

Utilization Of Mobile Phone Communication For Dairy Development Programmes In
Kenya: The Case Of Kiambu And Nairobi Counties

by

Janet A. Nyaoro

A thesis presented to the School of Communication

of

Daystar University
Nairobi, Kenya

In partial fulfilment of the requirements for the degree of

MASTER OF ARTS
in Communication

February 2019

APPROVAL

UTILIZATION OF MOBILE PHONE COMMUNICATION FOR DAIRY
DEVELOPMENT PROGRAMMES IN KENYA: THE CASE OF KIAMBU AND
NAIROBI COUNTIES

by

Janet A Nyaoro

In accordance with Daystar University policies, this thesis is accepted in partial
fulfilment of the requirements for the Master of Arts degree.

Date:

Michael Bowen, PhD,
1st Supervisor

Muthoni King'ori, PhD,
2nd Supervisor

Kinya Mwithia, PhD,
HoD, Strategic and Organizational Communication

Levi Obonyo, PhD,
Dean, School of Communication

Copyright © 2019 by Janet A. Nyaoro

DECLARATION

UTILIZATION OF MOBILE PHONE COMMUNICATION FOR DAIRY
DEVELOPMENT PROGRAMMES IN KENYA: THE CASE OF KIAMBU AND
NAIROBI COUNTIES

I declare that this thesis is my original work and has not been submitted to any
other college or university for academic credit.

Signed: _____
Janet A Nyaoro
11-1532

Date: _____

ACKNOWLEDGEMENTS

I would like to thank God almighty who saw me through this academic journey. I am grateful to Mr. John Muchai who started me off in this process at the time when I had not been appointed a supervisor. Special thanks to my first supervisor, Prof Michael Bowen, for your invaluable guidance in this study. You always smiled even when I felt upset with your constructive critics. Prof Bowen, I appreciate your intellectual and insightful contribution to this research. To my second supervisor, Dr. Muthoni Kingori, I say thank you for coming in and working speedily even during holiday like the Easter Holiday of 2018 to ensure I met the defence deadline. You even called to find out the status of data collection and that call motivated me to soldier on. And to Dr. Wambui Wamunyu, who took a personal interest and listened to my rants, I say thank you for your encouragement and support.

Finally, to all the respondents who took time out of their super busy schedules to participate in the research, I am grateful to you all

May the Almighty Lord bless you all.

TABLE OF CONTENTS

APPROVAL	ii
DECLARATION	iv
ACKNOWLEDGEMENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ACRONYMS AND ABBREVIATIONS	x
ABSTRACT.....	xi
DEDICATION.....	xii
CHAPTER ONE	1
INTRODUCTION AND BACKGROUND TO THE STUDY	1
Introduction	1
Background to the Study	1
Statement of the Problem	5
Purpose of the Study	6
Objectives of the Study	6
Research Questions	6
Justification of the Study	7
Significance of the Study	7
Assumptions of the Study	8
Scope of the Study.....	9
Limitations and Delimitations of the Study	9
Definition of Terms	10
Summary	12
CHAPTER TWO	13
LITERATURE REVIEW	13
Introduction	13
Theoretical Framework	13
General Literature Review	16
Empirical Literature Review	28
Conceptual Framework	32
Discussion	33
Summary	34
CHAPTER THREE	35
RESEARCH METHODOLOGY.....	35
Introduction	35
Research Design.....	35
Population.....	36
Sample Size.....	37
Sampling Technique.....	38
Data Collection Instrument	39
Type of Data.....	40
Data Collection Procedure	40
Pretesting.....	41
Reliability and Validity of Research Instruments	42
Data Analysis Plan	42
Ethical Considerations.....	43

