SACJ 36(2) December 2024
Research Article

Exploring adoption dynamics: Mobile technology in agricultural information dissemination among smallholder farmers in Gokwe South District, Zimbabwe

Samuel Musungwini[a], Izak van Zyl[b], Jan Kroeze[a]

[a] University of South Africa, School of Computing, Roodepoort, South Africa
[b] Cape Peninsula University of Technology, Centre for Postgraduate Studies, Cape Town, South Africa

ABSTRACT
There is a lack of acceptance, adoption and sustained use of mobile phones for agricultural purposes by smallholder farmers in Zimbabwe, but the reasons for this have not been critically explored. In this study, the authors used a naturalistic methodology to help uncover the nuances of adoption dynamics among smallholder farmers in Gokwe South District, Zimbabwe. Data was gathered from in-depth interviews and focus groups. The findings suggest that gender, age, land ownership size, farming experience, mobile device ownership, and the period of owning a mobile device are critical precursors to adoption and use. Furthermore, digital proficiency and literacy, affluence, mobile technology services cost and telecommunication infrastructure availability are vital in achieving continuous, sustainable use of mobile technology in the Zimbabwean agricultural sector. This research has practical implications for policy and practice and may inform national legislation encouraging the increased use and affordability of mobile devices in the local agricultural sector. The research also makes a theoretical contribution in terms of unpacking the key factors that inhibit the adoption of mobile technology in marginalised settings.

Keywords Mobile phones, Information and Communication Technology (ICT), smallholder farmers, information dissemination, adoption, Zimbabwe

Categories • **Human-centered computing** ∼ **Ubiquitous and mobile computing, Empirical studies in ubiquitous and mobile computing**

Email
Samuel Musungwini – musungwinis@staff.msu.ac.zw (CORRESPONDING)
Izak van Zyl – VanZylIz@cput.ac.za
Jan Kroeze – kroezjh@unisa.ac.za

Article history
Received: 22 May 2023
Accepted: 19 June 2024
Online: 11 December 2024

1 INTRODUCTION

Information and communication technologies (ICTs) have great potential to facilitate global socio-economic development, mainly in emerging economies, since the inception of the Mil-

Musungwini, S., van Zyl, I., and Kroeze, J. (2024). Exploring adoption dynamics: Mobile technology in agricultural information dissemination among smallholder farmers in Gokwe South District, Zimbabwe. *South African Computer Journal* 36(2), 124–158. https://doi.org/10.18489/sacj.v36i2.20003

SACJ is a publication of *SAICSIT*. ISSN 1015-7999 (print) ISSN 2313-7835 (online)

lennium Development Goals (MDGs) and subsequent development that ensued (Heeks, 2014). The successes achieved under the MDGs led to the conception of the United Nations 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs). The SDGs are an overarching framework premised on harnessing ICTs for sustainable development. The framework suggests that to create the world we envision, we must place the ICTs at the center of all socio-economic and development activities (Jones et al., 2017). In sub-Saharan Africa (SSA), mobile phone technologies are fashioning inimitable ways of communication and engagement among people from different social strata (Alnes, 2017). ICTs are a universal gateway to valuable public information and other essential basic services to the marginalised people in the Global South, as it is the only digital technology found in the hands of many people, including smallholder farmers. In particular, mobile phone technologies now straddle different socio-economic activities like agriculture (Awuor et al., 2019) and other areas of life (Porter et al., 2020). According to Dunjana et al. (2018), the significant role of agriculture in the Zimbabwean economy in the future will largely depend on the productivity of smallholder agriculture in Zimbabwe. Importantly, agriculture is an information-driven sector.

To boost the significance of agriculture as the primary source of livelihood for many people in the Zimbabwean economy, smallholder farmers need to benefit from information on complementary services in real time. Research has constantly linked mobile phones with development prospects in the developing world (Quandt et al., 2020). Mobile phones can afford smallholder farmers an avenue to obtain novel actionable agricultural information, input prices, and agricultural product market prices in real-time, as reported in the literature (Heeks & Ospina, 2019; Quandt et al., 2020). However, in the last five years, a large body of research has documented the low adoption and usage levels of mobile technologies for agricultural purposes (Issahaku et al., 2018; Musungwini, 2018; Van Greunen & Fosu, 2022; Wyche & Steinfield, 2016). Indeed, information and communication technology for development (ICT4D) is founded on comprehending ICTs' contributory role in the development process in any socio-economic area of life (Msendema & Nyirenda, 2019).

This paper attempts to broaden the understanding of adoption dynamics among smallholder farmers in Zimbabwe. This understanding may lead to crafting recommendations that may result in many smallholder farmers in Zimbabwe fully adopting mobile phones in their agricultural information dissemination activities. Research by Quandt et al. (2020), Lokeswari (2016), and Barakabitze et al. (2017) finds that even though mobile phones are widespread among the populace, including marginalised smallholder farmers, there is a lack of acceptance, adoption, and sustained usage by adopters. Hence, there has been a subsequent failure to scale up adoption and usage to non-adopters among smallholder farmers for agricultural purposes in SSA, including Zimbabwe. Studies have demonstrated that technology cannot impact any socio-economic activity until it has been adopted and used effectively by the intended beneficiaries (Barakabitze et al., 2017; Musungwini et al., 2023). Therefore, it remains challenging to offer crucial recommendations to address Zimbabwe's adoption, acceptance, and usage issues unless the country's context-specific elements hindering their adoption

and usage are established.

1.1 Theoretical development

Many studies on mobile phones and smallholder agriculture have compared adoption to non-adoption; hence, they are dichotomous in nature (Emeana et al., 2020; Issahaku et al., 2018; Kikulwe et al., 2014; Masuka et al., 2016; Palmer, 2012). There is, however, a need to explore the dynamic and subjective reasons behind non- or ill-adoption for agricultural purposes. According to Whetten (1989), theoretical advancement aims not to reproduce the same phenomena but to look for new knowledge that could amend current knowledge with sound reasoning. This study aims to explore smallholder farmers' adoption of mobile phones in their agricultural activities, which required the creation of a conceptual framework to serve as a roadmap for gathering and analysing data. Developing such a (fluid) conceptual framework aligns with Mishra et al. (2021), who suggested that rigidly applying pre-existing theories might limit researchers' ability to find novel, context-specific elements. Because of this, researchers may need to go beyond the traditional adoption theories and the broad theoretical frameworks commonly employed in IS research to uncover new information.

To achieve this endeavour, they could use exploratory, inductive approaches. However, the application of a conceptual framework is aligned with deductive studies, as a result, it followed that this research applied an abductive approach to satisfy the bottom-up data analysis. Abduction is the process of coming up with novel theories, conceptions, and explanations based on the discovery of unexpected events, data, or phenomena that do not conform to explanations provided by prior knowledge (Kennedy & Thornberg, 2017). This approach is particularly valuable in fields where established theories may be insufficient like in this research or where the research aims to explore uncharted territories (Timmermans & Tavory, 2012). This enabled researchers to develop a more nuanced and contextual understanding of the non-adoption of mobile phones for agricultural purposes by smallholder farmers (Cronholm et al., 2023).

Accordingly, in this research, an eclectic model was developed from the critical tenets of adoption models like the technology acceptance model (TAM) (Yousafzai et al., 2007), theory of reasoned action (TRA) (Loken, 1983), theory of planned behaviour (TPB) (Weigel et al., 2014) and diffusion of innovation theory (DOI) (Rogers et al., 2019). The researchers designed a nine-construct eclectic model to provide research boundaries and assist in formulating research questions. The model constructs are as follows: 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). Figure 1 depicts the eclectic model.

https://doi.org/10.18489/sacj.v36i2.20003

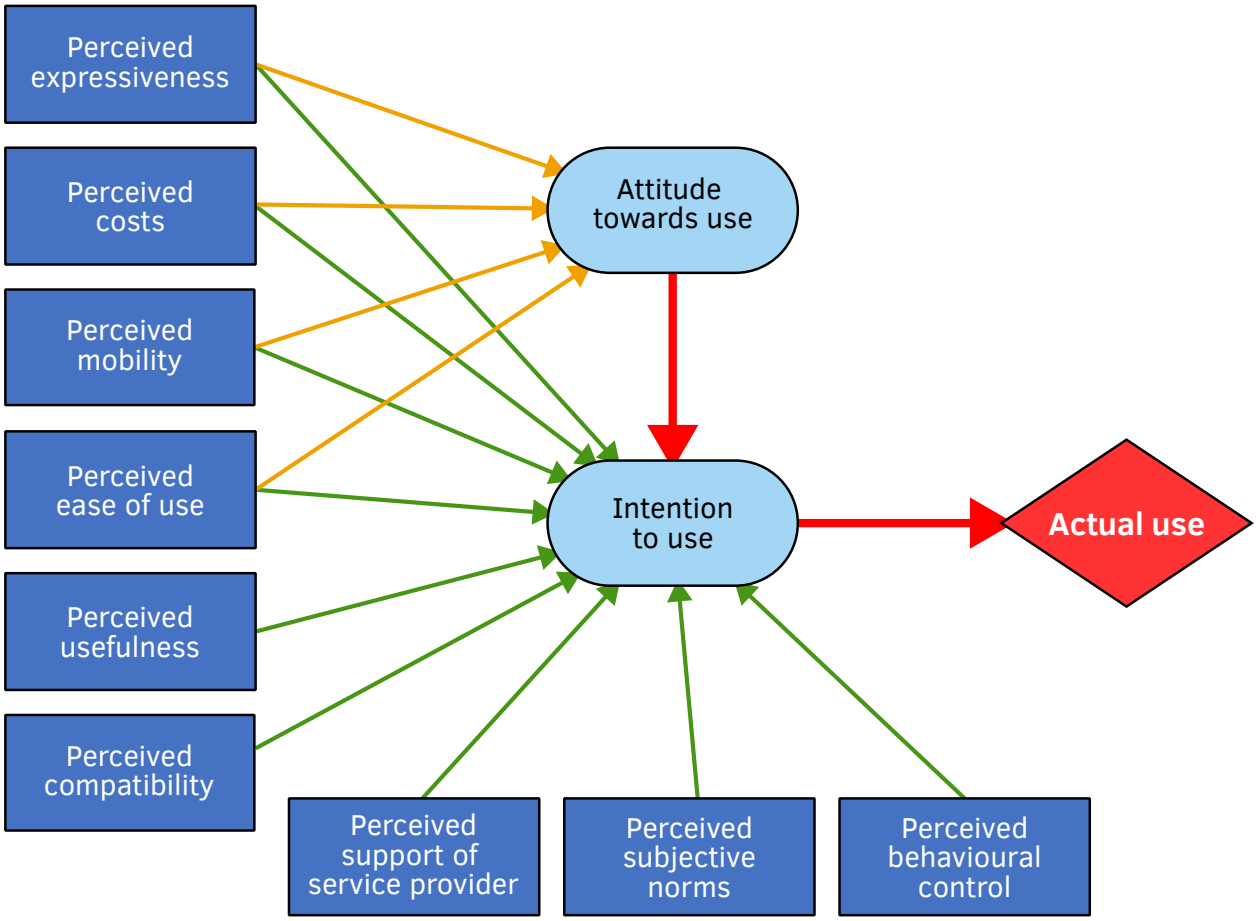

Figure 1: The eclectic model guiding this research (authors' construction).

