsible for the deployment and implementing of policies such as the **Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement team** and **Ministry of ICT Postal and Courier services** and **POTRAZ**? *[May you give a rationale for your answer?]*

2. Are the framework elements (functions) simple enough to be readily understood by the Agriculture Informatics experts, telecommunication companies, stakeholders responsible for deployment of mobile health products and services such as the **Ministry of Lands, Agriculture, Fisheries, Water, and Rural Resettlement team** and **Agricultural and Extension services**? *[May you give a rationale for your answer?]*

Relevance

3. Does the framework have the potential to improve the adoption of mobile phone technologies for agricultural purposes by smallholder farmers in Zimbabwe with the objective of improving their agricultural outcomes? *[May you give a rationale for your answer?]*

4. Are the proposed framework elements relevant to improving the use of mobile phone technologies by smallholder farmers to improve agricultural information? *[May you give a rationale for your answer?]*

b) Strengths and Weaknesses

5. What do you consider the strengths of the proposed framework?

6. What would you consider the weaknesses of the proposed framework?

[May you give a rationale for your answers?]

c) Additional Research

7. What extensions or areas for future research can be done on this framework?

d) Any other views or contributions that you think are relevant for improving the proposed framework.

APPENDIX F: INFORMED CONSENT



CONSENT TO PARTICIPATE IN THIS STUDY

I, _____(participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that once the interview or focus group discussion has been conducted and the information recorded on tape I can no longer withdraw from the research.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.

Participant's name & surname..... (please print)

Participant's signature.....Date.....

Researcher's name & surname.....(please print)

Researcher's signature.....Date.....



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APPENDIX G: STUDY SITES RESULTS: CASE SITE A: MUTANHAURWA

Research Site A: Mutanhaurwa Village

Mutanhaurwa village comprises 138 families of various status. There are families whose heads are based in South Africa and are headed by women, but the bulk of the families have the man of the house in place. Six (6) smallholder farmers were purposefully selected for the research as they met the criteria for selection, given the large number of potential respondents. The next section presents observations made at the homesteads of farmers in Mutanhaurwa village.

Observation Findings from Mutanhaurwa village

The researcher observed the following features (shown in Figures labelled AG for Appendix G and the digit represents the Figure number in this appendix. Figure. AG1, AG.2, AG.3, AG.4, AG.5 and AG4.6) in the homes of all selected participants in Mutanhaurwa village except the truck, which was found only at one homestead.



Figure AG.1: A field of Maize crop partially affected by a disease



Figure



Figure AG.3: Showing a village community granary where people keep their maize grain for safe keeping



ing produce to the

Interview Findings from Mutanhaurwa village

This section presents the research findings from the interviews conducted in Mutanhaurwa village at the interviewees' homesteads. Six individual interviews were conducted in Mutanhaurwa village. The researcher coded interviewees as SHFA, SHFB, SHFC, SHFD, SHFE and SHFF.

General demographic information

The demographic information of interviewees at Site A, Mutanhaurwa village, presented in this section includes gender, age, farming experience, level of education, and marital status. The researcher applied these demographic characteristics as they have a bearing on the farmers' attitudes towards the adoption and effective usage of mobile phone technology in agriculture. They inform discussion of the results of this research. In addition, these demographic characteristics assisted in the categorisation of farmers by the challenges they face.

This research used purposeful sampling because it enabled the researcher to select information-rich cases for in-depth study. Thus, six (6) research participants were chosen for the study at research Site A. Five of the research participants were male and one was female, making 83% male participation and 17% female participation. The age of the participants was 45 years, 52 years, 49 years, 42 years, 48 years and 37 years, respectively. The research found all participants at Case Site A to be seasoned farmers with farming experience spanning 9, 15, 18, 19, 22 and 24 years.

Farmers at the Mutanhaurwa research site are educated, with four having reached O Level, one ZJC and one having ended schooling at Grade 7. All the interviewed farmers had at least attended school and can do basic reading and writing. However, it was not within the ambit of this research to establish whether these participants passed the O level examination or not. Attendance was deemed enough for someone to be able to read and write, which is an essential skill for one to use mobile phone technology.

The next section presents findings from the interviews conducted at Mutanhaurwa village about the smallholder farmers' agriculture activities, characteristics and challenges.

Smallholder agriculture activities, characteristics, and challenges in Mutanhaurwa village, Gokwe South, Zimbabwe

This sub-section presents answers to research Sub-Question 1. The interview guide Section B, Questions 1 to 10 were applied to elicit answers to this research sub-question. Interview responses to research Sub-Question 1 show that farmers in Mutanhaurwa village own pieces of land and the size of the land ranges from three acres, for those with the smallest, to five hectares for the largest. Some farmers are content with the size of the land they have while others want more land. The community owns the grazing land collectively. Participants identified the Agriculture Extension Officer as the key source of farming knowledge of the farmers. A non-governmental organisation, such as German Agro, was also identified as critical in the training and equipping of farmers. All interviewees at Mutanhaurwa village were born in farming families and their first point of farming knowledge acquisition was learned by practice, and four (4) of them attained Ordinary level education, and two (2) boasted of having got an 'A' grade in Ordinary level Agriculture subject. Some farmers were also in Master Farmer certificate training. One farmer said:

Fertilizer is very expensive these days and if you have livestock, you can use manure. If you don't have livestock, even if you have money, when you want to plough the fields you have to pay others to plough for you, and the challenge is that they prioritise their fields and they will only come to plough for you when they are done with their fields. The rains are erratic thus you will not plant crops on time and they may not germinate. [SHFB]

Another farmer, who echoed those sentiments said:

I was born in a farming family and I grew up farming with my family. I get farming knowledge from the agricultural extension officer. There are also Non-Governmental Organisations (NGOs) like German Agro, and Christian Care which has provided training workshops for farmers in the area [...] at the Ordinary level I studied Agriculture subject of which I was very passionate about and I got an 'A' grade in the subject's ordinary level final examination. [SHFA]

Farmers in Mutanhaurwa village were doing field crop farming, horticulture, livestock and poultry production. All produced maize because it is the staple food of the people in Gokwe South and Zimbabwe at large. Other field crops produced on a variability scale by different farmers include cotton, sunflower, groundnuts, sorghum and sweet potatoes (*mbambaira*). All farmers practise horticulture, and they mainly produce vegetables for consumption and some for selling. Some produce tomatoes, green peppers and onions on a large scale as a business. All farmers had cattle varying from five to 13 heads of cattle, and one farmer kept donkeys as well. Cattle were considered very important in the life of a farmer because they provide draught power for ploughing the field, cow dung for manure, milk, and working capital as cattle may be sold when in need of money to finance agricultural activities and other household requirements. Other livestock kept include goats for manure, meat and working capital. One farmer kept donkeys and stated that he kept them specifically for marketing the products with the scotch cart to distinct places within Gokwe. In poultry, farmers keep roosters and rabbits for consumption. These farmers expressed:

The land is about sufficient. I just require more acreage. Farming is a business, and I need a large plot of land to cultivate a variety of crops to reach my goals in the agricultural company, I need at least six hectares. [...] In addition, I have cattle for draught power, and manure, and in times of need, cattle serve as capital, goats for meat, milk selling to cover common everyday concerns such as paying children's school fees, and cattle for manure. I also raise hens for eggs, meat, manure, and cash sales to help with regular home issues. Donkeys for draught power, which is crucial for me. Donkeys are especially used to transport vegetables, tomatoes, and other things throughout Gokwe. **[SHFB]**

The other farmer said:

Look, I am a Master Farmer certificate holder and I am pursuing an advanced farmer's certificate [...] The agriculture extension officer of the area provides us with training and usually performs was born into a farming family and I grew up farming with my family. There are also Non-Governmental Organisations (NGOs) like German Agro, and Christian Care, which has provided training workshops for farmers in the area. **[SHFE]**

Another farmer said:

It is an immense advantage to have your livestock because if you do not have livestock, you will not have the benefits listed above. Fertiliser is very expensive and if you have livestock, you can use manure. If you don't have livestock, even if you have money, when you want to plough the fields you have to pay others to plough for you, and the challenge is that they prioritise their fields and they will only come to plough for you when they are done with their fields. The rains are erratic so you will not plant crops on time and they may not germinate.

SHFC

Farmers in Mutanhaurwa village demonstrated that they confront challenges in their agricultural pursuits. Drought has been more regular in recent years as rain has become increasingly inconsistent. agricultural inputs have also become limited, at expensive pricing. Novel crops, animal pests, and illnesses were claimed to be emerging and

growing highly destructive. By any measure, the agrochemicals used to manage these pests and illnesses were prohibitively expensive. These were considered lethal, and any delay in treatment by a day may result in enormous losses for the farmers. Farmers also bemoaned the lack of profitable markets for their agricultural products. They reported that buyers and other stakeholders dictate market produce prices to them and as farmers; they were hard done by this because prices were not tallying with what they would have spent in the farming process. Thus, the absence of information and asymmetric information is a major impediment on the farmers' part.

Farmers at Mutanhaurwa village suggested that to overcome these challenges, there was a need to be involved in the setting up of market prices. They believed that there was a need for a mediation process involving the government, farmers, buyers and all stakeholders. Training and equipping farmers with information and farming knowledge. There is a need to deliver context-specific and actionable information in the proper time. Farmers require information about alternative sources of agricultural inputs and markets. All research participants in Mutanhaurwa village showed that they all depend on agricultural activities for their survival from food and sending their children to school and other household requirements. One farmer showed that he earns an average of Z\$3750-00 to as high as Z\$7500 per quarter (three months). One farmer showed that effectively, he earns an average of Z\$12000-00 on a poor year and Z\$18000-00 net on an excellent year.

At the time of carrying out the research the Zimbabwean dollar (Z\$), also known as the bond note or RTGS in electronic form, was trading as US\$1-00: 20 Bond notes and US\$1-00 to RTGS35-00 respectively. If one is using Z\$ in electronic form, the average reduces its value from a quarter up to a half. This means if I bill you to pay Z \$100-00 cash if you pay electronically, you may pay from Z\$125-00 up to Z\$150-00 in most cases depending on the day. On terrible days, we may ask you to pay double the billed price. The following is a response from one farmer:

I am into gardening, and it is the main anchor of my farming. I produce tomatoes, cabbage, onions, and vegetables. In the field, I mainly produce maize, a few sugar beans, and sometimes cotton. But of late I am also into producing sweet potatoes [...] maize is the staple food (Sadza) and some for selling and cotton is a cash crop and I specifically grow cotton for cash. The other crops are multipurpose that is they are for consumption and selling. I am into farming full time and I don't have other activities. [...] I have to make sure I am equipped. Farming is a livelihood and I have to live on it, my family depends on it [...] every three months get Z\$3750-00 to Z\$7500-00 collectively from my farming activities. **[SHFF]**

Mobile phone ownership and mobile agricultural applications and services used by smallholder farmers in Mutanhaurwa village in Gokwe South, Zimbabwe

The interview guide responses concerning research sub-question two show that farmers in Mutanhaurwa village have mobile phones, and some farmers have more than one mobile phone. All the respondents in Mutanhaurwa had Econet lines, and the reason given was that it was the only available and reliable network in the area. One farmer showed that he once owned a Telecel SIM card but had to abandon it, as it would appear as if it was like punishment as he had to walk for over two kilometres from his homestead to get the network:

[...] the major challenge is that of network availability although it's better than Telecel because when I was using it, I travel almost 2 kilometres to access the network. I bought my first phone 15 years ago. **[SHFD]**

Two of the farmers had smartphones, three had feature phones and one farmer had two basic phones. The farmers in this area have variable tenure as mobile phone owners and users ranging from nine to 18 years.