Summary	44
CHAPTER FOUR.....	45
DATA PRESENTATION, ANALYSIS, AND INTERPRETATION	45
Introduction	45
Response Rate	45
Presentation, Analysis, and Interpretation.....	46
Summary of Key Findings	86
Summary	90
CHAPTER FIVE	91
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS	91
Introduction	91
Discussion of the Key Findings	91
Conclusions	101
Recommendations of the Study.....	102
Areas of Further Research.....	105
REFERENCES	107
APPENDICES	114
Appendix A: List of Respondents	114
Appendix B: Interview Guide for Program Officers.....	115
Appendix C: Focus Group Discussion Guide for Dairy Farmers	119
Appendix D: Ethics Clearance Report	120
Appendix E: Research Permit	121
Appendix F: Anti-Plagiarism Report	122

LIST OF TABLES

<i>Table 2. 1: Ranking of Information Needs of Dairy Farmers in Karnal, India.....</i>	<i>31</i>
<i>Table 4. 1: Name of Dairy Development Program, Description of the Program, Number of Beneficiaries, and Duration in Place</i>	<i>47</i>
<i>Table 4.2: Description and Impact of Easyma Mobile Phone Communication Application.....</i>	<i>64</i>
<i>Table 4. 3: Benefits of Easyma Mobile Phone Communication.....</i>	<i>64</i>
<i>Table 4. 4: Information Needs of the Farmers</i>	<i>67</i>

DAYSTAR UNIVERSITY

LIST OF FIGURES

Figure 2. 1: The Technology Acceptance Model 14

Figure 2. 2: Conceptual Framework32

Figure 4. 1: Information Flow in Agroforce Mobile Phone Application63

Figure 4. 2: Strategies to Increase Use of Mobile Phone.....81

DAYSTAR UNIVERSITY

LIST OF ACRONYMS AND ABBREVIATIONS

C4D	Communication for Development
CABI	Centre for Biosciences and Agriculture International
CAK	Communication Authority of Kenya
EADD	East Africa Dairy Development
FAO	Food and Agriculture organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product (GDP
GIS	Geographic Information System
ICT	Information Communication Technology
IEEE	Institute of Electrical and Electronic Engineers (IEEE)
ILRI	International Livestock Research Institute
ITU	International Telecommunication Union
KDB	Kenya Dairy Board
M-ARD	Mobile phone applications for agriculture and rural development
NACOSTI	National Council of Science, Technology and Innovation
NGO	Non-Governmental Organization
SMS	Short Message Service
SNV	Netherlands Development Organisation
TAM	Technology Acceptance Model
USSD	Unstructured Supplementary Service Data

ABSTRACT

The purpose of this was to investigate the utilization of mobile phone communication for dairy development programmes in Kenya, focusing was in Kiambu and Nairobi Counties. The objectives of the study were to: Explore the extent of use of mobile phone communication by dairy development programs; find out the type information the dairy programs need to disseminate to dairy farmers via mobile phones; identify barriers encountered by dairy development programs in the use of mobile phone communication to improve dairy farming; and establish measures that can be put in place by dairy development programs to overcome the barriers. The study applied descriptive and qualitative research design. The target population was farmers and 15 dairy development programs in Kenya whose headquarters are located in Nairobi and Kiambu Counties. Primary data was collected through indepth interviews and focus group discussion (FGD). Data analysis was through visualization and grouping the information into themes guided by the research objectives. The study established that dairy development programs mainly used voice calls and short message service to communicate with farmers. Dairy information disseminated to farmers include information on cost of dairy inputs, milk production in Kenya, young stock management among others. Barriers encountered by dairy development programs include: human capacity and behavioural in using mobile phone communication by some farmers, lack of required skills to use the mobile phone communication in dairy farming, internet and network failures especially in rural areas among others. The study recommended that development practitioners in collaboration with the Government of Kenya (GoK) and other stakeholders should set up an institution to run dairy information centres by benchmarking best practice from other countries.

DEDICATION

I dedicate this thesis to my husband and my forever partner, Jim, and to my mother who is an angel looking out for me.