As stated by Whetten (1989), four main objectives of theory have been identified, which include a theory of analysing and describing, which offers a description of an investigation of the linkages between those concepts and the degree of generalisability in the associations and concepts, the boundaries that hold linkages and discoveries, and the analysis of a phenomenon of interest. The theory of explanation uses different theories of causation and reasoning techniques to explain why and how something happens; hence, the research uses the constructs of the eclectic model to describe the non-adoption of mobile phones by smallholder farmers. Usually, this explanation aims to encourage others to gain deeper comprehension or new perspectives on the phenomenon of interest.

1.2 Research connection to national and international development agendas

This research directly addresses three SDGs, namely SDG1: *"End poverty in all its forms everywhere in the world"*, SDG2: *"End hunger, achieve food security and improved nutrition and promote*

sustainable agriculture", and SDG3: *"Ensure healthy lives and promote well-being for all at all ages."* Agriculture is an information-intensive sector, and various studies like Gregor (2006), Etwire et al. (2017), Freeman and Mubichi (2017), Krell et al. (2020), Isaya et al. (2018), and Musungwini (2016) have shown that ICTs may play a pivotal role in transmitting and transferring agricultural knowledge. The SDG goals are also in sync with the African Union's Agenda 2063, adopted in January 2015 at the 24th Ordinary Assembly of the Heads of State and Governments of the continental body in Addis Ababa, Ethiopia (Dunjana et al., 2018; Ndizera & Muzee, 2018; Oguntuase, 2021). It is a twenty-goal continental strategic blueprint for transmuting Africa into a global powerhouse by 2063.

The research is also directly in line with Agenda 2063, Goal 1: *A high standard of living, quality of life, and well-being for all citizens*; Goal 3: *Healthy and well-nourished citizens*; Goal 4: *Transformed economies*; and Goal 5: *Modern agriculture for increased productivity and production* (Quandt et al., 2020). The government of Zimbabwe also developed its national strategic plan titled Vision 2030 and the National Development Strategy 1 (NDS1) to enhance Zimbabwe's food self-sufficiency status (Government of Zimbabwe, 2020). The macroeconomic measures crafted under this strategy also aim to raise smallholder farmers' agricultural output and productivity, among other things, provide adequate nutrition and food for their families, higher earnings, an increased likelihood for value addition, and the creation of value chains for the agro-business industry (Heeks & Ospina, 2019). Table 1 links the SDGs, Agenda 2063, and Zimbabwe's national development strategic plan [Vision 2030].

Table 1: The alignment between the United Nations Sustainable Development Goals 1, 2, and 3, the African Union's Agenda 2063 Goals 1, 3, and 5, and the Zimbabwe national development strategy [Vision 2030].

United Nations Sustainable Development Goals	**African Union's Agenda 2063**	**Zimbabwe's Vision 2030**
SDG1: End poverty in all its forms everywhere in the world.	*Goal 1*: A high standard of living, quality of life, and well-being for all citizens.	The objective is to improve food self-sufficiency and retain the country's regional breadbasket status. It seeks to increase self-sufficiency from the top 100% and reduce food insecurity from 59% in 2020 to less than 10% by 2025.
SDG2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	*Goal 5*: Modern agriculture for increased productivity and production.	
SDG3: Ensure healthy lives and promote well-being for all at all ages.	*Goal 3*: Healthy and well-nourished citizens.	

2 RESEARCH QUESTIONS

The key research questions in this enquiry are stated as follows:

a) *Why are most smallholder farmers in Zimbabwe not effectively using mobile phones for their agricultural activities when they successfully use them daily?*

b) *What can be done to ensure that smallholder farmers in Zimbabwe can adopt and use mobile phone technologies in their agricultural activities effectively?*

To achieve the research aim, the researchers began by exploring literature to establish why many smallholder farmers in Zimbabwe are not productively using mobile phone technologies in their agricultural information-seeking and sharing activities. The research started with a literature review of articles on Google Scholar covering mobile phone acceptance, adoption, and ultimate usage by smallholder farmers in the developing world. Priority was given to articles on mobile phones and smallholder agriculture in developing countries, especially SSA. After establishing the reasons why most smallholder farmers in Zimbabwe are not fully utilising their mobile phone technologies in their agricultural activities, the research makes suggestions that may be implemented to improve the acceptance, adoption, and eventual usage of mobile phone technologies for agricultural information-seeking and sharing by smallholder farmers in Zimbabwe. The first author then collected empirical data using 16 individual semi-structured interviews with smallholder farmers at farmers' markets in Zimbabwe and a ten-member focus group discussion (FGD) with several stakeholders in the agricultural value chain. The following section looks at the background and context of the study.

3 BACKGROUND AND CONTEXT

Agriculture has historically been a vital sector in the Zimbabwean economy, and due to its vibrance, the country was once lauded as the breadbasket of Africa, dating back to colonial times (Moyo, 2000). So vital is agriculture to the Zimbabwean economy that its current sorry state has a ripple effect across many areas of the country's economy. However, the Fast Track Land Reform Program (FTLRP) of the year 2000 marked a radical change in Zimbabwe's agricultural landscape as agricultural land was transferred from approximately 4 500 white commercial farmers to 130 000 smallholder farmers (Shonhe, 2019). The sudden transfer of land had a detrimental effect on the agricultural and economic fortunes of the country as this faced resistance from the commercial farmers and attracted strong opposition from the international economic powerhouses (USA, UK, among others), as posited by Mazwi et al. (2019). This conflict culminated in the departure of private financial support from financial institutions, resulting in underproduction as crop output significantly declined (Cliffe et al., 2011). This decline continued such that, in comparison with 1990s production levels, maize production had decreased by 65.8%, while wheat had declined by 69.8%, minor grains by 44.2%,

https://doi.org/10.18489/sacj.v36i2.20003

and tobacco output had reduced by 64.7% by the 2007–2008 agricultural season as reported by Moyo (2011).

However, over the years, the government has introduced a raft of heterodox economic and agricultural policy measures like the Command Agriculture Policy, which required farmers to be registered under the scheme and get provided with inputs but were compelled to sell the produce to the grain marketing board (GMB) (Mhaka & Runganga, 2023). The output has remained low, and one of the critical issues cited is the sustainability of these programs. The GMB has been accused of taking time to pay farmers, paying them low prices and, in some cases, below the cost of production. The rapid decline has continued, and as the evolving climate change has introduced frequent droughts in recent years, the agricultural sector has continued to be underproductive. As a result, smallholder farmers in Zimbabwe have remained very poor, and their agricultural production is unsustainable (Tatsvarei et al., 2018). In this context, digital information-seeking in agriculture has become vital.

Smallholder farmers in emerging economies, especially SSA, typically experience the same kinds of issues apart from contextual factors that may be country-specific. ICTs are critical to the socio-economic revolution in SSA and other developing regions. These nations' gross domestic product (GDP) is boosted due to this development. Because of the adoption of mobile technologies (among others), poverty can be eradicated, rural livelihoods – especially smallholder agriculture – can be strengthened, and overall citizen welfare can be raised in any given nation as reported in research by Msendema and Nyirenda (2019), Freeman and Mubichi (2017), Mthoko and Khene (2017), Nyajeka and Duncombe (2022), Govender (2023), and Musungwini et al. (2022), among others. Communication is a precursor to human development, and thus, it is vital to have an efficient information flow for agricultural productivity and improved food security in the developing world, as reported by Tongia and Subrahmanian (2006).

Thus, smallholder farmers must have access to all novel and ground-breaking context-specific agricultural research information relevant to their localities. More smallholder farmers now own mobile phones thanks to Zimbabwe's increasing mobile phone penetration rate, culminating in the falling prices of mobile handsets and the abundant availability of subscriber identity module (SIM) cards (Kemp, 2021). Smallholder farmers in the developing world, especially SSA, provide the bulk of the foodstuffs in their countries, and agriculture is the backbone of those nations' economies. These farmers make up a higher proportion of the population in developing nations, making them crucial (Bisht et al., 2020). Increased access to the most recent agricultural knowledge provides a chance for the growth of smallholder agriculture. In Zimbabwe, a developing country, the mobile phone is the ICT variant in the hands of almost everyone, including marginalised communities like smallholder farmers. Still, its use is intermittent, erratic and flawed.

https://doi.org/10.18489/sacj.v36i2.20003

4 LITERATURE REVIEW

The focus of the literature review is on the acceptance, usage and constraints of mobile phone technology among smallholder farmers in SSA in their agricultural information dissemination and sharing activities.