I buy data for Z\$10-00 every week (Z\$40-00 per month) for my Buddie and Z\$10-00 for my NetOne for voice calls and SMS. I frequently check for agriculture information on the internet whenever I can, but for my data to the last longer I switch off all other applications from updating. **[SHFC]**

One smartphone owner showed that his child bought the handset for him. The other one who owned a smartphone showed that it cost him US\$100-00. The average feature phone was said to have cost US\$29-00, and they said the basic phone cost US\$21-00. On mobile phone usage consumption like SMS, voice calling, and data for mobile apps, farmers with smartphones spent an average of Z\$45-00 to Z\$60-00 per month in Mutanhaurwa village, with the bigger allocation going to data. One farmer said:

Every farmer requires a mobile phone. It is very useful for information dissemination. I have a buddie [Econet SIM card] and my wife uses NetOne is cheaper on calling and SMS services. The smartphone cost me US\$100-00. and I also check messages WhatsApp messages 3 times a day, morning, afternoon, and evening, the rest of the time I switch data off. **[SHFD]**

Using a mobile phone in performing agriculture-related activities was a budding issue at the time of carrying out this research. Farmers showed that they were getting used to the idea, particularly with the help of the new agricultural extension officer, who was encouraging the farmers to use mobile phones. Two farmers in Mutanhaurwa showed that they were, at the time, partially getting weather information from their mobile phones. Naturally, farmers come together to share valuable information regarding agricultural

activities. All six interviewees showed that they had called to enquire about agricultural inputs and their prices from unique places and markets and prices for their agricultural produce, but this was not a frequent exercise.

Two of the interviewees in Mutanhaurwa were using their mobile phones to call/*WhatsApp* or SMS the agricultural extension officer of the area consulting about crops and livestock parasites and diseases, which are said to be continuously growing. These farmers are part of the farmers in Ward 15 who have created a *WhatsApp* group where members share and discuss any information about agriculture. The agricultural extension officer of the area is also a member of the group. Some farmers were receiving money for products from customers, be it GMB, Cottco or other dealers, and market vendors through Mobile Money Services (MMS) mainly *EcoCash* and paying for some inputs using the same facility.

I am using my mobile phone to call/*WhatsApp* or SMS 'Mudhomeni' [the agricultural extension officer] for consulting about crops and livestock, parasites, and diseases. [SHFE]

The mobile agriculture applications and services in Zimbabwe at the time of carrying out the research included the *EcoFarmer*, provided by Econet wireless company, eMkambo, an organisation offering a piece of agricultural information and knowledge through their mobile app, call centre, and USSD service. Agri Fin Mobile is operated by Mercy Corps Zimbabwe in partnership with the Swiss Agency for Development (SDC) which funds the service, this app offers agricultural advisory services to smallholder farmers.

I am also a member of the ABC group of farmers in Ward 15, these farmers are farmers who have created a *WhatsApp* group where members share and discuss any information about agriculture. This group works tirelessly to eliminate the intermediaries from our agriculture value chain. We want to sell directly to the market so the group is always exploring fresh markets. Every member should ensure that their products meet the group in terms of product quality. [SHFE]

Seedco's Agronomy Application tool offers agricultural advisory services for a variety of crops and livestock. ESOKO is an agricultural marketing application tool, which provides farmers with market information for diverse products on all markets in Zimbabwe and the prices being offered. *Kurima Mari* Mobile Farming Application is a mobile application designed to assist farmers with marketing expertise and foster sustainable development of smallholder farmers. Despite the availability of all these applications, no single farmer in Mutanhaurwa village had ever used any mobile agricultural application or service.

I have used the mobile phone for approximately 20 years but I only owned it 12 years ago [...] you know priorities and responsibilities differ. I am using a feature phone and I can say this is my fourth handset [...] my third handset did not last two weeks. It started giving me problems after three days and I went back to the dealer and it was fixed and appeared to function well [...] I went back to the dealer at Gokwe centre but to my surprise, the dealer was nowhere to be found and there were

many people with the same problem as mine. I use Buddie [Econet] because I usually receive money from relatives and customers through *EcoCash* and the network of Econet is available in Gokwe [...] These applications you are talking about, I heard Mudhomeni [agricultural extension officer] talking about them but I don't think they work on my phone. If I have any with crops and animal pests and diseases, I immediately call Agriculture Extension Officer. [SHFC]

Factors affecting the adoption and sustainable use of mobile phones by smallholder farmers in Mutanhaurwa village in Gokwe South

This sub-section answers research Sub-Questions 3, 4 and 5. The constructs of the theoretical model of this research model informed the formulation of interview guide questions to investigate factors affecting the use of mobile phones for agricultural purposes. This part solicited the perceptions of smallholder farmers and agricultural extension officers on the value derived from the use of mobile phone applications and services. The interview guide responses about research Sub-Question 3 show that farmers in Mutanhaurwa village found the mobile phone as a useful tool for agricultural education, as farmers are using mobile phones to receive instructions on what to do from the agricultural extension officer of the area. They require the agricultural extension officer (Agritex officer) to impart recent knowledge to farmers by conducting practical lessons and demonstrations. The agritex officer is required to cover approximately 1200 households training and imparting knowledge to all the farmers.

There is no transport provided for these officers to move from place to place. These officers are now turning to mobile phones to assist them in their work. They also conduct Master Farmer certificate training and Advanced Farmer training certification. The major challenge is that the area covered by the officer is too big to be covered by travelling on foot from household to household. The agritex officer groups farmers village by village and they choose a field to conduct practical educational activities. The interviewees in Mutanhaurwa showed that mobile phones have been very useful to them as the agricultural extension officer sometimes sends the smallholder farmers recorded demonstrations on video with full instructions later being availed. Over the years, farmers have implemented the instructions very well. The following are excerpts from the interviewees:

[...] farmers are faced with a myriad of challenges. There are potential mechanisms through which access to mobile phone coverage can positively affect the challenges of smallholder farmers. Improvement in smallholder farmers' coordination of procurement of inputs and marketing of products can avail several benefits like, reducing post-harvest losses, making perishable crops more profitable. [SHFB]

Since I started using the mobile phone, I can call diverse marketplaces like Gokwe centre, Kwekwe, Kudzanayi in Gweru, Renkini in Bulawayo, and Mbare in Harare. Products may flood one marketplace yet in another marketplace customers are looking for a commodity like hotcakes. [SHFD]

Mobile phone usage decreases the number of days between harvest and sale date by an average of five days for perishable crops, as a result, the output lost in the post-harvest goes down for perishable crops. In the end, mobile phone use increases profitability. I use my mobile phone to access information about the best seed kinds, the best planting dates, illnesses, and agrochemicals to use as pest and disease control. This increased knowledge has a stronger effect on agricultural activity production. [SHFF]

As a farmer, I want to embrace technology for the betterment of production. For example, as a farmer, I continuously interrogate the latest technology in agriculture to mechanise and modernise our agriculture. [SHFA]

Most farmers can use mobile phones, and they reported that phones reduce communication and information costs. This is evidenced by their capability to correctly insert SIM cards in their phones, top-up airtime from *EcoCash* accounts and airtime cards, SMS, and make voice calls. The researcher discovered that not all farmers were using their mobile phones for agriculture.

The mobile phone is usable as a tool for accessing agricultural information, sending and receiving agricultural information like market product prices, and information about weather forecasting. Farmers who have utilised mobile phones in receiving, communicating, sharing, and accessing agricultural information are finding the gadget indispensable. They say the mobile phone is proving to be precious as it can reduce information asymmetry and provides access to information on weather, input prices, the market price for products, diseases and other disasters in real-time, and is facilitating knowledge-sharing among some farmers.

The credibility of accessing vital agricultural information via mobile phone is one issue, which is uncertain. Some farmers still accept that they can search for information and get it by using their mobile phones and act on it without further consultation. Farmers found it easy to interact and call, SMS or *WhatsApp* other people. Two farmers in Mutanhaurwa commented that information from trusted sources was reliable and more actionable. This explains why they are more accepting of information from sources they know and trust like agricultural extension officers. The following were some of their submissions:

I frequently check for agriculture information on the internet whenever I can, but for my data to last longer I switch off all other applications from updating and I also check *WhatsApp* messages three times a day, morning, afternoon, and evening, the rest of the time I switch data off. [SHFB]

I acquired my first phone 13 years ago, I am still using the same line [SIM card], and it's Buddie. [...] Buddie network is the only network available in Gokwe and *EcoCash* serves a

lot [...] you can pay anything in any shop using *EcoCash*, GMB and other dealers are now paying with *EcoCash*. I can send my produce to Gweru, Harare, or Bulawayo by bus and then call vendors I deal with and they collect the farm produce and send me the money through *EcoCash*. [SHFF]

I am using my mobile phone to call/*WhatsApp* or SMS 'Mudhomeni' [the agricultural extension officer] for consulting about crops and livestock, parasites, and diseases. I am also a member of the ABC group of farmers in Ward 15 [...] these farmers are farmers who have created a *WhatsApp* group where members share and discuss any information about agriculture. [SHFE]

The interview guide responses about research Sub-Question Four show that farmers in Mutanhaurwa village believe that the adoption and usage of mobile phone technologies in their agricultural activities will assist them in overcoming the challenges they face in accessing agricultural information. One farmer showed that before the mobile phone came into their lives, they used to write letters, which would take weeks or months to get a response, send money to someone they had to send children by bus but when the mobile phone came on board, they are sending SMS messages and getting a response within that moment. They can now make voice calls with relatives in far countries and send and receive money. This farmer suggested that mobile phones have the potential to change the agricultural practice landscape as it has done to their lives. Interviewees further showed that there are potential mechanisms through which access to mobile phone coverage can affect the challenges of smallholder farmers. Improvement in smallholder farmers' coordination of procurement of inputs and marketing of products can result in several benefits like access to more cheap input supplier options, access to various lucrative markets for farm produce, access to new modern farming technology, and, most critically, access to real-time context-specific actionable information.

Before mobile phones, we used to write letters to inform other people about any development [sicknesses, funeral, family issues]... it would take days, weeks, or months to get the reply. However, nowadays thanks to the mobile phone we can SMS, *WhatsApp*, or call in real-time and get an instant response within a day. There are potential mechanisms through which access to mobile phone coverage can wear down challenges smallholder farmers face. If farmers can use mobile phones properly, this can cause an improvement in smallholder farmers' coordination of procurement of inputs and marketing of products. [SHFE]

Most farmers have mobile phones; however, the challenge is the efficiency and effective utilisation of these mobile phones. Mobile phone usage in agriculture results in several benefits accruing to these farmers. These benefits include lowering post-harvest losses by making perishable crops like tomatoes and vegetables more profitable. The mobile phone in agricultural operations, is sometimes, proving to be the difference between well-up smallholder farmers and marginalised smallholder farmers. Pests and diseases that

attack livestock and crops are increasingly developing and becoming more and more deadly with a shorter symptom period before demise, with some taking 48 hours; after showing symptoms the animal or the crop will be gone.

Additionally, farmers can utilise their smartphones to get information on the best seed kinds, best planting dates, diseases, and herbicides and pesticides to use in disease and pest management. The significance of this increased knowledge of agricultural productivity is larger. Therefore, farmers are called upon to embrace technology for the betterment of agricultural productivity.

I use my phone to acquire information about the best planting dates and the best seed types. **[SHFB]**

I also learn about ailments and the best agricultural chemicals to employ in treating illnesses and pests. This increased understanding may have a stronger effect on agricultural activity productivity. **[SHFD]**

As a farmer, I want to embrace technology for the betterment of production. For example, as a farmer, I continuously interrogate the latest technology in agriculture to mechanise and modernise our agriculture. **[SHFF]**

Agricultural extension officers are not the same. We used to have an old officer operating in this area, he was operating since when we were children and he retired three years ago. He was now behind and he was finding it difficult to embrace new technology yet agriculture is information-intensive and always developing [...] but the new officer is on the forefront, always demanding that every farmer must have a mobile phone, as he would want to send information to every farmer any time. **[SHFC]**

The researcher also interviewed the agricultural extension officer of the area who was new to the area. The Agritex officer suggested that smallholder farmers can benefit greatly from harnessing mobile phones for agricultural extension services. The agriculture extension services in Zimbabwe are responsible for several agricultural activities. They act as intermediaries between research institutes, laboratories, seed companies, fertiliser and other agrochemical companies and farmers. They facilitate the transfer of valuable agricultural information and other agriculture technological breakthroughs to smallholder farmers. They also assist smallholder farmers to reach decisions about developing and become better regarding sustainable production and general rural development.