DAYSTAR UNIVERSITY

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

Introduction

This chapter introduces the study by providing background information on mobile phone use in the dairy sector of Kenya, thus setting context for the problem statement, purpose and objectives of the study. Additionally, the study's research questions, as well as why the study is important are delineated. Moreover, this chapter presents the limitations of the study and how to overcome them as well as stating the underlying assumptions. Finally, various terms used in this study are defined and are operationalized.

Background to the Study

As recently as three decades ago, mobile telephones were viewed as a luxury and a status symbol. But today, the mobile phone is an accessible accessory that many people cannot do without. According to Bhavnani, Chiu, Jankiram and Silarszky (2008), a mobile phone is "a gadget that has become the primary form of communication in both developed and developing countries" (p. 5). Access to mobile communication and the resultant immense growth of mobile telephony has been argued to contribute to economic development. It is believed that mobile phones have the power to spur development, alleviate poverty, and bridge the perceived digital divide (Duncombe, 2012). This ubiquitous nature of mobile phones implies its accessibility to all, including farmers. The increasing usefulness of mobile phones demonstrates great potential that can be used to improve agricultural productivity. Bill and Melinda Gates through their Foundation have embraced mobile technology,

arguing that mobile banking help the poor transform their lives (Gates & Gates, 2015).

As mobile phone technology becomes widely accessible, there has been increased focus on the role mobile technology can play in improving social and economic development in emerging markets (World Bank, 2013). In India where a study was carried out among fishermen who used mobile phones, the Institute of Electrical and Electronic Engineers (IEEE) confirmed that with the wide-spread use of mobile phones, markets become more efficient as risk and uncertainty are reduced.

The link between use of mobile phones and livelihood has led to mobile technology innovations. An example of a game-changing technology is mobile money transfer system in Kenya branded as M-pesa powered by Safaricom – the leading mobile network operator. M-Pesa is the world's most successful money transfer service. It enables millions of people who have access to a mobile phone, but do not have or have only limited access to a bank account, to send and receive money, top-up airtime and make bill payments. (Demombynes & Thegeya, 2012; Vodafone, 2015). The mobile revolution has transformed the lives of Kenyans providing not just communication but also basic financial access in the form of phone based money transfer (Demombynes & Thegeya, 2012). The number of mobile subscribers in Kenya as at September 2018 is 46.6 million while money transfer subscriptions in Kenya as at September 2018 is 29,785,389 (Communication Authority of Kenya, 2019). Considering that money transfer was introduced in 2007, this is a fast-paced growth that shows the demand of mobile phone services for value addition services that goes beyond making and receiving calls.

Apart from the financial sector, one of the sectors that mobile phone use can have positive effect on is the dairy farming sector. The Kenya dairy industry is the single largest agricultural sub-sector in Kenya, larger even than tea (Wambugu, Kirimi, & Opiyo, 2011). The dairy sector accounts for about 3.8 percent of the national Gross Domestic Product (GDP) and 14 percent of agricultural GDP. It provides income, employment and food to over 22 million Kenyans (Smollo, Githaiga, & Barasa, 2017). This trend is not new as over the years, the dairy sector remains the most dominant sub-sector in Kenya (Bore, Owuoché & Mutai, 2015). The country's dairy cow population is approximated to be 7.6 million, the biggest in sub-Saharan Africa (International Fund for Agricultural Development, 2012).

In Africa, Kenya is the only country, after South Africa that produces enough milk for both domestic consumption and export (Nassiuma & Njoroge, 2013). The Kenya dairy sector plays a critical role in the livelihood of many Kenyans and contributes 4.5% of total country's GDP, making Kenya one of the largest producers of milk in Africa (Kenya Dairy Board, 2014). Because of the successes and potential of dairy sector, there are several development agencies that are working on dairy. The Kenya Dairy Board regulates the dairy sector in Kenya.

The demand for milk in Kenya is big. In 2018 alone, milk intake amounted to 634,294,096 litres (Kenya Dairy Board, 2019). There is no comparative data from Kenya Dairy Board on how much was produced in similar time. The latest 2016 statistics on production shows that, 5,275,345,000 litres of milk was produced. These statistics show need to coordinate on milk production and quality so as to improve intake and value addition of milk products.