4.1 Characteristics, challenges and information needs of smallholder farmers

Smallholder farmers mainly grow crops for subsistence purposes. However, research has shown that some have progressed to the extent that they can now grow cash crops but practically rely on family labour. They characteristically have minimal land to farm, do not have entitlement to that land and have limited access to capital, are highly exposed to risk and input technologies, and have limited market orientation (Etwire et al., 2017; Gregor, 2006). Research by Mthoko and Khene (2017) established several characteristics of smallholder farmers in developing nations. Most of these smallholder farmer traits hinder the development of their agriculture outcomes.

Contrary to their counterparts in the developed world, smallholder farmers are among the most marginalised and vulnerable people in the Global South (Kirsten & Van Zyl, 1998; Nkomoki et al., 2019; Van Zyl et al., 2014). Three-quarters of malnourished children found in SSA's rural areas belong to smallholder farmers (Krell et al., 2020). Despite this poverty-stricken tag, smallholder farmers in the developing world have a crucial role in attaining food security and driving agricultural growth to reduce poverty in their nations and on the continent. Studies such as Masuka et al. (2016), Ayanwale et al. (2013), and Kwapong et al. (2020) show that smallholder farmers seem to be more effective and resilient when they have improved access to information, valuable technologies, appropriate marketplaces, reasonable loans, good prices and insurance facilities.

The significant variance in information preferences among rural smallholder farmers can be ascribed to differences in agricultural operations and geographical location. Such variance results in disparities in information demands; however, information needs are generally similar since they revolve around weather, animal and crop farming, pest and disease management, and agricultural markets for agricultural output (Isaya et al., 2018). Researchers have determined that adequately addressing these smallholder farmers' informational demand is essential to the long-term sustainability of smallholder farming across developing nations. There have been calls to solve the looming food crises caused by the growing world population, and smallholder farmers are essential in this matrix.

https://doi.org/10.18489/sacj.v36i2.20003

4.2 Factors affecting mobile phone adoption and use in smallholder agriculture

According to research by Abraham and Pingali (2020) and Masimba et al. (2019), mobile technology adoption by smallholder farmers offers a basis for improving agricultural performance and the potential to achieve SDGs. Adoption strengthens farmer operations and activities and facilitates information dissemination in the field (Batchelor et al., 2014; Kabbiri et al., 2018; Mwantimwa, 2019). However, research has also shown that perceptual issues like usefulness and ease of use significantly impact users' adoption of mobile technology (Barakabitze et al., 2017; Emeana et al., 2020; Wyche & Steinfield, 2016). For this reason, smallholder farmers' perspectives of the role played by mobile phone technology in agricultural activities and the possible benefits perceived should be investigated.

A study by Quandt et al. (2020) established that factors like duration of ownership and digital competency level play a significant role in mobile phone acceptance, adoption and use in agriculture. This finding suggests that farmers who have had a mobile phone for a substantial amount of time are naturally better equipped to operate the device in other activities such as making voice calls, SMS messaging, and internet and other related applications. According to research by Ayim et al. (2022), Kacharo et al. (2018), and Eagle and Saleh (2020), socio-demographic variables also affect farmers' adoption and use of mobile technology to acquire agricultural information on climate and weather conditions, as well as adoption measures. Socio-demographic traits such as age, gender, marital status, family size, size of land held, level of farming experience and ownership of mobile phones are essential to their use of mobile technologies in agriculture. The studies above show that young, married, land-owning male farmers with sufficient farming experience and who own a mobile device are likelier to adopt and use their mobile phone technologies for farming.

Ultimately, ICT4D research attempts to establish the role of ICTs and associated technologies in the development process (Noruwana et al., 2018). ICT4D is premised on harnessing ICTs in poverty eradication, socioeconomic development, human rights and international development, among other domains. That is why policymakers, academia, non-governmental organisations (NGOs), politicians and government agencies have all developed a particular interest in the issue of smallholder farmers' successful acceptance and actual usage of mobile phone technology in agriculture in recent years, at least theoretically. However, in various regions of the globe, ICT4D policies have been developed and implemented, with variable results. What works in one instance does not necessarily work in another.

Theoretical attempts to comprehend local contexts have been at the heart of the challenge. However, studies agree that technology adoption and continual optimal usage occur rapidly and extensively when there is a reasonable knowledge of causal, local and circumstantial factors. Therefore, if ICTs are conceptualised, established and deployed in locally meaningful ways, and if the users embrace them, these ICTs can afford a platform for fostering development agendas in scalable, sustainable and long-term ways.

https://doi.org/10.18489/sacj.v36i2.20003

5 METHODOLOGY

The researchers employed a qualitative approach to explore the challenges confronting smallholder farmers in their quest to adopt mobile phones for agricultural purposes, as posited by Merriam and Grenier (2019). Most technology adoption research like Van Greunen and Fosu (2022), Masuka et al. (2016), Mwantimwa (2019), Kabbiri et al. (2018) and Kacharo et al. (2018) have used quantitative methods, mainly structured surveys. Qualitative research methodology is highly valued when researching the complexities of human behaviour. The research is premised on a 'why' question, typical of qualitative research. Hence a naturalistic methodology has been adopted in the study to help illuminate some key nuances about the mobile phone adoption dynamics among smallholder farmers. The second research question is a what question but builds on the first question. Hence, the qualitative research approach enabled the researchers to explore the participants' underlying motivations, values and beliefs. This research requires cross-sectional data as it explores smallholder farmers' perspectives on the acceptability, adoption and usage of mobile phone technologies across the spectrum rather than their impressions throughout time.

The research study's internal validity is reinforced when the interview guide and focus group discussion guide closely match the constructs and relationships described in the conceptual framework. This alignment guarantees that the techniques for gathering data are intended to gather pertinent information required to answer the research questions and evaluate the suggested theoretical connections. The researchers guaranteed the internal validity of the study by ensuring that the data gathered appropriately represents the theoretical concepts under investigation by creating questions and probes that directly map to the major constructs, see Section C of the interview guide (Appendix A) and Section B of the focus group discussion guide (Appendix B).

Data was mainly collected from smallholder farmers, while agricultural extension service staff and other vital informants in the value chain were also chosen as relevant populations. All 16 interviewees were smallholder farmers and the focus group participants included smallholder farmers, agricultural extension officers and other key stakeholders in the agriculture value chain. Participants were purposefully chosen to meet a variety of variables like their age, gender, level of education, family size, and farming experience to ensure a representative sample. Focus groups allow participants to build on each other's ideas. They can lead to more discussion than individual interviews since they allow for greater closeness and depth of information (Krueger & Casey, 2014). Participants may feel more at ease in a focus group. Still, it may be preferable to conduct individual interviews if the subject matter is sensitive (such as poverty or a lack of understanding of mobile phone use). Focus groups and interviews produce data with the same level of detail. This research used 16 interviews and one focus group to complement one another and ensure that multiple data sets were gathered. The focus group discussion was necessary to validate and amend the data obtained from the 16 individual interviews, thus leading to data saturation.

Observations were carried out in the three markets before the interviews were carried out. These markets have different capacities and clientele. Mbare Farmers' Market, located in Harare is the biggest and most active market in Zimbabwe. Kombayi Farmers' Market is located in Gweru, the third largest city, while the Gokwe Farmers' Market is more of a local market for the Gokwe South District. The first author observed smallholder farmers in the early morning hours as they interacted naturally with vendors in buying and selling agricultural products at each farmers' market (Armstrong, 2010). Naturalistic observation was applied in the initial observation at each market. However, as observation was a continuous process, participant observation ensued – as the first author carried out interviews, he also continued to observe the actions, activities and interactions. Seven participants were purposefully selected at the Mbare farmers' marketplace, five were chosen at the Kombayi farmers' marketplace, and four were selected at the Gokwe South District farmers' marketplace. Farmers were very busy, and some could not agree to set aside up to 40 minutes of their time for the interview as the interviews ranged from 27 minutes to 40 minutes in duration. The data from the 16 in-depth interviews, bolstered with the ten-member focus group discussion, provided valuable information for our research.

The interview participants were given code identities as Smallholder Farmer Number SHF [1-16] for anonymity purposes (Saunders et al., 2015). The 16 interviewees were rich cases; hence, they became critical informants as they possessed vital traits that the researchers desired for this study (Dworkin, 2012). Our sample number falls within the range of sample populations (15 to 25) in line with Marshall et al. (2013), Sandelowski (1995), and Vasileiou et al. (2018) and has been used by most previous researchers; see Kirsten and Van Zyl (1998), Nkomoki et al. (2019), and Van Zyl et al. (2014). The focus group discussion participants were given code identities as Focus Group Discussion Participant Number FGDP[1-10] for anonymity purposes. The details of participants to the FGD are shown in Table 2, summarising their life responsibilities, gender and the number of years that each has owned a mobile phone.

Table 2: Focus group discussion participants

Participant	Code	Mobile phone	Type of handset	Gender	Period of mobile phone ownership
Cotton Company of Zimbabwe representative for the Gokwe South District area	FGDP1	Yes	Smartphone	Female	8
Smallholder farmer	FGDP2	Yes	Smartphone	Male	11
Smallholder farmer	FGDP3	Yes	Smartphone	Male	10
Agricultural extension services officer	FGDP4	Yes	Smartphone	Female	7
Agricultural extension services officer	FGDP5	Yes	Smartphone	Female	6
Net One representative at Gokwe South District centre	FGDP6	Yes	Smartphone	Female	5
Econet representative at Gokwe South District centre	FGDP7	Yes	Smartphone	Male	9
Village head 1	FGDP8	Yes	Smartphone	Male	12
Village head 2	FGDP9	Yes	Smartphone	Male	15
eMkambo employee	FGDP10	Yes	Smartphone	Male	7

https://doi.org/10.18489/sacj.v36i2.20003

Qualitative methods enabled the researchers to explore the complexities of smallholder farmers and the social and cultural reasons that stimulate their adoption and use of mobile phones (Erlingsson & Brysiewicz, 2013). A qualitative approach is anchored on an inductive technique, and thematic patterns emerge from the data as a precondition for the study to align with the recommendations (Williams, 2000). However, this research applied an abductive technique as it fused tenets of deductive and inductive reasoning.