Agricultural extension officers act as a conduit for the transfer of agricultural information and innovative technology from various sources to smallholder farmers. The agricultural extension officers are not capacitated for executing their jobs by reaching every farmer in their area and imparting knowledge; hence, they are now turning to their mobile phones for help. The mobile phone can create, store, access and share information anytime and anywhere. Thus, agricultural extension officers are using mobile phones to create

educational and demonstration videos with a group of farmers and then share them with other farmers on *WhatsApp* platforms. They broadcast messages about anything concerning farming (weather information, pests and diseases, farming inputs and prices, markets for agricultural produce) to all farmers in the area under their supervision. Anyone (including this researcher) who wants to work with farmers in any area requires the blessings of the AEO of the area. The following is worth noting:

I usually record a video of myself explaining all should do what the groups and I advise them to watch the demonstration video first. I then send the two videos to the other groups. The videos are then played, and everyone will watch, and listen after that, if there are questions from any farmer, they are noted down. One of the meeting leaders will then call me and give me the questions [...] I will then advise the person who called to put the phone on the loudspeaker. I will then address every question raised at that meeting. This happens to all groups and in this way, I think smallholder farmers are benefitting a lot. [...] while it's inevitable that there would be challenges [multiple social issues among smallholder farmers] education and training of farmers is critical, agricultural extension can come in handy on education and training of farmers. **[AGEXT1]**

The previous responses to the interview guide responses concerning research Sub-Questions 2, 3, and 4 showed that most farmers in Mutanhaurwa village had mobile phones, and they believe that mobile phones are useful tools for their agricultural operations. However, some factors are militating against the widespread adoption and usage by all farmers in Gokwe. Most farmers are not using their mobile phones for agricultural purposes, but they are using them in their general, everyday lives. The interview guide responses concerning research Sub-Question 5 are presented in this section.

Interviewees cited that mobile phones are very expensive and thus beyond the means of every farmer. As a result, it compels farmers to look for alternatives—they often fall victim to counterfeit handsets that do not last long, and sometimes, they resort to buying second-hand (pre-owned) mobile phones from other people and second-hand shops. Due to a lack of digital literacy among many farmers, mobile phone technology services like voice calling and data are excessively expensive and out of the reach of many. The lack of essential infrastructure is another issue affecting, among others, access to energy and mobile telephony (such as base stations). Poor and irregular network coverage causes several 'dark spots' in the coverage of huge geographical areas. This also has ramifications on internet access for farmers as they access the internet via an erratic, poor network. Poor networks further reduce the battery life of mobile phones because mobile gadgets tend to consume more power as they attempt to boost connections. The following came from one of the interviewees:

The government to put in place infrastructure like base stations in rural and remote areas to enable network coverage in rural areas. If this is not done, harnessing mobile phones for the sustainable development of smallholder agriculture will remain a pipe dream for many farmers. **SHFQ**

Farmers generally have low socioeconomic standing, which makes it difficult for them to utilise mobile phones because the devices compete for limited resources with other farmer obligations. The other problem cited is that telecommunication companies, mobile applications, and services developers do not seem to value smallholder farmers because they have not invested in the education and training of farmers on the use of the agricultural mobile applications services they are offering. An exemplary case given is that of Econet which launched the *EcoFarmer* service, but the level of promotion and support given to the facility is non-existent as compared to other applications and services the company offers, like *EcoCash*, *EcoSure*, and *EcoHealth*.

Respondents believe that the education and training of farmers are critical. Farmers need to be educated and equipped on how to use mobile agriculture applications and services for them to enjoy these applications in their farming activities. The agricultural extension can come in handy in the education and training of farmers. Telecommunication operators and other application developers should engage agricultural extension officers in the area where they want to deploy their applications and services before launching them. An educated farmer is informed and empowered to act and put into practice what they would have learned. Smallholder farmers in rural areas should have access to low-cost mobile agriculture packages from mobile telecommunications operators, as well as SMS and Call services. Telecommunication companies like Econet and NetOne can also team up with mobile phone handset manufacturers like GTel, Samsung, or any other companies and devise a plan for handsets for farmers, like designing a tailor-made mobile phone for the farmers. This mobile phone should be set to meet a critical condition, which is that the phone must not be usable by any person other than the one it is registered to in case of theft. One farmer expressed these sentiments:

The Zimbabwean government through the Postal Regulatory Authority of Zimbabwe (POTRAZ) should deploy a base station in the rural areas. This would ensure the existence of a strong and reliable mobile telecommunication network in rural areas. The government should as well encourage the effective usage of mobile phones among rural smallholder farmers. **[SHFB]**

The relevant governmental agency should advise all farmers that all agricultural information about crops, inputs, pests, diseases and weather forecasts would be communicated on platforms supported by their mobile phones and then provide training

and education to them on using mobile phone technology applications in their agricultural activities. Respective government ministries and departments should educate farmers on the benefits of mobile phone technologies in the sustainable development of agriculture. It should enact legislation that supports the advancement and spread of ICTs in socioeconomic sectors, particularly agriculture, which seems to have received lip service over the years. Additionally, the construction of base stations and other infrastructure should be encouraged by telecommunications companies in rural and isolated locations. If society is to embrace, adapt, and employ mobile phones in agricultural activities, capacity building is crucial. For smallholder farmers in rural areas, subsidised mobile agricultural packages and low-service packages like SMS and call services will be useful. One farmer said:

Many farmers in Gokwe have seen the doorway to school so literacy levels sound. The socio[-]economic status of farmers is not as bad, as farmers have mobile phones and they are using them already to make voice calls, send and receive messages, and send and receive money. **[SHFC]**

The government should encourage rural smallholder farmers to use mobile phones productively through the agricultural extension service. However, proper consideration ought to be given to the socioeconomic circumstances of each farmer when doing this. All agricultural extension officers should be incentivised to use mobile phone technologies to communicate new developments and innovations with farmers. More awareness-raising initiatives by the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement should target smallholder farmers to promote mobile phone usage in agricultural marketing where market participation is appallingly low. Agricultural processing companies must be persuaded to take part and support farmers. The government should also take responsibility and make it mandatory for agricultural extension officers to use mobile phones and support the initiative with resources. Farmers opined:

[...] to stimulate the use of mobile phones in agricultural marketing where market participation is appallingly low, the Ministry of Agriculture should launch additional education programmes among smallholder farmers. **[SHFE]**

I believe that the education and training of farmers are critical. Farmers need to be educated and equipped on how to use mobile agriculture applications and services and understand the value of these applications to their farming activities. **[SHFD]**

I would like to believe that since the bulk of farmers is in their 40s [age range], they are in the prime age where they are responsible [have families to support]. In addition, able to learn fresh things. **[SHFB]**

There is a high level of mobile phone ownership in Gokwe, but the challenge is using phones for agricultural purposes. The major sociocultural issues affecting the acceptance, adoption and usage of mobile phones by everyone in society, including women, were reported outdated as male farmers in Gokwe are buying their spouses better mobile phones than theirs. At the time of the research, farmers in Gokwe were receiving agricultural information through the agricultural extension officer, radio, word of mouth, and partly television, mobile phone, and newspapers.

Farmers in Mutanhaurwa village concurred that mobile phones could facilitate agricultural stakeholder linkages. Mobile phones are useful educational tools. Additionally, this could eliminate informational asymmetries, communication expenses, and the cost of information. Mobile devices can deliver real-time data on weather forecasts, input costs, product market pricing, diseases, and other hazards. Furthermore, mobile phone technologies can help farmers communicate with one another and with banking, transaction services, and money transfers.

APPENDIX G:2-CASE SITE B: NYAMAZANA 5 VILLAGE

Nyamazana village, named after the founding family in the area, has grown so big that they have subdivided it into five sub-unit villages. Nyamazana 5, where the research was conducted, is a subset of five villages called Nyamazana. There is Nyamazana 1, 2, 3, 4 and 5. However, it was not within the ambit of this research to establish the statuses of Nyamazana 1 to 4. Nyamazana Village 5 comprised 78 families of varying status. Some families were headed by womed because the men were reportedly based in South Africa; but for most participants, the man of the family was present at the time the research was conducted. Six (6) smallholder farmers were purposively selected for the research since they met the criteria. This village is under the supervision of AGEXT2 and a 52-year-old woman. This officer accompanied the researcher in Nyamazana Village 5 from the familiarisation tour to interviewing farmers, although the officer would be absent from the actual interviewing process. Given many potential respondents, the researcher also applied the snowball effect whereby the agricultural extension officer presiding over the area would recommend the most likely suitable candidates; the researcher would then choose, as in Mutanhaurwa village. The next section briefly presents observations made at the farmers' homesteads in Nyamazana Village 5 since the researcher observed that physical features like fields, crops and homesteads were more or less the same.

Observation findings from Nyamazana 5 Village

Nyamazana Village 5 had 78 household units, and of these, six were selected, as described in the section above. The only notable differentiating feature at one farmer's homestead in Nyamazana Village 5 was the dairy-related features, including dairy cows.



Interview findings from Nyamazana Village 5

The previous section presented the observations made by the researcher at the homesteads of the research participants in Nyamazana Village 5. This section presents the research findings of the interviews conducted in Nyamazana Village 5 at the six interviewees' homesteads. The interviewees were labeled as SHFG, SHFH, SHFI, SHFJ, SHFK, and SHFL. The research sub-questions, which are answered in this section, were similar to the questions in the interview guide, as applied in Mutanhaurwa village. The presentations strive to provide more detail on any new themes generated, less detail, but with the reinforcement of the generated themes from interviews conducted in Mutanhaurwa village.

General Demographic information

The demographic information of interviewees at Site B, Nyamazana Village 5, presented in this section includes gender, age, farming experience, level of education and marital status, and family size. As with case site B, this research used purposeful sampling and snowball effect across all research sites. Thus, six (6) research participants were chosen for the study in research Site B. Four of the research participants at Nyamazana village five were male, and two (2) were female, constituting 67% male participation and 33% female participation. The age of the participants is 34 years, 58 years, 44 years, 39 years, 56 years and 46 years, respectively. The researcher found research participants in the

case of site B as experienced farmers with farming experience spanning six to 29 years of farming.

Two (2) farmers in the Nyamazana Village 5 research site were educated up to the Grade 7 level, and the other four (4) had reached the 'O' level. Although the statistics tally with gender participation, it is important to note that there is no correlation. The two participants with Grade 7 level education were approaching 60 years of age and were of both sexes. All of them had received some education and can do basic reading and writing, which may be a fundamental skill for one to operate a mobile phone application. The family size of research participants in Nyamazana Village 5, including the family head, spouse and children living at the homestead, and depending on the farming activities for survival, were as follows: four, five, five, six, seven and 17. The respondent SHFH had 12 children and four wives.