Development agencies have developed projects to improve milk production among small scale farmers. Kenya Dairy Board has registered 16 NGOs that are working on Milk related projects in Kenya (Kenya Dairy Board, 2015). The goal of these projects is to improve livelihoods and also contribute to improved economic development. The focus of the development agencies is small holder dairy farmers who dominate the dairy sector in Kenya with over 75% of the total milk output (Bore et al., 2015).

Aker (2011) posited that despite the importance of agriculture including dairy farming being important for economic development; it is yet to contribute significantly to growth in many parts of developing Countries (Aker, 2011). Milk production in Kenya is predominantly by small scale farmers, who own one to three dairy animals, and produce about 80 percent of the milk in the country (Wambugu et al., 2011). Nassiuma and Njoroge (2013) put this figure at 90% ownership by small scale farmers. These dairy farmers need information on a variety of topics at different times. With lack of information, they can do trial and error or rely on networks some of which are not reliable (Aker, 2011).

Thus mobile phone communication can be used to efficiently manage dairy farming. The effect of use of mobile phone is best explained by a farmer who pointed out that his mobile phone is his assistant that helps him to control the entire dairy farming business of 29 cows, from breeding to feeding to selling of milk (Ojina, 2017). This implies that by using the mobile phone, farmers can make the right decisions at different stages of dairy development to ensure optimal milk production and profitable sales of milk and milk products. Overall, studies show that use of dairy information through mobile phones could increase milk yield and that access to rapid

and low cost information help smallholder dairy farmers make better production and marketing decisions, which influence milk output (Smollo et al., 2017).

Therefore, there is need to meet the challenge of providing right information to dairy farmers. The challenge of getting credible data on milk production and marketing runs across all the milk producing districts in Kenya (Nassiuma & Njoroge, 2013). This calls for the need to embrace mobile technology as a more efficient way of reaching out to dairy farmers.

Statement of the Problem

Despite advances in communication technology and increasing use of mobile phone, dairy development programs that provide extension services use out-dated methods that have not embraced modern technology like mobile phone communication. The use of old technology without innovation renders extension services ineffective (Hedge, 2017). According to FAO (2017), extension methods comprise the communication techniques between extension workers in this case development programs and target groups. Ineffective extension services means development programs cannot relay timely information and feedback to dairy farmers.

The need for agricultural information is becoming more urgent because the number of extension agents who provide the information has been going down since 1990 and the number of farmers has been going up (Adongo, Wesonga & Mugivane, 2013). Furthermore, the Government of Kenya is on slow motion in employing and deploying enough extension agents to support the high dairy production statistics. There is therefore need for dairy development programs to fill this gap and come up

with innovations that will use mobile phone communication to improve extension services in dairy farming.

Purpose of the Study

The purpose of this study was to investigate the utilization of mobile phone communication for dairy development programmes in Kenya with particular focus on Kiambu and Nairobi Counties.

Objectives of the Study

The objectives of this study were:

1. To explore the extent of use of mobile phone communication by dairy development programs
2. To find out the type of information dairy development programs disseminate to dairy farmers through use of mobile phones
3. To establish barriers encountered by dairy development programs in using mobile phone communication to improve dairy farming
4. To establish measures dairy development programs could put in place to overcome barriers encountered in using mobile phone communication to improve dairy farming

Research Questions

The following were the research questions of this study:

1. To what extent did dairy development programs use mobile phone communication?
2. What type of information did dairy development programs disseminated to dairy farmers through use of mobile phones?

3. What barriers encountered by dairy development programs in using mobile phone communication in improving dairy farming?
4. What measures dairy development programs could put in place to overcome the challenges?