The transcription and coding process of the FGD and interview data resulted in coded data grouped according to the collective factors unveiled among FGD participants and interview participants. The data analysis approach, rooted in a bottom-up or abductive methodology, aimed to capture the nuanced perspectives of smallholder farmers regarding their adoption and use of mobile technologies in agricultural activities. The researchers followed the process for thematic analysis outlined by Braun and Clarke (2006). This involved familiarisation with the data corpus, categorisation and generation of initial codes, pattern identification, and critical theme evaluation and refinement. The researchers finally developed a thematic table to categorise and illustrate the relationships between themes and their associated codes, clearly representing the findings.

6 FINDINGS

Observational studies were carried out in the three markets before the interviews in this study. The first author observed smallholder farmers interacting with vendors without interference or manipulation at each farmers' market. The goal of this process was to gain an understanding of the relationships and interactions between smallholder farmers and vendors without directly manipulating them. Demographic data, such as the educational background of research participants, was used to evaluate the overall literacy level and gauge the potential knowledge level of participants when analysing the findings. The researchers wanted the smallholder farmers' overall farming experience to provide perspective into farmers' tenure as crucial because experience is a key factor influencing the acquisition of technological developments.

Of the 16 research participants chosen for the interview, nine were male, and the other seven were female, making 56.3% male and 43.7% female participants. Participants were between the ages of 38 and 54 at the time of the empirical fieldwork. The first author interviewed farmers with agricultural experience ranging from ten to more than 20 years at farmers' markets. Farmers in this study had a high degree of basic literacy as they had all completed at least an ordinary level of education schooling. Most children go through two years of early childhood learning after age four. They enrol in primary education for seven years at age six, culminating in a Grade 7 Certificate. At 13, the learners enrol in secondary education, which lasts six years and consists of lower and upper secondary education. The lower secondary educational level is the Ordinary (O) level, taking a four-year cycle (from Form 1 to Form 4), which leads to the awarding of the 'O' Level Certificate of which one is required to have attained an A, B or C symbol in at least five subjects including English language and Mathematics for one to be awarded a complete 'O' level certificate.

https://doi.org/10.18489/sacj.v36i2.20003

However, it was not within the scope of this study to determine whether these participants had completed and passed the 'O' level examination. A high school education is sufficient for someone to read, write and comprehend things, which is necessary for a mobile phone to be used competently. Figure 2 summarises demographic profile data for the research interviewees in this research.

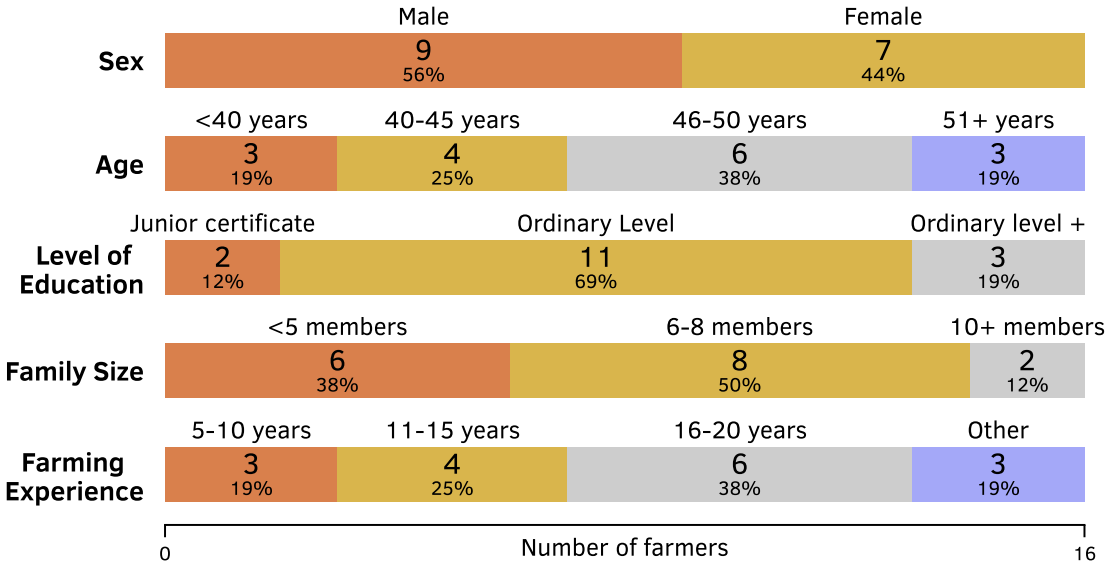

Figure 2: Summary of demographic data of interviewed smallholder farmers

Focus group participants boast a great deal of experience using mobile phone technologies. They are all directly involved in smallholder agriculture, as some were established smallholder farmers. General findings indicate that farmers mainly produce field crops, followed by horticulture, livestock, and poultry. The crops vary, but there is a convergence on cereals, with maize being identified as the major product because it is the primary food source for most Zimbabweans.

Smallholder farmers face myriad challenges in carrying out their agricultural activities, including lack of capital, high costs of inputs, late delivery of inputs from the government, drought, pests and diseases and lack of lucrative markets for their produce. Rudimentary and uncoordinated infrastructure like roads and bridges result in steep transport costs. Several measures proposed include delivering government input schemes on time, contract farming partnerships between organisations like the Cotton Company of Zimbabwe and farmers, input loan schemes and cattle loan schemes. Suggestions also included organising farmers into groups and providing them with loans for farming supplies or cattle collectively, rather than individually. FGD participants indicated that while agricultural extension service officers are mandated to supply all agricultural information and knowledge to smallholder farmers in their areas of supervision, it is now practically difficult for these officers because they are now limited by the lack of resources, such as motorbikes, for use in their everyday operations. How-

ever, these general findings are not directly relevant to our research question. The following sections present more nuanced findings relating to our research questions.

6.1 Factors having an impact on the acceptance, adoption, and sustainable use of mobile phones by smallholder farmers

According to research participants, using mobile phone technologies for agricultural information dissemination is very beneficial to farmers. Farmers demonstrated that they obtain meteorological information through their mobile phones in part. Some farmers indicated that they call or message (SMS or WhatsApp) their customers and arrange for them to pick up their items, which are delivered by buses to different towns. Some farmers band together and create a club, taking turns accompanying their products to marketplaces. Some farmers have developed ties with many vendors in various marketplaces, and they constantly enquire about prices before deciding to sell to specific markets. The research suggests that deciding which market to sell their products in will be based on comparing pricing in the various markets. One interviewee at the Mbare Farmers' Market had this to say:

> *I am from Mutoko village and have been a farmer for the past 23 years. My phone was purchased in 2003. I am on my sixth phone, a Smartphone … I switch between Econet and Net One lines [SIM cards]. [Econet] Buddy Econet is quite helpful since I get money from several customers via Ecocash … I brought several things from my club members for their consumers. Customers arrived, got their products, and then contacted farmers from my area to confirm receipt of goods. Depending on their arrangement with the farmers, some merchants will transfer the money to the farmers' phones via Ecocash, while others will hand me the cash.* [SHF3]

Other farmers interviewed at farmers' markets confirmed this. The interviewees utilised their mobile phones to call/WhatsApp/SMS the various markets at various times, and some joined WhatsApp groups with farmers and merchants as members. They talk about anything related to agricultural produce and pricing. Farmers demonstrate that mobile phones are assisting them because after calling different markets, they discover slight variations in prices in different markets; however, considering all factors, such as transportation costs and inconveniences, as well as the time spent travelling, they often settle for markets close to them. Another interviewee had this to say:

> *In my farming routines, I rely heavily on my cell phone, which is highly handy for exchanging agricultural information with other farmers and traders. Econet is more beneficial for me since the other networks are not available in Gokwe.* [SHF2]

Another interviewee weighed in on this:

> *Buddie is a treasurable asset for the transfer of money from clients via Ecocash. The Smartphone cost me US$150, and the feature phone cost me US$25. I buy data for Z$10 per*

week (Z$40 per month) for my Buddie and Z$10 for my NetOne for phone calls and SMS. [SHF6]

According to the respondents, high internet costs, voice calling, and handsets influence their intentions to use mobile phones. Except for four smallholder farmers questioned at the Gokwe South District Market, 12 farmers interviewed in Mbare and Kombayi farmers' markets possessed smartphones. Although there was much talk about most farmers buying used smartphones, three demonstrated that they purchased their mobile phones as new. Farmers interviewed at Gokwe market claimed they could not afford a smartphone because the costs were too exorbitant compared to their earnings from their produce, which were already low given their obligations to provide for their large families. The respondents demonstrated that they could use mobile phones and found them highly beneficial.

My phone helps me a lot … but acquiring it was difficult … I bought this smartphone by chance, and it was pre-used. I am not knowledgeable about using it as well. It requires data to be more useful, but it is very expensive to buy data. [SHF12]

Another farmer had this to say:

However, to make my data last longer, I disable all other programs from updating and checking WhatsApp messages as frequently as possible, but I must turn off the data connection for it to last longer. [SHF7]

According to the women farmers interviewed, society has no prejudice about their usage. The farmers showed that mobile phones are very compatible with their activities as they move around; when they receive new valuable information when travelling to other places, they change their destination. However, the farmers indicated that not all smallholder farmers use mobile phone technologies in their everyday agricultural activities for various reasons. Some reasons include the erratic network, which results in most farmers facing network blackouts in their areas or when travelling, thereby missing some crucial messages. Some missed messages would contain crucial actionable information, which they would have failed to take. Rural farmers typically only have access to the Econet network in the rural areas where they originate from, which limits their options for network subscriptions. Mobile phone handsets are a challenge for most farmers. Still, the major challenge is a low level of technical know-how among most farmers, and this limits their inclination to acquire (new) mobile phones.