Smallholder agricultural activities, characteristics, and challenges in Nyamazana Village 5 in Gokwe South, Zimbabwe

This sub-section presents answers to research Sub-Question 1 about Nyamazana Village 5. The interview guide Section B, Questions 1 to 10 were used to elicit answers to this research sub-question as was done in Mutanhaurwa village. Interview responses to research Sub-Question 1 show that farmers in Nyamazana Village 5 have their pieces of land, and the size of the land ranges from four to six hectares. Most of the farmers are comfortable with the size of the land they have as none complained. All farmers extolled the Agriculture Extension Officer as the key source of valuable farming information and knowledge for the farmers. Non-governmental organisations were named as critical in training and equipping farmers, although these farmers could not name one. Like in Mutanhaurwa, all interviewees in Nyamazana Village 5 were born into farming families and their first point of farming knowledge acquisition was learning by practice. Four (4) farmers were also in Master Farmer certificate training, while one was undergoing training for the Advanced Farmer certificate.

Look, I am a Master Farmer Certificate holder and I am pursuing an advanced farmer's certificate [...] I frequently check for agriculture information on the internet whenever I can.
[SHFL]

Farming crops and livestock are like those in Mutanhaurwa. The notable difference is that interviewee SHFK is into dairy farming, and at the time of the research, she had completed seven years as a dairy farmer. This farmer had four Holstein Friesian dairy cows. Besides what other farmers were doing, this farmer was producing milk and

delivering it to the Dairy Marketing Board (DMB) depot at Gokwe centre. Sometimes, the DMB tanker passes through her homestead to collect the milk. The dairy farmer said:

I started the dairy project after they taught us about it at a workshop. It's a very challenging project and you have to be focused [...] I don't have the equipment at the moment, but I am surviving. As a woman who lost a husband, I became the breadwinner, so I had to step up, [...] my priority is food security at home first so in the field I mainly produce maize, followed by groundnuts, a few round nuts (nyimo), sweet potatoes and sugar beans. I needed to make sure my children go to school, so I went for milk production. The other crops are multiuse that is they are for consumption and selling. **[SHFK]**

Farmers in Nyamazana Village 5 lamented the drawbacks of their agricultural activities. In recent years, rain has become increasingly erratic; consequently, drought has become a common feature. These were said to be fatal, and any delay to cure by a day may cause unprecedented losses for the farmers. Farmers also bemoaned the problem of lucrative markets for their agricultural products. These problems were almost identical to the ones faced by farmers in Mutanhaurwa village. One farmer said:

These days farming is very difficult, some new pests and diseases affect crops and livestock. Years back we used to rely on plants like aloes among other herbs but now are days the pests have become so lethal. **[SHFI]**

Some farmers in Nyamazana Village 5 echoed the sentiments of those at Mutanhaurwa, suggesting that, to overcome the challenges they faced, there was a need for farmers to be consulted and consequently involved in the setting up of market prices for their produce. Education and training of farmers with information and farming knowledge should be prioritised. There is a need to deliver context-specific and actionable agricultural information in real time. Farmers require information on alternative sources of agricultural inputs and markets. Nyamazana Village 5 farmers suggested that they be provided with capital by the government to empower them. Farmers criticised command agriculture/smart farming as mortgaging farmers because the program funders are farmers themselves, who, ultimately, do not benefit from the program.

I have not been enlisted to benefit from command agriculture, but I always hear those who have been involved in it complaining every time and some of those farmers have opted out of the program. **[SHFH]**

Nyamazana Village 5 farmers revealed that they all depended on agricultural activities for their survival: from food provision and sending their children to school to all household requirements. The dairy farmer specified that she earns, on average, Z\$2750-00 to (as high as) Z\$5000-00 per month. One farmer showed that effectively, he earns an average of Z\$15000-00 in a poor year and Z\$35000-00 gross income in a decent year.

Mobile phone ownership and mobile agricultural applications and services used by smallholder farmers in Gokwe South, Zimbabwe

This sub-section addresses mobile phone ownership and mobile agricultural applications used by farmers in Nyamazana Village 5. To achieve this, research Sub-Question 2 in the interview guide, Section C, Questions 1 to 12 were applied.

The researcher found that farmers in Nyamazana Village 5 possessed mobile phones, and in other households, there was more than one mobile phone. All the respondents in Nyamazana Village 5 had Econet lines, and the reason given was that it was not only the only available and reliable network in the area, but the other reason was that the *EcoCash* facility enables farmers to send and receive money to and from anyone anywhere and transact in any shop. Nyamazana 5 and Mutanhaurwa are equidistant from Gokwe centre as the villages are situated on either side of the major road to Gokwe or Kwekwe. Three of the farmers had smartphones, and two of these farmers had basic phones (popularly called *Chimbudzi* in Shona), while the other farmer had a feature phone as well. Thus, four farmers in Nyamazana Village 5 had two mobile handsets each.

When asked to explain, this farmer had another SIM card for NetOne, which was used in the basic phone; the other three farmers had two handsets, indicating that the basic phone was very handy, as the battery lasted longer, about three to seven days variably, so they spent most of the time using the same SIM card in the basic phone and then placing it in the other handset in the mornings and evenings. Farmers in this area have variable tenure as mobile phone owners and users ranging from eight to 16 years. The average price range of smartphones used by farmers, as found in the study, in this area, was between US\$80-00 and US\$100-00. Regarding mobile phone usage, the consumption of services like SMS, voice calling, and data for mobile apps, farmers in Nyamazana Village 5 spent on average Z\$35-00–Z\$65-00 per month, with the bigger allocation going to data. Farmers expressed this:

The network for Telecel and NetOne is very erratic and has to travel almost around a kilometre to access the network. [SHFI]

I use Buddie [Econet] because it is the only operator with a network available in Gokwe [...] the current handset cost me US\$90-00. The applications you are talking about, I do not know them and I have never used them, so I cannot say anything about them. [SHFL]

Nyamazana Village 5 farmers were not actively using mobile phones in performing agriculture-related activities, except for calling marketplaces to enquire about the prices of farm produce and input availability and prices. Farmers showed that they were

receiving notifications from the agricultural extension officer about invitations to attend meetings. Interviewees pointed out that they were using mobile phones to call/ WhatsApp or SMS the agricultural extension officer of the area consulting about crops and livestock parasites. These farmers are part of the farmers in Ward 15 who have created a *WhatsApp* group through which members share and discuss any information about agriculture. The farmers revealed that the agricultural extension officer for Mutanhaurwa was conducting many activities with farmers by using a mobile phone, compared to their officer. Some farmers in Nyamazana Village 5 were receiving money for products from customers; GMB, Cottco or other dealers and market vendors were paying farmers through Mobile Money Services (MMS), mainly *EcoCash*, and paying for some inputs using the same facility. The dairy farmer (SHFK) revealed that the mobile phone was a very handy tool for her since dairy farming is always plagued by challenges like diseases and animal feed issues.

I am using a smartphone and a basic phone I get my WhatsApp messages in the morning and evening. I use Buddie [Econet] because I usually receive money from relatives and customers through *EcoCash* and the network of Econet is available in Gokwe. If I have any problems with crops and animal pests and diseases, I immediately call Agriculture Extension Officer. [SHFH]

At the time of this research, there were several mobile agricultural applications and services in Zimbabwe (see the section on Mutanhaurwa). Despite the availability of all these applications, only one farmer in Nyamazana Village 5 had used the *EcoFarmer* agricultural application service. However, at the time of this research, the farmer had abandoned the application.

[...] all ABC members should ensure that their products meet the group in terms of product quality. However, the things you talked about [...] I have only used *EcoFarmer* but it was very erratic. I do not even know what its purpose is. It was just like reading a magazine because I was only getting updates sporadically. [SHFL]

Factors affecting the adoption and sustainable use of mobile phone technologies by smallholder farmers in Nyamazana Village 5 in Gokwe South

This sub-section addresses research Sub-Questions 3, 4 and 5 and, as in Mutanhaurwa, the constructs of the theoretical model of this research were applied to elicit from the farmers which factors affect the usage of mobile phone technologies for agricultural purposes. The farmers in Nyamazana Village 5 regarded the mobile phone as a very useful tool for agricultural activities. Their agricultural extension officer uses the mobile phone to disseminate vital agricultural information to the farmers, inviting them for

meetings. Most farmers can use a mobile phone, and they say it can reduce communication and information costs. This is supported by their capability to insert the SIM cards correctly into their phones, top-up airtime from their *EcoCash* accounts and airtime cards, send SMSs and make voice calls. However, mobile phones are not usable by all people, but they can eradicate this; with awareness, education and proper training, all people could productively use mobile phone technology in agricultural activities. The mobile phone is useful as a tool for accessing agricultural information and sending and receiving agricultural information, like market product prices and information about weather forecasting.

The results show that farmers have only recently started utilising mobile phones in receiving, communicating, sharing, and accessing agricultural information with other farmers they know. These farmers say the mobile phone has proved very prized in that, whenever they face diseases and other disasters, they have to call upon their agricultural extension officer and received real, valuable and actionable information in real time and can be proficient in facilitating knowledge-sharing among farmers. The issue of the credibility of accessing vital agricultural information via the mobile phone is seemingly uncertain. Some farmers still accept that they can search for information and obtain it using their mobile phones and act on it without further consultation. Farmers found it easily acceptable to interact, call, send SMSs or *WhatsApp* with people they knew, and they said such information was credible and more actionable if the source was trustworthy. That is why they are more accepting of information from sources they know and trust, like the agricultural extension officers.

I use my mobile phone to get information about the best planting dates, and acceptable seed types, learn about diseases, and research agrochemicals that may be used to combat diseases and pests. This increased knowledge can have a significant impact on the profitability of agricultural activities. **[SHFJ]**

Every farming activity requires information daily. I run this dairy project and I need information on animal feed [...] sometimes the tanker comes to collect the milk at home and sometimes it does not so I usually receive information when the tanker is not coming on the mobile phone and I make plans to ferry the milk to the depot. However, there have been cases where I did not get the information and the tanker did not turn up [...] in such cases I call the depot and get clarity. Milk is a perishable product; it goes bad fast, so you need actionable information in real, it is no longer guesswork. However, the major challenge is that of network availability. **[SHFK]**

The farmers in Nyamazana Village 5 perceive the mobile phone as a useful gadget for their agriculture operations, as they are using it to receive information easily from their agricultural extension officer about meetings. Most farmers believe that the mobile phone

can reduce communication and information search and access costs. The mobile phone was considered usable by most farmers as they could operate their mobile phones by charging, inserting the battery, SIM card, and memory card correctly, top-up airtime from *EcoCash* accounts and airtime cards, SMS, and make voice calls. The farmers have a positive perception as they perceive that the mobile phone can improve the coordination of procurement of inputs and marketing of products, which can result in several benefits for the farmer. Most of the potential benefits tally with findings in Mutanhaurwa village. Pests and diseases that attack livestock and crops are increasingly budding and becoming more and more deadly with a shorter symptom period before demise, with some taking 48 hours after showing symptoms, after which the animal or the crop dies. Some excerpts from the interviews conducted with the farmers include:

The proper use of the mobile phone can see an improvement in smallholder farmers' coordination of procurement of inputs and marketing of products. This can cause many benefits. [SHFJ]

The researcher found the mobile phone to be very compatible with almost all farming information-seeking and sharing-related behaviour. Farmers may use their mobile phones to access knowledge on optimal planting dates for dissimilar crops like maize, cotton and groundnuts. Mobile technology in agriculture allows farmers to be aware of good seed varieties being produced in line with climate change and dry conditions. Farmers will learn about diseases and agrochemicals used to cure diseases and pests. Smallholder farmers' agricultural productivity might be more positively impacted by this increased information, and farmers will inevitably adopt mobile phone technology to increase their output.

Agricultural extension officers facilitate the transfer of valuable agricultural information and other agricultural technological breakthroughs to smallholder farmers. They assist smallholder farmers in making decisions that ensure farmers can develop and improve regarding sustainable production and general rural development. The AEO bemoaned the working conditions for agricultural extension officers, citing a lack of support for field operations. They used to have motorbikes and fuel for field supervision, enabling the officers to perform their work. Although the hierarchy of the Department of Agricultural Extension was initially against the use of mobile phones, insisting that officers should not utilise mobile phones in data collection and collation, it became supportive of the idea.