Justification of the Study

This study was meant to tap into the current growth of mobile technology to benefit dairy farmers in Kenya. Background information in this study provides statistics to show how Kenyans have embraced mobile telephones and practitioners in dairy development need to embrace use of this technology as well. Studies on use of mobile phone become obsolete quickly and there is therefore need to update knowledge. It will fill the information gap by ensuring mobile communication is used to provide timely information that will facilitate dairy farmers make timely decision and take action at the farm level. This can lead to improved milk production, improved income and economic development.

Significance of the Study

The study is expected to benefit various categories for people. First, the findings of this study would benefit dairy farmers in Kenya who will receive support from dairy development programs on how to use the mobile phone to obtain information on dairy farming. Secondly, program officers working in dairy development programs can use the findings of this study to tap opportunities on mobile phone communication innovations that have been developed for the benefit of dairy farmers for improved impact on their programs. Thirdly, donor agencies can use

the findings of this study to appreciate and hopefully support the use of mobile phone communication hence leading to sustainable funding.

Fourthly, the Government of Kenya can utilize the findings of this study to effectively implement dairy farming programs. This study may hopefully be an advocacy tool that will provide evidence to motivate the government to create enabling environment for mobile phone communication in dairy farming. Last but not least, the literature created out of this study may be useful to the academic fraternity in the field of development communication. In addition, the study will add into knowledge through documenting of innovative ways to disseminate dairy farming information for development. Future researchers can use this study as a reference when conducting research in the development communication field or in dairy farming.

Assumptions of the Study

This study made the following assumptions:

1. All other hardware resources required in dairy farming were available, for example availability of building materials, availability of animal feed, water, land et cetera. This assumption was necessary because information does not operate in a vacuum. Information would only be effective if for example a dairy farmer has other capacities needed to carry out the various dairy production activities for example hygienic housing infrastructure for livestock.
2. Dairy development program officers were honest and truthful when providing information. This is because the research was not an

evaluation of their performance in innovation but an assessment that was meant to improve on communication in dairy farming.

3. Dairy development programs have cordial relationships with their donors and they receive a continuous stream of funding to support mobile phone communication.
4. All dairy development program officers who represented dairy development programs and farmers owned at least a basic mobile phone.
5. The adoption of good mobile phone in the dairy sector had improved productivity, income, and overall economic growth.

Scope of the Study

The study was conducted in Kenya with particular focus on dairy development programs whose headquarters are located in Nairobi Kenya. The dairy development program officers who were representatives of the dairy development programs were the respondents of this study. The dairy development programs included those that incorporated the use of mobile phones in coordinating daily activities of dairy farming. This study also targeted dairy farmers supported by the dairy development programs as secondary respondents. The farmers were based in various parts of the country mostly Kiambu, Eldoret and other regions where the dairy development programs operate the field activities even though the headquarter are in Nairobi

Limitations and Delimitations of the Study

1. First, information about mobile use is fast-paced, and what is written today is outdated tomorrow (Information and Communication for Development & World Bank, 2012). To curb this, the researcher conducted this research within the

shortest time possible before the current information was obsolete. In addition, the most current available information was sought.

2. Secondly, identification of dairy development programs that incorporate use of mobile phones was difficult since there is no readily available information from desk research. In addition, dairy development programs change their focus and can shift from one agricultural product to another. To overcome this, Kenya Dairy Board was the main source of information and focus was on dairy development programs that were registered with the board.
3. Finally yet importantly, scheduling appointments with program officers might have been a problem since most of the officers were busy with daily program activities. Some could even cancel appointments because they prioritized their daily work, which was commendable and understandable. To curb this, the researcher tried to use her current networks in the dairy production sector and created a rapport with respondents. Also the researcher was flexible to travel to any workshop venue in Kenya in order to meet relevant respondents.

Definition of Terms

Dairy development: Processes that promote the proper conditions for dairy farming so that safe quality milk can be produced from healthy cows using management practices that are sustainable and effective from an animal welfare, social and economic perspective (FAO, 2011). This study adopted FAO's definition as it is but included promoting production of milk as a business and not as a way of life as is usually the practice among small scale farmers in Kenya.