In Zimbabwe, a sizeable segment of the populace, especially the disadvantaged, owns a mobile phone. Nevertheless, the challenge was using phones for agricultural purposes. Mobile phones can deliver actionable, ground-breaking, and context-specific information to farmers in actual time. This can reduce arbitrages as farmers communicate in real-time, saving them time and energy and consequently boosting production. FGDP1 had this to say:

I feel that the mobile phone is 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. Cottco occasionally provides information to cotton farmers … it is not as frequent.

Mobile phones enable farmers to access services, lucrative agricultural markets for their produce, and nascent farming technologies.

> *I am using a smartphone, but the cost of data is very high for a farmer. My sister in Botswana bought the phone for me. The mobile phone is handy in the work of a farmer because the market for farm produce is very volatile, and the prices can change in any instance. 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.* [SHF14]

Participants in the FGD agreed as a group that Gokwe South District had a high percentage of mobile phone penetration 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.*

Not every farmer has a mobile phone, but almost every household has at least some kind of mobile phone. Some households have two or more mobile phones. Other households have a smartphone, while most households have feature phones. The FGD also pointed out that farmers may have a SIM but no handset in some situations. These farmers usually seek to use their colleagues' handsets. FGD participants indicated that a few farmers get information on agricultural issues through their mobile phones, and FGDP7 pointed out:

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

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

> *… all agriculture information about crops, inputs, pests, and diseases, whether broadcasted on the radio … but it is general and not geographically specific and not actionable by farmers. … Agricultural extension officers are always on the ground relaying any critical and groundbreaking information to farmers. … if [I] get anything critical that should be communicated to farmers, even if it is broadcasted on the radio. It is my responsibility to ensure that the information has reached all farmers in the area which 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. Most households have mobile phones and I have their 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]

Some farmers receive agricultural information, especially from the agricultural extension officers, using their mobile phones, but very few directly access, enquire or search for information for themselves. FGDP4 said this:

> *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.*

Base station infrastructure is lacking, which causes the availability of the network to fluctuate as pointed out by FGDP7: *"Infrastructure is a real challenge and I agree"*. The proliferation of cheap, poorly manufactured nameless handsets of poor quality is problematic as these phones malfunction in a brief period after their acquisition. As one participant suggested:

> *Farmers are also exposed to 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 steep price of authentic mobile devices 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 Econet is found in many places.*

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 *"education and training of farmers are critical."* POTRAZ, which is 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 must be trained about any mobile phone agricultural service. They should teach farmers as they greatly influence the farmers; farmers listen to them and have hero worship for them.

> *The mobile 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 know.* [FGDP5]

The research participants highlighted the need for smallholder farmers to be trained and empowered on effective ways of using mobile phone applications in agriculture.

> *The agriculture department should disseminate all agricultural information about crops, inputs, pests and diseases, and the weather by broadcasting through mobile phones.* [FGDP9]

Econet has embarked on an exercise to push the adoption of its mobile phone service called EcoFarmer through its network of agents, where all EcoCash agents in farming areas encourage farmers to register on the EcoFarmer platform. It then involves the farmers in some promotional activities where they win prizes.

> *… They are also given promotional regalia … We have just registered farmers in Gokwe, and I think bit by bit we will get there with the support of other stakeholders like agricultural extension and chiefs and village headman we will get there.* [FGDP7]

An organisation like Econet could also look at its capacity and develop contingent measures for farmers' handsets, contracting a vendor to supply mobile phones for farmers at concessionary rates.

The researchers tabulated the themes that emerged from the in-depth interviews and FGD data with thematic information on the prospects of mobile phone technology, the challenges associated with using it, and possible solutions. Table 3 presents the thematic analysis data from the 16 individual interviews and the focus group discussion.

Table 3: Thematic analysis of mobile phone capabilities, challenges faced by smallholder farmers using them for agriculture and proposed solutions.

Statement	Codes	Themes
- I feel that the mobile phone is very useful in the everyday life of a farmer as agriculture is information-centric. - Cottco occasionally provides information to cotton farmers. - I bought my phone 12 years ago. - I am using a smartphone and I can say this is my fifth handset. - Econet is very useful because I receive money from many customers through EcoCash. - The mobile phone is precious to me in my farming activities. It is useful for agriculture information sharing with other farmers and vendors.	**Mobile phone capabilities** - It is a means of learning. - It is a communication gadget. - It can significantly reduce information acquisition costs. - It can ease information asymmetry. - The mobile phone can be a conduit for agricultural information like climatic circumstances, weather, input prices, the market price for products, diseases, and other cataclysms in real-time. - It can reduce losses of perishable agricultural produce. - It is capable of accelerating knowledge-sharing. - It can facilitate financial service options and money transfers between buyers and sellers.	- Tool for communication, learning and banking services. - Payment facility

[Continued …]

https://doi.org/10.18489/sacj.v36i2.20003

Table 3: […continued]

Statement	Codes	Themes
- Infrastructure is a real challenge. - Farmers are exposed to dealers who sell counterfeit handsets, at low prices that are not durable. - The cost of mobile phone agriculture applications and services is very high and is not affordable for many. - There is the problem of an erratic network. - I alternate [between] Econet and NetOne lines. - I use a smartphone, but the cost of data is very high for a farmer.	**Challenges of using mobile phones** - There is a lack of infrastructure. - There are counterfeit mobile phone handsets. - Mobile handsets are costly. - There is an erratic network. - There is low ownership of mobile phone handsets. - There is a high cost of mobile phone technology services like data. - There is a lack of digital skills. - Mobile phone technology applications are complex.	- Poor infrastructure - Costly mobile phone services
- Education and training of farmers are critical. - Mobile 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. - The government should educate and train all farmers about using mobile phone applications in their agricultural activities. - At the time of carrying out this research, Econet was registering farmers and giving promotional regalia like t-shirts and caps to wear.	**Suggestions to address the challenges of using mobile phones.** - There is a need for the training of farmers. - There is a need to engage an Agritex officer to deploy mobile phone technologies before launching them. - The government should facilitate the training of farmers by equipping Agritex officers. - There is a need for private sector involvement. - There is a need for the erection of base stations in most rural areas. - POTRAZ should regulate the prices of mobile phone technology services.	- Training empowerment - Partnerships

7 DISCUSSION

7.1 Why many smallholder farmers do not effectively use mobile phones for agricultural activities

The research found a high level of mobile phone ownership and general use in Zimbabwe. However, there is a problem with the low adoption and usage of mobile phone technologies for agricultural purposes in Zimbabwe. Low adoption was attributed to smallholder farmers' alleged lack of technical expertise and the exorbitant cost of mobile phone handsets and related agricultural applications and services, including data, which many people cannot afford. The focus group participants mentioned that some farmers have mobile phone SIM cards but no handsets, suggesting that the situation in the study location (Gokwe South District) may differ from that in other parts of the nation. Hence, the inability to utilise a mobile device without owning one affects using mobile phones. The results suggest that smallholder farmers' aspirations to become more productive are affected by the high cost of mobile phone technology and related services like mobile agricultural applications, cost of calling, data, level of

education attained, their age and gender, as well as the complexity of mobile phone technology applications. These findings tally with findings by Masuka et al. (2016), Weigel et al. (2014), Masimba et al. (2019), Mwantimwa (2019), Kabbiri et al. (2018), and Batchelor et al. (2014) among others.

The study found that some of Gokwe South's smallholder farmers are frequently without smartphones and dependable internet access, which limits their exposure to digital technologies and makes them less confident when using mobile agricultural apps. As a result, their digital literacy is low. The intricacy of these applications and the perceived challenge in using them hold back farmers from making full use of these resources. This presents a major obstacle to the uptake and use of mobile agriculture apps like ESOKO, eMkambo, EcoFarmer, and Mubatsiri among others.

The study found that smallholder farmers may benefit from employing mobile phones in their farming operations. The results of this study suggest that older, uneducated female smallholder farmers who do not own mobile phones are prevented from adopting and using mobile phone technologies in their daily agricultural information-seeking and sharing. In contrast, younger, educated male smallholder farmers who own mobile phone technologies are better equipped to adopt and use them in agricultural information-seeking and sharing. The research is qualitative and a small sample with deeper nuances was used, hence the findings may need to be investigated further using the quantitative approach for generalisability to other contexts.

7.2 Proposed solutions to increase adoption

Historically, agricultural extension service officers in Zimbabwe provided all agricultural information and solutions. However, these officers are now handicapped by the unavailability of resources like motorbikes for use in their daily operations; hence, they face challenges when disseminating agricultural information to smallholder farmers in their areas of supervision. Participants cited an array of uses for the mobile phone, such as a fundamental communication tool, a tool for learning, a banking tool, and a payment system, among other things. These uses suggest that the mobile phone is an asset that can reduce agricultural information collection costs and ease information disparity among smallholder farmers if it is effectively used. These findings corroborate with research by researchers such as Misaki et al. (2018) and Chikuni and Kilima (2019), that pointed out challenges confronting smallholder farmers in finding agriculture information and the usefulness of mobile phones. Therefore, the sustained usage of mobile phones for agricultural information dissemination purposes has the potential to lessen agriculture production losses and accelerate information transfer. It may result in the improvement of smallholder farmers' agriculture outcomes in Zimbabwe.

The results suggest the need to work with the agricultural extension services department as they are vital in the agriculture value chain to ensure that farmers use their mobile phones productively for agricultural reasons. The government could also help farmers get the training they need to use their mobile phones in a way that would benefit them. Effective use can be

achieved by providing agricultural extension service officers with the tools and authority to guarantee that smallholder farmers are informed about using agricultural mobile phone applications. The above recommendations align with findings by Van Loon et al. (2020), which established the role played by the key stakeholders in adopting, using and scaling new technology in agriculture across three continents. The results suggest that agricultural extension service officers are naturally interested in this project because they stand to gain from it. This research has previously shown that mobile phones can enhance their work. This tallies with research by Masuka et al. (2016), Musungwini (2016), and Misaki et al. (2018), which established that smallholder farmers have the potential to become more productive and contribute to the development and growth of their economies if their conditions are improved, especially agricultural information access.