It is my responsibility to ensure that the information reached all farmers in the area that I preside over. However, given the challenges of transport and the area size that I should

cover, it is not possible. I have now turned to the mobile phone in most of my engagements with farmers and fortunately, every household has a mobile phone and I have all the mobile phone numbers. I send SMS messages to farmers and I advise them on meeting points where I explain to them any information, which is very important. Sometimes I would call them to my homestead for meetings and we spend the day discussing challenges they are facing and any recent information. Most farmers have mobile phones but few have smartphones, so if I use WhatsApp, I will leave more farmers out. I have some farmers whom I have given responsibilities as leaders because of their commitment. They usually do the logistics for me. I advise the leaders to set up meetings, leaders of a group visit me on an agreed day, and we share information. This happens to all groups and in this way, I think smallholder farmers are benefitting a lot. **[AGEXT2]**

Most farmers do not use their mobile phones for agricultural purposes but use them in their general, everyday lives. The interviewees cited that mobile phones were very expensive and beyond the reach of every farmer. Most of the issues raised are in conformance with findings from Mutanhaurwa village. The identified challenges can be summarised thus: 1) farmers have mobile phones but are not optimally using them for agriculture; 2) the issues cost of mobile phone handsets and the associated services; 3) the problem of the absence of critical infrastructure, which includes mobile telecommunication (like base stations), access to electricity (among others) and poor and erratic network coverage. Farmers generally have low socioeconomic standing, which makes it difficult for them to properly utilise mobile phones because the device and its associated services compete for limited resources with other farmer obligations.

Respondents believe that the education and training of farmers are critical. Farmers need to be educated and equipped on how to use mobile agricultural applications and services for them to enjoy these applications in their farming activities. The agricultural extension can come in handy in the education and training of farmers. Government entities should inform farmers about the contribution and advantages of mobile technology to the long-term viability of agriculture. It should draft laws that encourage the growth and adoption of ICTs in socioeconomic fields, especially agriculture, which has largely received lip attention over the years. The government should also take responsibility and make it mandatory for agricultural extension officers to use mobile phones and support the initiative with resources.

Farmers in Nyamazana Village 5 concurred that mobile phones can facilitate agricultural stakeholder linkages. Additionally, it can lessen information asymmetry, communication expenses, and the cost of information. As a result, the usage of mobile phones can enhance the availability and dissemination of vital agricultural information, such as weather forecasts, input costs, market pricing for goods, disease outbreaks, and other

disasters in real time. The knowledge is then more useful. Farmers can share knowledge more easily thanks to mobile phones, which also make banking and transaction services for buyers and sellers easier:

Sometimes we encounter counterfeit mobile phone gadgets and they quickly malfunction and break down. The cost of calling, SMS messaging and data are very high. The *EcoCash* is good but the service charges have been steep [...] there seems to be a reduction nowadays perhaps because of One Money's coming on board. [SHFK]

The socio[-]economic status of farmers is not as bad, because farmers have mobile phones and they are using them already to make voice calls, send and receive messages, and send and receive money. [SHFJ]

APPENDIX G:3-CASE SITE C: MUTORANHEMA VILLAGE

As was done at the previous two research sites, the researcher purposively selected six smallholder farmers in Mutoranhema village who met the criteria. The agricultural extension officer presiding over the area recommended the most likely suitable candidates from which the researcher made selections. The next section presents data gained in Mutoranhema village.

Observation findings from Mutoranhema

At the time of the research, Mutoranhema village comprised 118 household units, and the researcher selected six for the study. The features observed at the interviewees' homesteads in Mutoranhema village were more like those observed in Mutanhaurwa and Nyamazana.

Interview findings from Mutoranhema

The researcher conducted six individual interviews in Mutoranhema village. Interviewees were labeled SHFM, SHFN, SHFO, SHFP, SHFQ and SHFR. As in all the other research sites, research sub-questions answered in this section were regarding questions in the interview guide.

General Demographic information

The demographic information of interviewees at Site C, Mutoranhema village, presented in this section includes gender, age, farming experience, level of education, and marital status. Three of the research participants in Mutoranhema village were male and three were female, making 50% male participation against 50% female participation. This case differed slightly from the first two case sites; the three women who took part were married and their spouses were still alive at the time of the research. When the researcher visited these women's homesteads, they said the husbands were somewhere running some errands. The researcher inquired whether they (the women) were permitted to be interviewed by strangers in the absence of their husbands; all of them gave positive affirmations. This was a positive development, given the patriarchal nature of Zimbabwean society. This is often deep-rooted in rural communities. The ages of the participants were 41 years, 33 years, 47 years, 53 years, 43 years and 40 years, respectively.

The research participants at case Site C were more averagely seasoned farmers, except for two who had more experience than the others. Most had farming experience spanning seven to 10 years. The other two had 16 to 21 years, respectively. Out of the six (6) farmers sampled in the Mutoranhema village site, only (one) 1 had reached the Zimbabwe Junior Certificate (ZJC) educational level, with the other five having reached the O level. All of them had, at least, gained an education with basic skills in reading and writing. Therefore, farmers in Mutoranhema can be assumed educated sufficiently to use mobile phones. The family size of research participants in Mutoranhema village, including the family head, spouse and children currently residing at the homestead and depending on the farming activities for survival, were as follows: six, five, seven, six, five and five. This seems to be the normal trend across most farmers in all the sites, except in special circumstances.

Smallholder agricultural activities, characteristics, and challenges in Mutoranhema village in Gokwe South, Zimbabwe

This sub-section presents the agricultural activities, the characteristics, and the challenges of research interviewees in Mutoranhema village. The sub-section addresses research Sub-Question 1, and the interview guide Section B, Questions 1 to 10, were used to draw out the answers to this research sub-question. Farmers in Mutoranhema village have their pieces of land; the size of the land ranges from four acres to five hectares. This land is inclusive of the field, the household yard and the garden. As in other villages, the entire village, however, jointly owns the grazing land. Most of the farmers were satisfied with the size of the land they had since nobody complained. Like in Nyamazana and Mutanhaurwa villages, all farmers in Mutoranhema commended the agricultural extension officer as the key source of valuable farming information and knowledge for the farmers.

The three (3) male farmers and one (1) female farmer reported that they were born into farming families, and this was their first point of farming knowledge acquisition and practice. Only (one) 1 farmer had a Master Farmer certificate, and the other five (5) were still undergoing training and being supervised by the agricultural extension officer. Farmers identified Cottco as a valuable organisation regarding training, but it was only providing training biased toward cotton farming. They showed that if other crop companies would follow suit, it would be beneficial to farmers. They also identified German Agro as a key Non-governmental organisation in the training and equipping of farmers. Farmers reported that they are into farming crops and livestock, as the other villages discussed above. However, the notable differences are that interviewees SHFO and SHFP were into cotton production and, at the time of the research, they had been perennial farmers for the previous five years. Interviewee SHFM reported that he was into Irish potato production. While all respondents produced sweet potatoes, interviewee SHFQ was producing enormous quantities at the time for commercial purposes. Asked to explain further, farmers attributed this variability of crop production among them to the work of the agricultural extension officer of the area. The agricultural extension officer was said to be lobbying and encouraging farmers to produce diverse crops at different times, so they do not flood the market. Planning ensures different farmers produce

dissimilar crops at any given time, resulting in their produce fetching more value at the market.

Like at the other research sites, farmers in Mutoranhema village bemoaned the drawbacks of their agricultural activities. These include erratic rainfall and exorbitant prices for scarce agricultural inputs for their activities. Various crop and livestock pests and diseases were emerging and increasingly becoming very harmful. Farmers also bemoaned the problem of the lack of lucrative markets for their agricultural products. Cotton farmers indicated that Cottco engaged them through contract farming, and they received inputs from Cottco. Upon harvesting, they are compelled to sell the cotton lint to Cottco. They say the problem of being contracted to Cottco left them with no alternative market to which to sell their produce, should Cottco prices become unfavourable. They also noted that, unlike other crops, cotton could not be used for anything domestically; therefore, cotton is a designated product to some extent.

Suggestions raised by farmers in Mutoranhema for addressing the challenges of farmers concurred with suggestions from the previous two research sites. Farmers criticised the command agriculture/smart farming program. They showed that it was inferior compared to the Cottco contract farming as Cottco at least takes a direct interest in capacitating farmers and equipping them with skills, so they produce better yields while commanding agriculture mortgages farmers because the program favours funders and farmers are left to do the rest for themselves. Mutoranhema village farmers showed that they depended on their agricultural activities for their survival, from providing food and sending their children to school, to all house requirements. One cotton farmer revealed that he earns on average Z\$500-00 to Z\$5000 net per month from gardening; however, cotton earns him a gross income of around US\$900-00 to about US\$1600 per year. The following are extracts from the interviews conducted:

I get farming knowledge from the agricultural extension officer. There are also Non-Governmental Organisations (NGOs) like German Agro, which have provided training workshops for farmers in the area. [...] At the Ordinary level, I studied Agriculture subject of which I was very passionate about and I got an 'A' grade in the subject's final examination.
[SHFN]

The land is adequate it is a fit for my requirements. I produce Sweet potatoes in enormous quantities and maize. I do a bit of gardening and it helps me so much. I have cattle for draught power, manure, and in times of need cattle serve as capital, goats for meat, milk selling to cover general everyday problems like paying school fees for children, for manure.
[SHFQ]

My family and I are dependent on farming as a means of subsistence [...] depending on the year, I receive anywhere between \$15,000 and \$20,000 annually from my farming efforts.
[SHFO]

Mobile phone ownership and mobile agricultural applications and services used by smallholder farmers in Mutoranhema village in Gokwe South, Zimbabwe.

This sub-section addresses mobile phone ownership information by farmers in Mutoranhema village and the mobile agricultural applications they are using. To achieve that, research Sub-Question 2, interview guide Section C, Questions 1 to 12 were applied. This enabled the researcher to elicit answers to this research sub-question. All the respondents in Mutoranhema village had Econet lines, and the reason given was that it was the reliable network in the area and that it supports *EcoCash* mobile money facility, which enabled them to receive money from sales and relatives, to safekeep money, and transact electronically. One respondent said he once tried to use *OneMoney*, a mobile money service provided by NetOne, but that the problem was support services. The participant said he had to go to Kwekwe, a distance of 115 kilometres to cash out his money using OneMoney (The NetOne mobile money facility). In addition, they have not yet integrated the OneMoney facility into many businesses as a payment platform.

Farmers in the Mutoranhema area have variable tenure as mobile phone owners and users range from six to nineteen years. One farmer had three handsets, a smartphone, two basic phones, and all three lines. When pressed to explain, the farmer said he had bought one basic phone and the smartphone, and that his children had given him the other basic phone. The other farmer had a smartphone and a feature phone, all of which he had bought for himself. The farmer said the smartphone cost US\$95-00 and the feature phone US\$27-00. The other four farmers owned feature phones with dual sim cards, although they were using single sim cards. On mobile phone usage consumption like SMS, voice calling, and data for mobile apps, farmers in Mutoranhema village spent an average of Z\$30-00-Z\$65-00 per month at the time of the research, with the bigger fund allocation spent on data.