Program: Set of interrelated projects designed to achieve related goals in a long period of time. Programs have wide resource base, bigger target group, Long term, Covers a whole country.

For this research, the term is used to refer to a set of interrelated projects and activities that are carried out by organization that promote dairy development. Most of the activities are donor funded and have time limit ranging from 1 year to 10 years.

Utilization: The action of making practical and effective use of something.” (Oxford Dictionary). For this study, it is the action by program officers of making practical and effective use of mobile phone communication to support dairy farmers.

Mobile phone: A portable telephone that works by means of a cellular radio system (Collins English Dictionary). For this study, it can be any mobile device not only limited to telephone but also any mobile gadget that be used to disseminate and receive agricultural information

Communication: Giving, receiving or exchanging ideas, information, signals or messages through appropriate media, enabling individuals or groups to persuade, to seek information, to give information (Jureddi & Brahmaiah, 2016). For this study, the information or ideas refer to those pertaining to dairy farming and the media is through mobile phone. The individual or groups refer to program officers, their organizations, the dairy farmers and their dairy farming groups or dairy cooperatives.

Program officer: A staff in charge of a program who is in charge of fundraising and decision making process in terms of design and implementation of programs. For this study the program can be under an NGO, a foundation, a government or private sector as part of corporate social responsibility. They can also be referred to other names for example program managers, head of program, technical

advisor or any other name that corresponds to their internal processes and job description.

Dairy farmer: A person or institution that manages a farm where cows are raised for the production of milk and other dairy products. The management involves a wide range of activities for increasing the production of Milk (Sokanu, 2015). For this study, the definition by Sokanu applies but also the person was one who invested capital in dairy farming but may not necessarily be involved in day to day running of the farm.

Summary

This chapter has highlighted the trends in mobile phone communication that sets the stage for the gap that requires dairy development programs to fill through use of mobile phones to support dairy farmers. The chapter has outlined the objectives and the research questions that will help the researcher to assess how prepared the dairy development programs are in using mobile phone communication. The study is justified by the increased use of mobile phone and the importance of dairy industry as a main contributor to economic growth in Kenya. The significance of the study to all stakeholders including dairy industry, academic scholars, the government, development agencies, and dairy farmers has been explained. The next chapter provides relevant literature review to this study.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter provides relevant literature to this study which includes theoretical, general and empirical literature. The most appropriate theory for this study is the theory of technology acceptance model. The general relevant general and empirical literature is discussed based on the purpose of the study and the study's objectives which include the use of mobile phones by dairy development programs, the barriers in utilizing of mobile phones, and the measures to curb these barriers. Finally, the chapter provides the study's conceptual framework which is derived from the reviewed theoretical, general, and empirical literature.

Theoretical Framework

Technology Acceptance Model

Technology Acceptance Model (TAM) was advanced by Davis (1986) to model user acceptance of information system. TAM is a theory which aims to determine behaviours of users towards a particular technology by employing two factors; perceived ease of use and perceived usefulness. According to this theory, people who perceive technology as useful and easy to use will accept it more than those who do not. The concept of the theory is as shown in Figure 2.1.

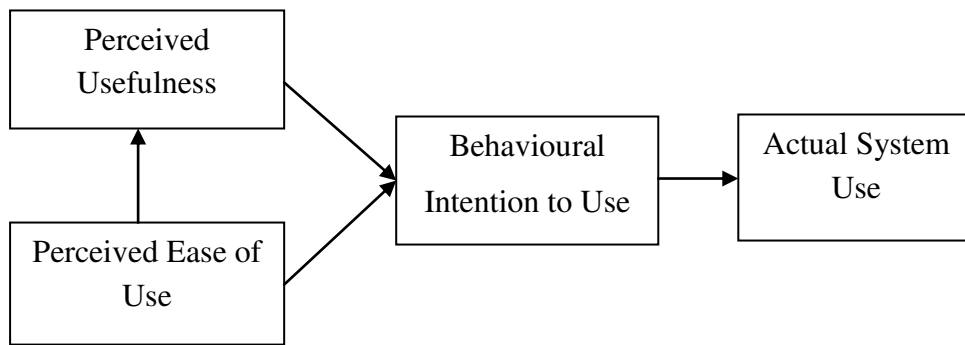


Figure 2. 1: The Technology Acceptance Model

Source: Davis et al. (1989), Venkatesh et al. (2003)