The findings also suggest that it would be necessary to categorise these farmers according to their socioeconomic situation and demographic factors and create purposeful training programs aimed at encouraging these smallholder farmers in Zimbabwe to accept and use mobile phone technologies. The findings imply that the government or its agents should educate and train all farmers in using mobile phone applications in their agricultural activities, including information about crops, inputs, pests, diseases and meteorological information delivered via mobile phone technologies. Since most rural areas require the construction of base stations, private sector engagement may be necessary. In most countries, the private sector usually deals with this issue. According to Simuka and Chinakidzwa (2022), the government of Zimbabwe has mandated that the country's Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) levies a 5% tax on telecommunication companies' profits through the Ministry of Finance and Economic Development to finance the construction of telecommunication infrastructure in rural and other areas where the companies deem it to be uneconomic to set up such infrastructure. If the Zimbabwean government is serious about achieving its national development strategy [Vision 2030], it should ensure that the revenue collected through this levy is used responsibly for setting up telecommunication and other infrastructure in rural areas where smallholder farmers are situated.

Additionally, the results suggest that POTRAZ should monitor the prices of mobile phone technology services to ensure that they are affordable for a wide range of individuals, particularly the disadvantaged, such as smallholder farmers in the Zimbabwean context. Prohibitive costs seriously hamper mobile technology's acceptance, adoption and continuous use. The research's conclusions are important because they can directly affect the achievement of SDGs 1, 2, and 3 and indirectly affect other SDGs in the development framework if the challenges presented are resolved. As was previously noted, attaining the SDGs also means meeting the Agenda 2063 objectives of the African Union and goal 1: *"A High Standard of Living, Quality of Life and Well Being for All Citizens"*, goal 3: *"Healthy and Well-nourished Citizens"*, goal 4: *"Transformed Economies"* and goal 5: *"Modern Agriculture for Increased Productivity and Production"*. On the local front, the research findings have direct implications for the National Development Strategy 1 (NDS1), which seeks to increase Zimbabwe's level of food security. The macroeconomic measures developed by this plan also aim to improve smallholder farmers'

agricultural output and productivity to, among other things, ensure that their families have access to a sufficient supply of food and nourishment, and addressing the issues identified in this research is one way of ensuring the attainment of Vision 2030.

Other issues found The study also established that smallholder farmers in Zimbabwe, like their counterparts in other countries in SSA, engage in various agricultural activities, including field crop production, market gardening, poultry and livestock keeping. The research also established that farmers face multiple challenges ranging from drought, new and constantly evolving pests, bugs and diseases, low market prices for agricultural produce, and inconsistent government policies. Smallholder farmers in Zimbabwe are involved in many farming initiatives to boost their living standards but face inherent and manufactured obstacles that endanger their way of life. The research participants made recommendations that, if heeded, could help lessen the challenges smallholder farmers face practically every day. The farmers proposed that the Zimbabwean government publish feasible crop producer prices quickly and include farmer representatives in crafting agricultural policies, such as debates on the publication of crop producer prices. These findings tally with the literature carried out by Musungwini (2018), Dube (2020), Khan et al. (2019), and Mittal and Mehar (2016), among others.

Practical implications This research has practical implications for policy and practice. The government of Zimbabwe may craft legislation promoting the proliferation of mobile phone handsets, which may reduce their prices and increase affordability for smallholder farmers and other marginalised groups in Zimbabwe. The government can incentivise telecommunication operators by subsidising mobile services for development-oriented activities like agriculture, health and other productive service areas. The government may also make it mandatory for all agricultural extension officers to be trained and equipped with knowledge on how to use mobile technologies effectively to impart the knowledge to smallholder farmers as they work directly with them. The initiatives above enable the attainment of the country's Vision 2030, The United Nations SDG goals 1, 2 and 3, and The African Union Agenda 2063 goals 1, 3 and 5.

Theoretical contributions This research developed and used an eclectic model with nine (9) constructs, namely 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) – see Figure 1. The findings suggest that smallholder farmers in Gokwe South are wary of the perceived lack of support from service providers in addressing their unique challenges, such as addressing network outages, providing affordable data plans, or offering specialized agricultural services and content. This perceived lack of support can create a sense of uncertainty and distrust, further discouraging the adoption of mobile phones in their agricultural activities.

https://doi.org/10.18489/sacj.v36i2.20003

The research also established that, for most smallholder farmers, the cost of mobile phones and their associated services is a significant obstacle to their adoption and use of mobile phones in their agricultural activities. Because the cost price is a fundamental feature of an artefact (such as a mobile phone) or a service (such as voice calling, SMS messaging or WhatsApp) and cost perception is a secondary characteristic, the research aligns with Moore and Benbasat (1991) who contends that a person's impression of cost differs from the actual cost of a good or service. In terms of perceived cost, adopters (smallholder farmers in this case) consider the price of mobile phones and their associated services relative to their disposable income; as a result, perceived cost is contingent upon the disposable income of the individual smallholder farmer. Therefore, transparency (such as tariff models and cost per minute) and monetary expenses (such as acquisition and usage charges) are two aspects of perceived costs.

This research found that their perception of costs significantly predicted smallholder farmers' propensity to use mobile devices. The paper explains the factors causing non-adoption and a prediction of the non-adoption of mobile phone technologies for agricultural purposes in the Zimbabwean context. The intricate interplay of the eclectic model constructs, namely Perceived Costs, Perceived Mobility, Perceived Ease of Use, Perceived Usefulness, Perceived Compatibility, Perceived Support of Service Provider, Perceived Subjective Norms, and Perceived Behavioural Control helps to explain the non-adoption of mobile phones by smallholder farmers in developing regions. Understanding and addressing these factors is crucial for promoting the effective integration of mobile technology in agricultural development initiatives. The research makes a theoretical contribution to the body of literature. From a Zimbabwean perspective, it offers a better understanding of smallholder farmers' non-adoption of mobile phones for agricultural purposes. The findings can be generalisable to other contexts where they may be needed for a deeper understanding of analysing and explaining (non-)adoption.

This research concurs with findings by Etwire et al. (2017), Merriam and Grenier (2019) and Krueger and Casey (2014), who established the importance of socioeconomic factors as espoused in technology adoption models like TAM (Yousafzai et al., 2007), TRA (Loken, 1983), TPB (Weigel et al., 2014) and DOI (Rogers et al., 2019) among others. The findings suggest that most smallholder farmers in Zimbabwe own mobile phones and competently use them. However, the research established that most farmers were not using their mobile phones for agricultural purposes due to various dynamics and primarily because of a lack of support from telecommunication service providers. These factors provide a novel explanation of smallholder farmers' non-adoption of mobile phones in Zimbabwe.

Limitations of the research Smallholder farmers in Zimbabwe are scattered across multiple areas like small-scale farms, resettlement sites and tribal trust grounds known as 'reserves'. Gokwe South District is merely one district with a substantial farming population; hence, the experiences of Gokwe farmers, agricultural extension service officers, other FGD participants, and the 16 interviewees do not necessarily reflect the views of all smallholder farmers in Zimbabwe. Furthermore, while interviews and FGDs are helpful techniques for gathering qualitative research data, they have flaws that may influence the research findings. Some

focus group contributors may overshadow the conversation, and the interviews are costly in resources and time-consuming; hence, only a small sample was used.

8 CONCLUSION AND RECOMMENDATIONS

The research was undertaken because there is a lack of acceptance, adoption and sustained usage of mobile phones for agricultural purposes by smallholder farmers in Zimbabwe but the reasons for the low adoption had not been explored satisfactorily. Understanding the reasons for the disappointing adoption of agricultural applications (such as ESOKO, eMkambo, EcoFarmer, Mubatsiri and others) may help researchers, developers and software companies to improve their app designs and ways to roll out new software in rural areas. A naturalistic methodology, within an abductive approach, was used in the study to help elucidate some important intricacies about the adoption dynamics among smallholder farmers.

The research found that smallholder farmers in Zimbabwe face several impediments to adopting and using mobile technologies, including limited access to mobile phone services, lack of technical knowledge, high cost of mobile phones and inadequate infrastructure. Farmers are essential for economic growth and eradication of poverty in rural families and the country in general. However, farmers face numerous obstacles that limit their output, including timely agricultural information when it is most needed. Additionally, crop and animal diseases are constantly changing, and while there are mobile agricultural applications to assist in such circumstances there are many challenges that need to be addressed for adoption by smallholder farmers to be realised. Hence, there is no readily available solution at the moment, leaving smallholder farmers exposed to real time actionable information challenges.

The research makes a theoretical contribution to better understanding the critical factors that inhibit the adoption of mobile technology in marginalised settings. The eclectic model with nine constructs, developed and used to guide the empirical work, proved to be a useful framework to study an environment with a high mobile penetration but disappointing use in agricultural settings. The model could be useful in other environments showing similar discrepancies.