Using the mobile phone in performing agriculture-related activities was a nascent issue at the time of this research in Mutoranhema, as farmers in this area specified that they only call the agricultural extension officer for guidance. Interviewees in Mutoranhema were using their mobile phones to call, *WhatsApp* or SMS the agricultural extension officer of the area, consulting them about crops and livestock parasites and diseases,

which are continuously sprouting. The farmers were not yet calling research institutes. Farmers insisted that they were only using their mobile phones to call, SMS and *WhatsApp* the agricultural extension officer only for agriculture-related matters. However, farmers acknowledged that they receive money for their farm produce from Cottco and other dealers and market vendors through Mobile Money Services (MMS), mainly *EcoCash*, and paying for some inputs using the same facility. Despite the availability of mobile agricultural applications, no farmer in Mutoranhema village had used any of the mobile agricultural application services available in Zimbabwe:

I have had a mobile phone for eight years and I have had several handsets along the way [...]. I have three handsets, a smartphone, and two basic phones and all three lines. Regarding the applications you are talking about, we were only informed about them by our new agricultural extension officer, but I have never used them, so I cannot say anything about them. [SHFM]

I once tried to use *OneMoney*, and I allowed someone to transfer money into my *OneMoney* account. It took forever to use the money as no shop had the facility for one to pay using *OneMoney* and there are no *OneMoney* agents in Gokwe. Therefore, I had to go to Kwekwe, a distance of 115 kilometres to cash out my money using. It felt like a punishment to me. [SHFO]

Factors affecting the adoption and sustainable use of mobile phone technologies by smallholder farmers in Mutoranhema Village

This sub-section addresses research Sub-Questions 3, 4, and 5, as in Mutanhaurwa. The researcher applied the constructs of the theoretical model developed in this research to elicit from the farmers which factors affected the usage of mobile phone technologies for agricultural purposes. Smallholder farmers in Mutoranhema village had appropriated the mobile phone as a valuable tool for agricultural purposes. They were using the mobile phone to interact and discuss agriculture issues among themselves and with the agricultural extension officer. The cotton farmers showed they were using mobile phones to communicate information about cotton with Cottco officials. They also get updates about recent developments in cotton that affect cotton productivity. There could be issues regarding the mixed perceptions of the Mutoranhema farmers' trust in mobile phone use for the sustainable development of smallholder activities in Mutoranhema. Some seemed not to have been accustomed to the idea that a mobile phone could be the only tool they might need to fulfil all their farming information requirements.

The farmers could operate their mobile phones as they could perform basic mobile phone housekeeping activities like sending SMSs and other messages, making voice calls, making payments, and receiving and sending money using *EcoCash*. The farmers

interviewed in Mutoranhema were using their mobile phones to receive, communicate, share and access general communication information with others. Farmers do not consult mobile application services and research centres but have been quick to contact their agricultural extension officers. However, no farmer has used mobile phone agricultural applications. These farmers say the mobile phone has proved very valuable in that whenever they have faced diseases and other disasters, they have called upon their agricultural extension officer, and they have received real, valuable and actionable information and are capable of easing knowledge-sharing among smallholder farmers. The farmers also cited a multiplicity of functions embedded in the mobile phones like listening to radio programs and news, using the calculator, using the camera to take pictures, and using the clock and alarm system to schedule a wake-up time and perform their farming activities.

Farmers in Mutoranhema had not fully embraced the idea of trusting the information they access through their mobile phones as credible. This was an unresolved issue as these farmers were still to accept that they could search for information and obtain it using their mobile phones and act on such information without further consultation. Farmers found it easy and acceptable to interact with, call and send SMS or *WhatsApp* messages to other farmers, agricultural extension officers or other stakeholders, provided they knew them.

These sentiments were revealed thus:

I connect with the officer via my mobile phone to learn about the best agronomic practices, good seed varieties, and diseases and agrochemicals to use to manage the diseases and pests. With this better information, my agricultural activities will be more productive. **[SHFO]**

The mobile phone can be a good diary where you can set reminders with alarm notifications. I also listen to the radio on my phone and get some current affairs discussions. **[SHFI]**

The mobile phone has multiple functions embedded on the gadget like listening to radio programs and news, using the calculator, using the camera to take pictures, using the clock and alarm system for scheduling time to wake up. **[SHFR]**

The farmers in Mutoranhema were very positive about the mobile phone as a useful tool in their agricultural operations, as they are using it to receive instructions and information on what to do from the Cottco officers in the area. The farmers said the arrival of the new agricultural extension officer has been a catalyst to the usage of their mobile phone technologies in agricultural activities. Although this is just a budding issue, there has been an improvement in the coordination of smallholder farmers procuring inputs and marketing products in Mutoranhema village, which has resulted in several benefits. Most

farmers have mobile phones; however, the challenge is the efficiency and effective utilisation of these mobile phones.

Mobile phone usage may result in the accrual of several benefits to the advantage of these farmers. The interviewees showed that with the enlightenment they were then receiving from their new agricultural extension officer for the area, they foresaw a boom in their farming ventures because of using mobile phone technologies. Farmers believe they may also use their mobile phones to obtain farming knowledge of the ideal planting dates and good seed varieties and learn about diseases and agrochemicals to use in controlling diseases and pests. They believe that access to improved knowledge has a significant influence on the production of agricultural activities. Here are some excerpts from the interviews conducted in Mutoranhema:

Our new agricultural extension officer has been very instrumental in encouraging farmers to use mobile phones in their everyday lives. This can cause many benefits. **[SHFN]**

I use my mobile phone to acquire information about the best planting times for particular seed types. I also study ailments and the agrochemicals that are employed in the fight against pests and ailments. This increased understanding may have a stronger effect on agricultural activity productivity. **[SHFM]**

Agriculture information about crops, inputs, pests, and diseases, the weather is broadcasted on [the] radio and we used to work with that, but things have changed a lot and, in most cases, now the information on the radio in general and not geographical; hence, it is not actionable by farmers. **[SHFR]**

I have heard about the possibility of using the mobile phone for agriculture, but I have not yet done that [...] I believe over time I will practice using the mobile phone for agricultural purposes. **[SHFQ]**

The same reasons affect the broad adoption and usage of mobile phones by all farmers in the communities of Mutoranhema and Nyamazana in Gokwe South 5. Most farmers are not using their mobile phones for agricultural purposes while using them in their general, everyday lives. The farmers interviewed mentioned that mobile phones were very expensive, beyond the means of most farmers. Some farmers turn to second-hand mobile handsets, while others fall victim to counterfeit handsets that do not last long in their search for alternatives. The cost of mobile phone services like voice calling and data is prohibitive for many smallholder farmers. Farmer SHFP also stated that years ago, when they started farming, mobile phones did not exist, so some farmers like him were not digitally skilled; they were 'digital immigrants'. Hence, they required training on some mobile functions. There is also the problem of the absence of vital infrastructure, which

includes electrical support and mobile telecommunication (like Base stations), and other telecommunications support services.

The farmers also showed a lack of awareness of the uses and availability of such issues, as they perceived agriculture mobile applications as a challenge impeding mobile phone adoption use and scalability. A perceived lack of support from the service providers and other associated developers is among the top challenges farmers face. There is also a lack of confidence in some farmers in their capabilities to operate mobile phones and their associated applications. The research respondents were positive that if they were provided with proper education and empowered with the right skills, they would do well in their usage of mobile phone technologies for agricultural purposes. In Gokwe, there is a high degree of mobile phone ownership, but the problem is using phones for agricultural reasons. The fundamental sociocultural obstacles influencing the acceptance, adoption and usage of mobile phone technologies by everyone in society are believed to be outdated. At the time of the study, farmers in Gokwe were obtaining agricultural information through the agricultural extension officer, radio, word of mouth, and, to a lesser extent, television, mobile phones and newspapers.

Farmers in Mutoranhema village are optimistic and confirm that mobile phones could help agricultural stakeholders connect if they are correctly positioned in the agricultural value chain. The mobile phone can lower farmers' communication and information searching and acquisition expenses, as well as favourably impact the problem of information asymmetry in the agriculture value chain. More information about the proposals offered by farmers in Mutoranhema can be found in the Mutanhaurwa section since the recommendations are almost identical. This was revealed as follows:

There is a lack of technical skills among many farmers, particularly the old. Remember, these phones are new and we are only getting used to them on the go, thus many farmers are not digitally skilled, and they are not prudent in the usage of their mobile phones. There is also a general lack of awareness of the uses and availability of such issues as agriculture mobile applications. **[SHFP]**

The mobility possessed by the gadget makes it superior to other gadgets. Gokwe's farmers' perceived positive subjective norms favour the harnessing of mobile phones in agricultural activities. **[SHFO]**

Farmers should be trained to use mobile agriculture applications and services and understand the value of these applications to their farming activities. The agricultural extension can come in handy in the education and training of farmers. **[SHFM]**

APPENDIX G:4-CASE SITE D: MASHOVE VILLAGE

Six smallholder farmers were purposively selected from Mashove village for the research as they met the criteria. Given the large number of potential respondents, the researcher also applied the snowball effect, whereby the agricultural extension officer presiding over the area recommended the most likely suitable candidates, and then the researcher made a selection. The next section presents observations made at the homesteads of farmers in Mashove village.

Observation Findings from Mashove village

At the time of the research, Mashove village reportedly had 132 household units. The researcher selected six farmers as described in the section above and observed no unique features at the interviewees' homesteads in Mashove village, and, as a result, the researcher decided not to include images of the observed features.

Interview Findings from Mashove village

This sub-section presents the research findings from the interviews conducted in Mashove village. The researcher conducted six individual interviews in Mashove village; the interviewees were labelled SHFS, SHFT, SHFU, SHFV, SHFW and SHFX. As in all the other research sites, the research sub-questions answered in this section were regarding questions in the interview guide.

General Demographic information

The demographic information of interviewees at site D, Mashove village, presented in this section includes gender, age, farming experience, level of education and marital status. As with the other cases of all research sites, the demographic characteristics were applied since they influence the farmers' attitudes towards the acceptance, adoption and effective usage of mobile phone technology in agriculture. A total of six research participants were selected for the study at research site D. Five of the research participants in Mashove village were male, and one was female, constituting 83% male participation and 17% female participation. The ages of the participants are 59 years, 51 years, 46 years, 43 years, 40 years and 43 years, respectively. Most farmers had farming experience spanning eight to 22 years; one participant had 31 years of farming experience at the time of this research. Out of the six (6) farmers sampled in the Mashove

village site, only one had reached the Zimbabwe Junior Certificate (ZJC) educational level, with the other five having reached the O level. All of them had been sufficiently educated to have basic reading and writing, which is sufficient for using mobile phones. The family sizes of the research participants in Mashove village, including the family head, spouse and children currently residing at the homestead, and depending on the farming activities for survival were as follows: six, five, seven, six and five. This seems to be the normal trend across most farmers in all the sites, except in special circumstances.

Smallholder agriculture activities, characteristics and challenges in Mashove.

In this section, the researcher presents the characteristics and challenges of the research interviewees in Mashove village. This answers research Sub-Question 1 and the interview guide, Section B, Questions 1 to 10 were used to elicit answers to this research sub-question. The farmers in Mashove village have their pieces of land and the size of the land owned by farmers to be ranging from five acres to six hectares. The researcher elicited this information from the interviewees and the land was not physically measured. The acreage and hectares owned by farmers were inclusive of the crop field, the homestead yard, and the garden. The entire village jointly owns the grazing land, so it is not recorded. Most farmers are satisfied with the size of the land they have, as nobody complained. The crops produced by farmers in Mashove, the livestock they owned, the challenges they faced, the suggestions they proposed to overcome the identified challenges, and the general incomes they got from their farming activities were the same as the other three villages. Therefore, the researcher omitted them. Some interview excerpts are as follows:

My father then allocated me six acres for farming from his farming land. I was fortunate because I am the only son in the family [SHFT]. I have livestock like donkeys and cattle for draught power and in times of need cattle serve as capital, goats for meat, milk selling to cover general everyday problems like paying school fees for children, for manure. [SHFW]

Mobile phone ownership and mobile agricultural applications and services used by smallholder farmers in Mashove village in Gokwe South, Zimbabwe

This sub-section addresses mobile phone ownership information by farmers in Mashove village and the mobile agricultural applications they are using. This was used to answer research Sub-Question 2, and to accomplish that, the interview guide, Section C, Questions 1 to 12 were used. This enabled the researcher to elicit answers to this research sub-question. Both men and women farmers in Mashove village had mobile

phones and Econet lines. Two respondents owned NetOne lines, but the problem is a lack of support services like agents who provide support to NetOne service users. One respondent had all three SIM cards Econet, NetOne, and Telecel. They said that if one needed to use *OneMoney*, which is a cheaper service than *EcoCash*, there are no places to buy using *OneMoney* around Gokwe, but one must travel to Kwekwe, Gweru, and other towns to cash out his money using *OneMoney*. One farmer had three handsets: a smartphone, a feature phone, and a basic phone. The other interviewees had one handset each, one had a feature phone and four had basic phones.