Perceived usefulness is defined as the prospective user's subjective probability that using a specific technology will increase his or her job performance within an organizational context. Perceived ease of use refers to the degree which the prospective users expect the technology to be free of effort (Davis, Bagozzi, & Warshaw, 1989). Behavioural intention is a measure of strength of one's intention to perform a specified behaviour. The relationship represented in TAM implies that all else being equal, people form intention to perform behaviours towards which they have positive affect (Davis et al., 1989).

More recent studies have had both positive and negative feedback on TAM. The feedback are mostly from computer experts who have gone ahead to develop TAM2 and TAM3. Venkatesh & Davis (2000) developed the TAM2 by adding two more determinants to the original TAM: social influences and cognitive instrumental processes. The social influences include subjective norms and images. On the other hand, the cognitive instrumental process includes job relevance, output quality, result demonstrability and perceived ease of use (Alomary & Woolard, 2015).

It seems there was further dissatisfaction with both original TAM and TAM2. This led to the formulation of TAM3 by Venkatesh and Bala (2008) to give a higher

level of significance to 'perceived ease of use'. TAM3 included the dimensions of computer self-efficacy, perception of external control, computer anxiety and computer playfulness (Alomary & Woolard, 2015).

A study by Lai (2017) analysed all technology acceptance models including TAM, TAM2, TAM3 among others with a view of deciding which will be the most applicable theory for an e-payment platform. The study found that the original TAM was the best model for the new e-payment platform. The reason for the selection of the original TAM was based on context of whether the technology to be tested was voluntary or mandatory and whether subjective norms apply. Thus TAM2 and TAM3 were not selected because "the situation was for products to be implemented in the marketplace and taken into consideration of subjective norm that included society not required for this study involving the novelty technology of single platform E-payment System" (Lai, 2017 p. 32). The findings of Lai's (2017) study further indicate that the selection of a model was based on context and nature of the technology being advanced.

This study adopted the original TAM due to its simplicity and relevance to development communication. This is a voluntary system and subjective norms that common in other models of adoption do not apply in this case. Furthermore, the newer versions of TAM have too many variables and too many relationships between the variables (Alomary & Woolard, 2015). The additional variables for TAM2 and TAM3 were added by computer system experts to advance their own field of study hence additions like computer efficacy and computer playfulness.

Despite the criticism which has led to inclusion of more variables, the original TAM model has been recognized as a powerful, valid and highly reliable predictive

model that can be used and it is easy to apply it in several contexts (Sharma & Chandel, 2013; Lai, 2017).

In the context of this study, the technology that we seek acceptance for is that of mobile phones. The users who need to accept the technology are program officers representing dairy development programs that work with dairy farmers. The extent of utilization of mobile phone communication to improve success of dairy farming programs will be the discovery of this study.

General Literature Review

The sections reviews general relevant literature in line with popularity of mobile phone communication as a useful technology whose time to adopt is now, as well as its benefits to the information needs of the dairy farmers. This section will also review some barriers and opportunities of mobile phone communication in dairy farming. The review of barriers and opportunity will incorporate ease versus complexity of use of mobile phone as a tool for information dissemination by program officers implementing dairy development programs in Kenya.

Use of Mobile Phones by Dairy Development Programs

According to International Telecommunication Union (ITU), it is a fact that use of mobile phone communication is gaining popularity globally and locally (ITU, 2014). The number of mobile-broadband subscriptions has reached 2.3 billion, with 55 per cent of them in developing countries. The projection was that globally, mobile-broadband penetration could to reach 32 per cent by end of 2014 – almost double the penetration rate just three years earlier (2011) and four times as high as

five years earlier (ITU, 2014). This implies that the projection has been surpassed by 23 per cent.