An improvement in smallholder farmers' awareness of mobile technologies and adequate training to enable them to utilise their mobile phones efficiently in their agricultural activities, coupled with favourable policies that encourage the development of user-friendly and affordable applications, may enhance uptake. In addition, many of the above difficulties may be significantly reduced by promptly providing smallholder farmers with crucial information. The research recommends possible avenues for future researchers to explore, for example, analysing the effect of mobile technologies on smallholder farmers' productivity and income or assessing the impact of mobile phone technologies on the gender dynamics of smallholder farming households. There is a need to develop strategies, models or frameworks to increase smallholder farmers' access to mobile technologies, improve affordability and network availability and equip them with digital skills, which may lead to improved usage. Future researchers may carry out quantitative studies using a larger sample size to evaluate our findings.

https://doi.org/10.18489/sacj.v36i2.20003

References

Abraham, M., & Pingali, P. (2020). Transforming smallholder agriculture to achieve the SDGs. In S. Gomez y Paloma, L. Riesgo & K. Louhichi (Eds.), *The role of smallholder farms in food and nutrition security* (pp. 173–209). Springer: Cham. https://doi.org/10.1007/978-3-030-42148-9_9

Alnes, K. J. (2017). *Mobile money adoption in East Africa: A cross-country study of best- and least-performing countries* [Master's thesis, Lund University]. https://lup.lub.lu.se/student-papers/search/publication/8918206

Armstrong, J. (2010). Naturalistic inquiry [PDF available at https://www.researchgate.net/publication/256294652_Naturalistic_Inquiry]. In N. J. Salkind (Ed.), *Encyclopedia of research design* (pp. 880–885, Vol. 2). SAGE. https://doi.org/10.4135/9781412961288.n262

Awuor, F., Otanga, S., Kimeli, V., Rambim, D., & Abuya, T. (2019). E-pest surveillance: Large scale crop pest surveillance and control. *Proceedings of the 2019 IST-Africa Week Conference*, 1–8. https://doi.org/10.23919/ISTAFRICA.2019.8764824

Ayanwale, A. B., Olarinde, L. O., Oladunni, O. A., Nokoe, K. S., Adekunle, A. A., & Fatunbi, O. (2013). Enhancing smallholder farmers income and food security through agricultural research and development in West Africa: Impact of the IAR4D1 in the KKM PLS. *Proceedings of the 4th International Conference of the African Association of Agricultural Economists (AAAE)*. https://doi.org/10.22004/AG.ECON.160575

Ayim, C., Kassahun, A., Addison, C., & Tekinerdogan, B. (2022). Adoption of ICT innovations in the agriculture sector in Africa: A review of the literature. *Agriculture & Food Security*, *11*(1), 1–16. https://doi.org/10.1186/s40066-022-00364-7

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. *The Electronic Journal of Information Systems in Developing Countries*, *78*(8), 1–23. https://doi.org/10.1002/j.1681-4835.2017.tb00576.x

Batchelor, S., Scott, N., Manfre, C., Lopez, A. V., & Edwards, D. (2014). Is there a role for mobiles to support sustainable agriculture in Africa? *Proceedings of the 2014 Conference ICT for Sustainability*, 272–280. https://doi.org/10.2991/ict4s-14.2014.33

Bisht, I. S., Rana, J. C., & Ahlawat, S. P. (2020). The future of smallholder farming in India: Some sustainability considerations. *Sustainability*, *12*(9), 3751. https://doi.org/10.3390/su12093751

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chikuni, T., & Kilima, F. T. M. (2019). Smallholder farmers' market participation and mobile phone-based market information services in Lilongwe, Malawi. *The Electronic Journal of Information Systems in Developing Countries*, *85*(6), e12097. https://doi.org/10.1002/isd2.12097

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

Cronholm, S., Göbel, H., & Cao, L. (2023). Abductive design science research: The interplay between deduction and induction. *Proceedings of the Australian Conference on Information Systems (ACIS 2023)*, 1–12. https://aisel.aisnet.org/acis2023/12

Dube, L. M. (2020). Command agriculture and food security: An interrogation of state intervention in the post-fast track land redistribution era in Zimbabwe. *Journal of Asian and African Studies*, *56*(7), 1626–1643. https://doi.org/10.1177/0021909620979330

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. https://kobra.uni-kassel.de/handle/123456789/2018040955223

Dworkin, S. L. (2012). Sample size policy for qualitative studies using in-depth interviews. *Archives of Sexual Behaviour*, *41*(6), 1319–1320. https://doi.org/10.1007/s10508-012-0016-6

Eagle, D., & Saleh, N. (2020). The economics of smallholder farming. In M. Robinson & D. Klauser (Eds.), *The sustainable intensification of smallholder farming systems* (1st edition, pp. 33–64). Burleigh Dodds Science Publishing. https://doi.org/10.1201/9781003048053

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*, *12*(2), 485. https://doi.org/10.3390/su12020485

Erlingsson, C., & Brysiewicz, P. (2013). Orientation among multiple truths: An introduction to qualitative research. *African Journal of Emergency Medicine*, *3*(2), 92–99. https://doi.org/10.1016/j.afjem.2012.04.005

Etwire, P. M., Buah, S. A., 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

Freeman, K., & Mubichi, F. (2017). ICT use by smallholder farmers in rural Mozambique: A case study of two villages in central Mozambique. *Journal of Rural Social Sciences*, *32*(2), 1–19. https://egrove.olemiss.edu/jrss/vol32/iss2/1

Govender, N. (2023). Small-scale and subsistence farmers' resilience and sustainable livelihoods due to COVID-19: Possibilities of networking with ICT and WhatsApp. *Alternation Special Edition*, *41*, 407–441. https://doi.org/10.29086/2519-5476/2023/sp41a05

Government of Zimbabwe. (2020). Towards a prosperous & empowered upper middle income society by 2030: National development strategy 1 (January 2021 – December 2025) (Strategy document). https://www.veritaszim.net/node/4583

Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly*, *30*(3), 611–642. https://doi.org/https://doi.org/10.2307/25148742

Heeks, R. (2014). ICTs and poverty eradication: Comparing economic livelihoods and capabilities models. *Development Informatics Working Paper Series*, (58). https://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), 70–96. https://doi.org/10.1111/isj.12177

Isaya, E. L., Agunga, R., & Sanga, C. A. (2018). Sources of agricultural information for women farmers in Tanzania. *Information Development*, *34*(1), 77–89. https://doi.org/10.1177/0266666916675016

Issahaku, H., Abu, B. M., & Nkegbe, P. K. (2018). Does the use of mobile phones by smallholder maize farmers affect productivity in Ghana? *Journal of African Business*, *19*(3), 302–322. https://doi.org/10.1080/15228916.2017.1416215

Jones, P., Wynn, M., Hillier, D., & Comfort, D. (2017). The sustainable development goals and information and communication technologies. *Indonesian Journal of Sustainability Accounting and Management*, *1*(1), 1–15. http://ijsam.org/index.php/ijsam/article/view/22

Kabbiri, R., Dora, M., Kumar, V., Elepu, G., & Gellynck, X. (2018). Mobile phone adoption in the agri-food sector: Are farmers in sub-Saharan Africa connected? *Technological Forecasting and Social Change*, *131*, 253–261. https://doi.org/10.1016/j.techfore.2017.12.010

Kacharo, D. K., Mvena, Z. S. K., & Sife, A. S. (2018). 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

Kemp, S. (2021). Digital 2021: Zimbabwe: All the data, trends, and insights you need to help you understand how people use the internet, mobile, social media, and ecommerce in 2021 (DATAREPORTAL) [Accessed: 12 September 2024]. https://datareportal.com/reports/digital-2021-zimbabwe?rq=Zimbabwe

Kennedy, B. L., & Thornberg, R. (2017). Deduction, induction, and abduction. In U. Flick (Ed.), *The SAGE handbook of qualitative data collection* (pp. 49–64). SAGE. https://methods.sagepub.com/book/the-sage-handbook-of-qualitative-data-collection/i569.xml

Khan, N. A., Qijie, G., Ali, S., Shahbaz, B., & Shah, A. A. (2019). Farmers' use of the mobile phone for accessing agricultural information in Pakistan: A case of Punjab province. *Rural Science*, *49*(10), 1–12. https://doi.org/10.1590/0103-8478cr20181016

Kikulwe, E. M., Fischer, E., & Qaim, M. (2014). Mobile money, smallholder farmers, and household welfare in Kenya. *PLOS ONE*, *9*(10), e109804. https://doi.org/10.1371/journal.pone.0109804

Kirsten, J., & Van Zyl, J. (1998). Defining small-scale farmers in the South African context. *Agrekon*, *37*(4), 551–562. https://doi.org/10.1080/03031853.1998.9523530

Krell, N. T., Giroux, S. A., Guido, Z., Hannah, C., Lopus, S. E., Caylor, K. K., & Evans, T. P. (2020). 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

Krueger, R. A., & Casey, M. A. (2014). *Focus groups: A practical guide for applied research*. SAGE. https://uk.sagepub.com/en-gb/eur/focus-groups/book243860

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. *The Qualitative Report*, *25*(8), 2011–2025. https://doi.org/10.46743/2160-3715/2020.4241

Loken, B. (1983). The theory of reasoned action: Examination of the sufficiency assumption for a television viewing behavior. *Advances in Consumer Research*, *10*(1), 100–105. https://openurl.ebsco.com/EPDB%3Agcd%3A3%3A1107251/detailv2?sid=ebsco%3Aplink%3Ascholar&id=ebsco%3Agcd%3A6430806&crl=c

Lokeswari, K. (2016). A study of the use of ICT among rural farmers. *International Journal of Communication Research*, *6*(3), 232–238. https://www.fao.org/family-farming/detail/en/c/854506/

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research?: A review of qualitative interviews in IS research. *Journal of Computer Information Systems*, *54*(1), 11–22. https://doi.org/10.1080/08874417.2013.11645667

Masimba, F., Appiah, M., & Zuva, T. (2019). Influencing factors of mobile technology adoption by small holder farmers in Zimbabwe. In R. Silhavy, P. Silhavy & Z. Prokopova (Eds.), *Intelligent systems applications in software engineering. CoMeSySo 2019. Advances in intelligent systems and computing* (pp. 125–134, Vol. 1046). Springer International Publishing. https://doi.org/10.1007/978-3-030-30329-7_12

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*, *44*(2), 121–135. https://hdl.handle.net/10520/EJC199004

Mazwi, F., Chemura, A., Mudimu, G. T., & Chambati, W. (2019). Political economy of command agriculture in Zimbabwe: A state-led contract farming model. *Agrarian South: Journal of Political Economy*, *8*(1-2), 232–257. https://journals.sagepub.com/doi/10.1177/2277976019856742

Merriam, S. B., & Grenier, R. S. (2019). *Qualitative research in practice: Examples for discussion and analysis* (2nd edition). John Wiley & Sons.