At the time of this research, farmers in this area showed that they only call the agricultural extension officer for guidance. Interviewees said they were using their mobile phones to call/*WhatsApp* or SMS their agricultural extension officer of the area consulting about crops and livestock parasites and diseases are to be continuously embryonic. However, the drawback to this was the fact that the agricultural extension officer took longer to respond to SMS messages and *WhatsApp* messages, so we resorted to calling. When the researcher pressed for an explanation, some farmers attributed this to the fact that the man is advanced in years. The Agriculture Extension Officer attested to this and pointed out that he was about to retire in December 2019. (In addition, he eventually retired in the last stages of the data collection process.) However, they insisted that they were only using their mobile phones to call, SMS, and *WhatsApp* the input suppliers sporadically for inputs and prices and vendors for market prices. Despite owning mobile phones and the availability of various mobile phone agricultural applications, no farmer in Mashove village reported using any of the available applications. They noted:

The applications you are talking about, I have never used them. [SHFW]

I have one handset.so I only place the line, which I want to use at that time. [SHFV]

One challenge we face is that when we send WhatsApp or SMS messages to our agricultural extension officer it takes longer to get a response to an SMS message, so we resort to calling. The fact is that he is now old and about to retire. Maybe it is because of eyesight. [SHFX]

Factors affecting the adoption and sustainable use of the mobile phone by smallholder farmers in Mashove village

Responses to the interview guide Questions C14 to C17 concerning research Sub-Question Three show that farmers in Mashove village were not yet convinced a mobile phone is a valuable tool for agriculture. They were using the mobile phone to interact and

discuss issues with the agricultural extension officer on voice calls as it was taking longer for them to get a response with SMS or *WhatsApp* messaging. The farmers were able to call the input suppliers and market dealers to enquire about the prices. That was the extent to which they were using it in agriculture-related matters.

The farmers in Mashove had mixed trust towards mobile phone technology usage in the sustainable growth of smallholder agricultural activities in Zimbabwe. The farmers demonstrated that the mobile phone was handy in their farming activities, but they cited limitations affecting the full appropriation of mobile phones. The limitations included the reciprocity of the mobile phone is reciprocal; it is a communal device, of which the usefulness, effectiveness and efficiency are subjective because it requires two capable users at both ends for the operation to be successful in most circumstances. Some seem not to have adapted to the idea that a mobile phone can be the only gadget needed by every farmer to fulfil all their farming information requirements.

However, farmers in Mashove said they preferred to talk to the agricultural extension officer, dealers and other farmers they knew. A credibility issue around accessing vital agricultural information via mobile phone from unknown sources also emerged. Farmers in Mashove are still to accept that they can search for information using their mobile phones and act on it without further verifications. Farmers found it more easily acceptable to interact and call, SMS or *WhatsApp* with people they knew and respected. They said:

I cannot trust the information I get on the mobile phone from strangers. [SHFW]

Buddie network is the only network available in Gokwe and *EcoCash* serves a lot [...] you can pay anything in any shop using *EcoCash*. GMB and other dealers are now paying with *EcoCash*. [SHFS]

That is why I said the efficiency, usefulness, reliability of the mobile phone is a subjective issue dependent on the interlinked users at the two ends. [SHFT]

The responses to interview guide questions concerning research Sub-Question 4 displays the Mashove village farmers' mixed perceptions about mobile phone use for their agricultural operations. These farmers are sceptical about the usefulness and effectiveness of mobile phone technology in addressing challenges regarding access to agricultural information. They are concerned about the challenges they are facing regarding the usage of mobile phone technologies. These challenges include a limited aptitude for mobile phone use by the farmers and other key stakeholders in the value

chain, like agricultural extension officers resulting in information sharing being limited to voice calls only.

Farmers revealed that they are not well-resourced, and usage of the mobile phone consumes resources, as a result, they lack the financial resources to spend money on phone calls. The mobile phone acquisition and usage charges are quite expensive for farmers. The network coverage is also a major challenge, and there is a lack of support from the telecommunication service providers. Farmers view the lack of network availability and the absence of supporting services like support and distribution agencies for other networks as retrogressive to their farming practices. There are no support services for Telecel and NetOne (like airtime, mobile money agencies), agencies selling mobile phone handsets, and the unavailability of electricity. Farmers who utilise mobile phones for receiving, communicating, sharing and accessing agricultural information find the device indispensable. They claim that the mobile phone is proven invaluable since it can decrease information asymmetry, enable real-time access to information on the weather, input prices, product market prices, diseases and other disasters, and make it easier for farmers to share their knowledge. The following was said:

I believe over time they may give us a young agricultural officer who will assist us to practice using the mobile phone for agricultural purposes. **[SHFW]**

The responses from farmers at Mashove village characterised several challenges they face in using mobile phones. There is a perceived lack of support with complementary telecommunication services from telecommunication service providers. This includes base stations, which enable network coverage. As earlier alluded to, there are no airtime top-up scratch cards for NetOne and Telecel, so it takes time to get it because one would have to send someone to town to get the airtime. The *EcoCash* self-top-up service offered by EcOnet only enables the farmers to top up Econet lines, but the challenge is the bottom line, which requires one to top up from Z\$5-00 upwards, so if the wallet does not have more than Z\$5-00 one cannot top up their phone. The findings were that barriers to widespread adoption and use among all farmers in Gokwe included the government policy, the perceived expenses of mobile telecommunication services, and the mobile and telecommunication services. Most farmers in Mashove village have not appropriated their mobile phones for agricultural purposes, but they are using them in their general everyday lives. Interviewees cited that mobile phones are very expensive beyond the means of every farmer. The cost of mobile phone services like voice calling and data is

prohibitive for many farmers. Farmers generally have low socioeconomic standing, which makes it difficult for them to utilise mobile phones effectively because the device competes for limited resources with other farmer obligations.

Measures should be enacted to ensure that farmers can afford to buy phones. There should be infrastructure in place that ensure the network is available, less erratic and more readily accessible to farmers within their environment. They called upon the government to reward agriculture by creating legislation, which could provide tailor-made telecommunication services and facilities for farmers. Mobile phones facilitate money transfers; promote banking and transaction services between buyers and sellers. All these benefits might come to fruition if the government produces policies and measures to ensure that farmers have networked mobile phones. The following was recorded:

Lack of support from the service providers of mobile and telecommunication services and Government and most farmers in Gokwe are discouraged from using mobile telecommunication services due to their perceived high prices. This is evidenced because most farmers are not using their mobile phones for agricultural purposes but they are using them in their general everyday lives. **[SHFU]**

There is a need for a deliberate policy and consented effort from the government to craft, support, and fund the expropriation of ICT in agriculture. **[SHFV]**

APPENDIX G:5-CASE SITE E: DZAWANDA VILLAGE

The researcher purposively selected six smallholder farmers in research Site E for interviews as they met the criteria. Given a large number of potential respondents, the researcher also applied the snowball effect whereby the agricultural extension officer presiding over the area recommended the most likely suitable candidates from which the researcher chose. The next section briefly presents observations of the farmers in Dzawanda village's homestead; the physical features were more or less the same as those of the previous sites.

Observation Findings from Dzawanda village

At the time of the research, Dzawanda village consisted of 129 household units; six farmers were selected, as described in the section above. Most features concurred with the features observed in all the previous research sites. However, the following features were unique to Dzawanda village, as presented below. There was a very vibrant piggery project collectively run by seven farmers as a community project and, at the time of the research, consisted of 247 pigs. Some individual farmers also had piggery projects in Dzawanda village and there was a community garden project with tomatoes.



Figure A-G 6: Community piggery project in Dzawanda village



Figure A G 7: Community garden project for farmers in Dzawanda village

Interview findings from Dzawanda

The previous section presented the observations made by the researcher in the homesteads of the research participants in Dzawanda village. This section presents the research findings of the interviews conducted in Dzawanda village at the interviewees' homestead. The researcher conducted six individual interviews in Dzawanda village, and the participants were labelled SHFY, SHFZ, SHFAA, SHFAB, SHFAC and SHFAD. After the participant labelled SHFZ, there was a need to restart from A but now doubling the letters as AA, AB and so on to avoid coding duplication. As in all the other research sites, the research sub-questions answered in this section were regarding questions in the interview guide.

General demographic information

The demographic information of interviewees in Dzawanda village presented in this section includes gender, age, farming experience, level of education and marital status. As with all research sites, the demographic characteristics are applied as they affect the farmers' attitudes towards the adoption and effective usage of mobile phone technology in agriculture. As was the case with all previous research sites, this research used purposeful sampling and snowball effect across all research sites. Thus, six research participants were selected for the study in research site E. Four (4) research participants in Dzawanda village were male, and two (2) were female, constituting 67% male participation and 33% female participation. The participants' ages were 49 years, 43 years, 44 years, 40 years, 48 years and 54 years, respectively. Farmers in Dzawanda village had farming experience spanning from 10 to 32 years.

Participant SHFAD had 32 years of farming experience at the time of this research. He is a trained soldier who was deployed at the Zimbabwe National Army farm as an artisan at the age of 22 and remained on the farm for five years. He was then seconded to receive agricultural training at the local agricultural college and obtained a certificate, as well as a Diploma in Agriculture. The farmer has vast amounts of theoretical and practical agricultural knowledge. The educational level of farmers in Dzawanda village was as follows: two held a Diploma in Agriculture, two had an O level, one had a Certificate in Agriculture, and one had reached the Zimbabwe Junior Certificate (ZJC) educational level. However, it was not within the ambit of this research to verify and authenticate the qualifications. Importantly, all the farmers had been educated at least to the level of basic reading and writing knowledge sufficient for using mobile phones. The family size of

research participants in Dzawanda village, including the family head, spouse and children living at the homestead and, depending on the farming activities, dependants were as follows: six, five, five, five, 24 and five. As in most villages, most farmers in all the sites had five to seven family members per household, except in special circumstances.

Smallholder agricultural activities, characteristics, and challenges in Dzawanda village in Gokwe South, Zimbabwe

This sub-section presents the agricultural activities, characteristics and challenges of the research interviewees in Dzawanda village. This addresses research Sub-Question 1; the interview guide, Section B, Questions 1 to 10 were used to elicit the answers to this research sub-question. Like all the other research sites in this study, Dzawanda farmers' interview responses to interview guide Questions B1 to B10 concerning research Sub-Question 1 show that these farmers have portions of land; the size of the land ranges from three-point five acres to five hectares, including the homestead, garden and fields (cropland). The entire village jointly owns the grazing land, so that is not recorded. All the interviewed farmers were satisfied with the size of the land they have since nobody complained about that.

While most farmers in Dzawanda village had acquired basic knowledge about farming, like those in the other four villages, there was a marked difference, with two participants holding diplomas in agriculture. As mentioned earlier, research participant SHFAD had 32 years of farming experience at the time of this research. This farmer was a trained soldier who had joined the Zimbabwe National Army at 18, and at the age of 22, he was deployed to the Zimbabwe National Army farm as an artisan for five years. The individual possesses vast knowledge and exposure to theoretical and practical agricultural knowledge and issues. He was later seconded to pursue agricultural training at the local agricultural college, Mupfure Vocational Training Centre, where he obtained a certificate and a Diploma in Agriculture. This farmer has garnered vast amounts of practical farming experience over years of serving in the army at the military farm.

While most of the crops and livestock at this site are like the other four research sites, there are some differences. Dzawanda village has groups of farmers working together on a project as teams or clubs. There is the above-mentioned piggery project and the garden project with tomato plants. The other active projects at the time of collecting data are the poultry project, where farmers collectively keep traditional chickens together and the

rabbit project. The piggery project has seven collaborators, the chicken project involves 12 farmers, the rabbit project has eight members, and the garden project has 15. This signifies the difference between Dzawanda village and the other villages. In terms of average earnings from agriculture, Dzawanda farmers are on the higher end, as they earn more than their counterparts from the other four sites on average. These farmers explained that they sold their products in various ways by reaching agreements with the buyers. These farmers invoice customers who do not buy in cash or use foreign currencies like Rands, Pula or US\$ due to inflationary pressure. The following was noted:

I am running a very productive piggery project as an individual and as a club with my colleagues. In the club, we are seven members and we pulled our resources together and came up with the project. The project is developing, and there have been challenges here and there, but with the help of our agricultural extension officer, we have managed thus far. Our collective target is to raise and slaughter 1000 pigs per year. [SHFZ]

Farmers have many challenges, we do not have lucrative markets for our products [...] the agrochemicals for controlling these pests and diseases are very expensive. [SHFAA]

I run two projects, a poultry project for income generating and a piggery project. It is quick money but requires some discipline. I am also a member of two community projects piggery and poultry projects. I brought community projects after retiring from the army four years ago. With my pension, I could kick-start my projects and the community projects, which I championed. There was no limit on the number of members. What it requires is your contribution of money and availability to perform the day-to-day duties required for the project. We take turns performing duties like feeding the chicken and cleaning. I have livestock for draught power, and manure, and in times of need cattle serve as capital, goats for meat, and milk selling to cover general everyday problems like paying school fees for children, for manure. I also have chickens for eggs, meat, manure, and selling for cash to address general household problems. [SHFAD]

Mobile phone ownership and the mobile agricultural applications and services used by smallholder farmers in Dzawanda village in Gokwe South Zimbabwe

This sub-section addresses information on the mobile phone ownership of the farmers in Dzawanda village and the mobile agricultural applications they are using. To achieve that, research Sub-Question 2, the interview guide Section C, Questions 1 to 12 were applied. This enabled the researcher to stimulate answers to this research sub-question. All respondents at Dzawanda village had Econet lines; one interviewee had two SIM cards, both for Econet, and one respondent had SIM cards for all three major telecommunication operators in Zimbabwe, i.e., Econet, NetOne and Telecel. While most respondents stated that Econet is the only available and reliable network in Gokwe, the farmer who owned three SIM cards justified his reason by stating that Econet was for using the *EcoCash* facility, NetOne was for voice calls and SMS messaging, and Telecel was for data

because it was cheaper compared to the other two networks. The farmers said NetOne was cheaper for calling and SMS than Econet and Telecel, while Telecel was cheaper on data than NetOne and Econet. Both *OneMoney* and *Telecash* had no supporting agencies for money and were not linked to any transacting operator at the time of the research. Of the other four participants, two had both Econet and NetOne SIM cards, and the other two farmers had one Econet line each.

All the research participants in Dzawanda village had smartphones; two farmers had all three varieties of handsets each, while the remaining four had two handsets each. Farmers in Dzawanda village used mobile phone technologies in performing agriculture-related activities, with extensive usage of the mobile phone in housekeeping agricultural activities and community projects. Interviewees in Dzawanda indicated that mobile phones were very useful since they were practising agricultural activities that were not common with many other farmers in the area. These farmers were using their mobile phones to call and for *WhatsApp* or SMS messaging in their community projects groups, sharing information and knowledge about piggery production, rabbit production, and crop and livestock parasites and diseases. Farmers also created *WhatsApp* community groups for sharing information. A farmer would take a photo or video of a sick animal and share it with other farmers and the agricultural extension officer, meaning quick feedback could be obtained from the agricultural extension officer. Farmers in Dzawanda village were spending more on mobile data than farmers in the other four (4) research sites.

On average, these farmers utilised *WhatsApp* and *Facebook* farming groups to participate in debates and share information. These farmers are constantly active on their mobile phones, probing for information, such that they usually spend an average of Z\$20-00 to Z\$25-00 per week on data. One farmer buys the smallest monthly data bundle of OneFusion for Z\$110-00. The farmers in this area indicated that they had used some of the mobile agricultural application services available in Zimbabwe. These farmers were actively using data bundles provided by the mobile telecommunication operators Econet Wireless, NetOne and Telecel to access applications. The applications in use were *EcoFarmer*, provided by Econet Wireless, and *Kurima Mari*, by German Agro (Welthungerhilfe). These farmers pointed out their challenges in using some mobile agricultural applications due to the cost involved in such usage. Without sufficient data, some mobile phone technologies are not accessible and usable. The perpetual absence

of certain network services in some regions makes it difficult for smallholder farmers because this compels them to use one service provider; hence, they have no choice. The *EcoFarmer* application is also not accessible via other mobile phone telecommunication companies because it is an application designed by Econet for its clients. This has a lock-in effect on the users as one is required to be a subscriber of Econet before they can use *EcoFarmer*. The following was recorded:

I have had a mobile phone for 23 years and I have had seven handsets along the way I use two Buddie [Econet] lines, not because it is the only operator with a network available in Gokwe, but because there is some sentimental value. I bought the first SIM card when one required selling a whole livestock beast to attain this line. It was around US\$200-00 but after the coming of the multi-currency phase in Zimbabwe the SIM card now costs less than US\$0.50. [SHFAB]

The current handsets cost US\$120-00 for smartphones and US\$23-00 for the feature phone. The applications you are talking about require farmers to be trained on how to use them. [SHFAD]

A farmer may take a photo or video of a sick animal and share it with other farmers and the agricultural extension officer, and instant feedback may then be obtained from the agricultural extension officer and another farmer. [SHFY]

It's good that we use these applications and they help us [...] I am an Ecofarmer and this is the way to go for farmers. [SHFAC]

The mobile phone technology applications for agriculture are very good, but I think there should be continuously updated with new content and information every day [...]. [...] now there are new evolving pests which are not curbed by mobile phone technology applications use. [...] We usually call the Agritex officer for solutions. [SHFY]

Factors affecting the adoption and sustainable use of the mobile phone by smallholder farmers in Dzawanda village

In this sub-section, the researcher addresses research Sub-Questions 3, 4, 5 and 6, and as what transpired in the other four villages, The constructs of this research's theoretical model were used to frame the questions that enabled uncovering data from the farmers and ascertaining which variables influence the use of mobile phones for agricultural applications. The participants in Dzawanda village stated that the cell phone was very valuable to them since it allowed them to acquire knowledge on piggeries, rabbit production and illnesses. The agricultural extension officer was also able to educate and teach farmers by using cell phones. The cell phone enabled exchanges between farmers and other value chain players. The farmers demonstrated how useful a mobile phone was in their agricultural operation. The agricultural extension officer stated that she planned to record voice/video instructions for farmers, demonstrating what they should do via her mobile phone and sending that to farmers via *WhatsApp*. In addition, these

farmers demonstrated how they do various calculations in their agricultural activities, including project budgets and expenditures, using mobile phone calculators. The agricultural extension officer receives calls from farmers seeking advice on urgent problems with crops, animals and animal diseases. The farmers also use their smartphones to tell time, alarms to wake them up early, and reminders because farming is exhausting, and farmers need to rise early to work on their broiler projects. The following was recorded:

In one device, it contains a clock, radio, bank, payment system, communication device, data storage device, and photo and video camera. [SHFAD]

Since I started using the mobile phone, my products are now fetching more revenue on the market because I always call different markets looking for better prices. Sometimes, the mobile phone has assisted me in making informed decisions and make loss minimising decisions. [SHFZ]

We get regular updates on what is happening with our pigs regularly. Members on duty record the state of affairs as they assume duty and update the group. At the end of their duty, they compile the prevailing state of the pigs and send them to the group. [SHFY]

The responses of the Dzawanda village farmers to the interview guide questions concerning research Sub-Question Four demonstrate that they have positive perceptions about the mobile phone as a useful device for their agricultural operations. Farmers asserted that their mobile phone user experience has caused their agricultural activities to blossom. They believed the mobile phone was capable of addressing most challenges farmers face regarding agricultural information. As agriculture is information-centric, information must be obtained in real time to be productively actionable. Mobile phones can facilitate real-time, context-specific, and geographical situational-specific actionable information to farmers. All other channels provide 'stale' information.

The perceived benefits of mobile phones by farmers in Dzawanda village include accessibility to current information on input prices and availability and produce market price. The farmers said the mobile phone could also facilitate increased interaction with their stakeholders in the value chain, as already happening with Cottco agents and market vendors. Before utilising the mobile phone (as earlier discussed), conveying messages from point to point was a costly and laborious exercise. Using the mobile phone has caused a huge reduction in the need to travel and the accompanying costs incurred. The mobile phone has also revolutionised lines and channels of communication,

making markets more accessible to farmers. The mobile phone is facilitating local market chains and enabling farmers to make informed decisions:

The proper use of the cell phone can see an improvement in smallholder farmers' coordination of procurement of inputs and marketing of products. [SHFY]

The mobile phone has assisted me in getting money from different clients while at home. Sometimes we engage with customers on Facebook or WhatsApp, where I sometimes ask customers to offer their buying prices. There can be a bidding war of some sort, which is beneficial to the farmer. [SHFAA]

No other gadget or medium can facilitate tailor-made information that is actionable. [SHFAC]

The interview guide responses concerning research Sub-Question Five obtained from Dzawanda revealed that farmers think telecommunication companies like Econet and NetOne should ensure the existence of telecommunication infrastructure, like base stations in rural areas, to ensure that the network is available. These telecommunication companies could also team up with mobile phone handset manufacturers like GTel, Samsung or other companies to devise handsets for farmers, such as designing a tailor-made mobile phone for farmers that cannot be used by any other person than the registered user in case of theft. Furthermore, such phones should be provided to farmers cost effectively at an affordable price to authenticated farmers.

Farmers believe that the government, through agricultural extension services, should inform them of the use of mobile phone applications in their agricultural activities and also broadcast all agricultural information, including on crops, inputs, pests, diseases and weather forecasts, to their mobile devices. The government should inform farmers about the functions and advantages of mobile phones for the long-term viability of agriculture. To connect farmers in their communication-intensive operations, telecommunications providers should establish infrastructure such as base stations in rural and isolated locations.

The farmers considered Gokwe South unique in its high percentage of mobile phone ownership. The main sociocultural issues affecting the acceptance, adoption and usage of mobile phones by everyone in society, including women, are now regarded outdated. Most of the farmers in Gokwe South have some level of formal education, and they range in age from late 30s to early 50s. Hence, they can be trained to use mobile phones for agriculture productively. Some of the issues raised are in tandem with those raised by the farmers from other sites. Thus, this researcher did not record such information. Some of the issues raised were expressed thus:

Many farmers are not digitally skilled; they are not prudent with the use of their mobile phones. **[SHFZ]**

The socioeconomic status of farmers is not as bad as farmers have mobile phones and they are using them already to make voice calls, send and receive messages, and send and receive money. **[SHFAB]**

If I was moving in the field and I spotted any pest I don't know or if I spotted a plant showing some signs and symptoms, I am not familiar with I would have to send children to the agricultural extension officer with the message. It would take two to three days for the officer to come. If that were to happen nowadays, the entire field would be a write-off. The proper use of the mobile phone can see an improvement in smallholder farmers' coordination of procurement of inputs and marketing of products. **[SHFAD]**