Mhaka, S., & Runganga, R. (2023). Impact of agricultural production on economic growth in Zimbabwe. *Managing Global Transitions*, *21*(4), 303–328. https://doi.org/10.26493/1854-6935.21.303-328

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), e12034. https://doi.org/10.1002/isd2.12034

Mishra, V., Walsh, I., & Srivastava, A. (2021). 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

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. *The Journal of Agricultural Education and Extension*, *22*(2), 199–212. https://doi.org/10.1080/1389224X.2014.997255

Moore, G., & 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/https://doi.org/10.1287/isre.2.3.192

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. (2011). Changing agrarian relations after redistributive land reform in Zimbabwe. *Journal of Peasant Studies*, *38*(5), 939–966. https://doi.org/10.1080/03066150.2011.634971

Msendema, M. B., & Nyirenda, G. B. (2019). Unravelling development capabilities enhanced by ICT in informal micro-finance settings: Case of women village banks in Blantyre, Malawi. *Proceedings of the 2019 IST-Africa Week Conference*, 1–8. https://doi.org/10.23919/ISTAFRICA.2019.8764871

Mthoko, H., & Khene, C. (2017). Building theory in ICT4D evaluation: A comprehensive approach to assessing outcome and impact. *Information Technology for Development*, *24*(1), 138–164. https://doi.org/10.1080/02681102.2017.1315359

Musungwini, S. (2016). A model for harnessing the power of mobile phone technology to improve smallholder agriculture in Zimbabwe. *Proceedings of the 5th International Conference on M4D Mobile Communication Technology for Development: M4D 2016 General Tracks*, 237–252. https://www.diva-portal.org/smash/get/diva2:1056790/FULLTEXT02

Musungwini, S. (2018). Mobile phone use by Zimbabwean smallholder farmers: A baseline study. *The African Journal of Information and Communication*, *22*, 29–52. https://doi.org/10.23962/10539/26171

Musungwini, S., Gavai, P. V., Munyoro, B., & Chare, A. (2023). Emerging ICT technologies for agriculture, training, and capacity building for farmers in developing countries: A case study in Zimbabwe. In P. Raj, K. Saini & V. Pacheco (Eds.), *Applying drone technologies and robotics for agricultural sustainability* (pp. 12–30). IGI Global. https://doi.org/10.4018/978-1-6684-6413-7.ch002

Musungwini, S., Van Zyl, I., & Kroeze, J. H. (2022). The perceptions of smallholder farmers on the use of mobile technology: A naturalistic inquiry in Zimbabwe. In K. Arai (Ed.),

Advances in Information and Communication. FICC 2022. Lecture Notes in Networks and Systems, 439 (2) (pp. 530–544). Springer. https://doi.org/10.1007/978-3-030-98015-3_37

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

Ndizera, V., & Muzee, H. (2018). A critical review of Agenda 2063: Business as usual? *African Journal of Political Science and International Relations*, *12*(8), 142–154. https://doi.org/10.5897/AJPSIR2018.1114

Nkomoki, W., Bavorová, M., & Banout, J. (2019). Factors associated with household food security in Zambia. *Sustainability*, *11*(9), 2715. https://doi.org/10.3390/su11092715

Noruwana, L., Chigona, W., & Malanga, D. F. (2018). How information and communication technologies empower disadvantaged communities in Cape Town, South Africa. *Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists*, 171–178. https://doi.org/10.1145/3278681.3278702

Nyajeka, P., & Duncombe, R. (2022). The use of mobile phones by women livestock keepers in Zimbabwe. *Proceedings of the 2022 International Conference on Information and Communication Technologies and Development*, 1–11. https://doi.org/10.1145/3572334.3572401

Oguntuase, O. J. (2021). Africa, 2030 Agenda and Agenda 2063: The imperative of transnational governance (E. Osabuohien, E. Oduntan, O. Gershon, O. Onanuga & O. Ola-David, Eds.). *Handbook of research on institution development for sustainable and inclusive economic growth in Africa*, 1–14. https://doi.org/10.4018/978-1-7998-4817-2.ch001

Palmer, N. (2012). Using ICT to enable agricultural innovation systems for smallholders ICT innovations [Accessed: 11 September 2024]. http://www.fao.org/docrep/018/ar130e/ar130e.pdf

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

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

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2019). Diffusion of innovations 1. In D. W. Stacks, M. B. Salwen & K. C. Eichhorn (Eds.), *An integrated approach to communication theory and research* (3rd edition, pp. 415–434). Routledge. https://doi.org/10.4324/9780203710753-35

Sandelowski, M. (1995). Sample size in qualitative research. *Research in Nursing & Health*, *18*(2), 179–183. https://doi.org/10.1002/nur.4770180211

Saunders, B., Kitzinger, J., & Kitzinger, C. (2015). Anonymising interview data: Challenges and compromise in practice. *Qualitative Research*, *15*(5), 616–632. https://doi.org/10.1177/1468794114550439

Shonhe, T. (2019). The changing agrarian economy in Zimbabwe, 15 years after the Fast Track Land Reform programme. *Review of African Political Economy*, *46*(159), 14–32. https://doi.org/10.1080/03056244.2019.1606791

Simuka, J., & Chinakidzwa, M. (2022). A stakeholder founded business model for strategic management of innovation hubs: A case of Zimbabwe universities innovation hubs. *Journal of African Education*, *3*(2), 155–179. https://doi.org/10.31920/2633-2930/2022/V3N2A6

Tatsvarei, S., Mushunje, A., Matsvai, S., & Ngarava, S. (2018). Farmer perceptions in Mashonaland East province on Zimbabwe's agricultural land rental policy. *Land Use Policy*, *75*, 468–477. https://doi.org/10.1016/j.landusepol.2018.04.015

Timmermans, S., & Tavory, I. (2012). Theory construction in qualitative research: From grounded theory to abductive analysis. *Journals of the American Sociological Association*, *30*(3), 167–186. https://doi.org/10.1177/0735275112457914

Tongia, R., & Subrahmanian, E. (2006). Information and communications technology for development (ICT4D) – a design challenge? *Proceedings of the 2006 International Conference on Information and Communication Technology for Development (ICTD)*, 243–255. https://doi.org/10.1109/ICTD.2006.301862

Van Greunen, D., & Fosu, A. (2022). ICT adoption challenges: Case of rural small-scale farmers in the Amathole district municipality of South Africa. *Proceedings of the 2022 IST-Africa Conference (IST-Africa)*, 1–9. https://doi.org/10.23919/IST-Africa56635.2022.9845556

Van Loon, J., Woltering, L., Krupnik, T. J., Baudron, F., Boa, M., & Govaerts, B. (2020). Scaling agricultural mechanization services in smallholder farming systems: Case studies from sub-Saharan Africa, South Asia, and Latin America. *Agricultural Systems*, *180*(102792), 1–13. https://doi.org/10.1016/j.agsy.2020.102792

Van Zyl, O., Alexander, T., De Graaf, L., Mukherjee, K., & Kumar, V. (2014). ICTs for agriculture in Africa (English) [Accessed: 22 August 2024]. http://documents.worldbank.org/curated/en/802551468204543390/ICTs-for-agriculture-in-Africa

Vasileiou, K., Barnett, J., Thorpe, S., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over 15 years. *BMC Medical Research Methodology*, *18*(148), 1–18. https://doi.org/10.1186/s12874-018-0594-7

Weigel, F. K., Hazen, B. T., Cegielski, C. G., & Hall, D. J. (2014). Diffusion of innovations and the theory of planned behavior in information systems research: A metaanalysis. *Communications of the Association for Information Systems*, *34*, 619–636. https://doi.org/10.17705/1CAIS.03431

Whetten, D. A. (1989). What constitutes a theoretical contribution? *Academy of Management Review*, *14*(4), 490–495. https://doi.org/10.5465/AMR.1989.4308371

Williams, M. (2000). Interpretivism and generalisation. *Sociology*, *34*(2), 209–224. https://doi.org/10.1177/s0038038500000146

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

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007). Technology acceptance: A meta-analysis of the TAM: Part 2. *Journal of Modelling in Management*, *2*(3), 281–304. https://doi.org/10.1108/17465660710834462

A THE INTERVIEW GUIDE

Dear respondent,

This interview guide was 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. You are free to provide your responses to the questions. Your responses will be confidential.

General Information

Ward Village of Origin .....

Section A: Respondent' 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. How big is your farming land?
B2. Which crops are you producing on your farmland?
B3. Do you have livestock?
B4. What are the major challenges that you face in your agricultural activities?
B5. What do you think should be done to overcome these challenges?
B6. Do you depend on agriculture only for income for your family?
B7. 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 Usability of Smallholder Farmers.

C1. Do you own a mobile phone?

https://doi.org/10.18489/sacj.v36i2.20003

C2. How long have you had a mobile phone?

C3. Which type of phone do you use and are there any reasons?

C4. Which mobile network do you subscribe to?

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 the acquisition of mobile phones and airtime and their prices?

C8. Do you think you are capable of effectively and efficiently using the mobile phone?

C9. Can you state the agricultural activities you use your mobile phone for?

C10. In your opinion, do you think the mobile phone and its agricultural applications and services are affordable to farmers?

C11. Is the mobile phone compatible with many everyday agricultural activities of farmers?

C12. Do you think the adoption of mobile phones can help farmers overcome the challenges of accessing agriculture-related information?

C13. In your opinion, what role should be played by mobile telecommunication companies and other agricultural mobile application companies to assist farmers to realise their full potential?

C14. What role should the government /government officials play to enable more farmers to use their mobile phones when communicating agriculture-related information?

https://doi.org/10.18489/sacj.v36i2.20003

B THE FOCUS GROUP DISCUSSION GUIDE

Section A

1. What are the agricultural practices that farmers in the Gokwe South District area are involved in?
2. What are the challenges faced by farmers in carrying out their agricultural activities in the Gokwe South District?
3. In your view, how can these challenges be addressed?
4. What are the sources of agricultural information for farmers in the Gokwe South District?

Section B

1. What is the general level of mobile phone ownership in Gokwe South District?
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 South District 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 mobile phones for agricultural purposes faced by farmers in the Gokwe South District?

https://doi.org/10.18489/sacj.v36i2.20003