Consequently, implications for development agencies today are no longer basic access to mobile phones but what can be done with the phones (Information and Communication for Development & World Bank, 2012). Affordable mobile phones in developing countries and the opportunities they usher in for the poor will be one of the most dramatic game-changing technologies the world has ever seen (Hatt, Gardner, Wills, & Harris, 2013). Locally, Kenya has transitioned from a culture in which there was virtually no telephone service of any kind, to one in which mobile phones are now widely utilized among farmers and at rural markets (Adongo et al., 2013).

According to Abraham (2006), the use of mobile phone is of great beneficial to all stakeholders in the dairy farming value chain, a fact that is supported by several scholars. Abraham (2006) further argued that with use of mobile phones, there is greater market integration; there are gains in productivity. Nakasone, Torero and Minten (2013) also noted that the use of mobile phones improves ease of communication. In addition, mobile phones provide personalized agricultural information at low costs, as it helps the farmers to coordinate with buyers and secure inputs from suppliers more efficiently (Abrahams, 2006; Cassaburi, Kremer, Mullainathan, & Ramrattan, 2014). The Centre for Biosciences and Agriculture International (CABI), which is a global knowledge bank on agricultural information, also confirmed that access to the right information, absorbed and applied correctly, can increase productivity and improve livelihoods in many of the farming households (CABI, 2014).

The use a mobile phone to achieve agricultural productivity in Kenya is an area that is evolving but in a low rate. But what is clear, according to the Communication Authority of Kenya (CAK), is that there is no shortage of mobile telephone solutions and Kenya as a country is filled with positivity when it comes to information communication technology (ICT) in general and mobile phone technology in particular (CAK, 2013). ICT has been a core development pillar in Kenya's growth plan. In 2013, Kenya released the national broadband strategy to help transform the country into a knowledge-based society driven by a high capacity, nationwide broadband network (CAK, 2013).

Such positive environment means Kenya, which has been referred to as Silicon Savannah, is home to many successful technological organizations which incubate ideas that can benefit dairy farming (Bright & Hrubry, 2015). One such idea is the iCow – an agricultural information service with a variety of products available as a mobile subscription service through *285# to help farmers enhance productivity (iCow, 2015). M-pesa is a popular mobile money transfer that has revolutionized mobile phone technology in Kenya and is spreading globally (Vodaphone, 2015). It is, however, evident that other than M-pesa, there is low awareness of other mobile phone based services and applications (InfoDev, 2012). Value added services such as M-pesa and iCow thus allow mobile phone owners to get more value with their mobile phones apart from using them for just receiving and making calls. These two examples show that one technology is well known and another is barely known.

There are many other mobile phone applications designed for local farmers. A study on mobile applications for rural development conducted by World Bank lists and describes 92 mobile applications for agriculture and rural development (Qiang,

Kuek, Dymond, & Esselaar, 2011). There are still more apps that are being developed every day. E-dairy is one such mobile application specifically designed for dairy farming. E-dairy creates awareness among small dairy farmers in sending messages utilizing their mobiles to obtain their animal health, veterinary services, and other related just in time dairy extension services. It is backed by a developed database that can be accessed via messages by the dairy farmer and service providers (Qiang et al., 2011).

According to Martin and Abbott (2011), use of mobile phone is a technical process and however simple it is, can still pose a challenge to some users. For instance, there are other basic uses of mobile phones which can tend to be ignored but they are very useful to farmers. Unique uses include: use of the calculator to figure proper market pricing, use of the speakerphone function for group meetings, storage of agricultural information, voice recording of agricultural lessons, and use of the phone's camera for agricultural educational purposes (Martin & Abbott, 2011). This is made possible because, mobile phones can also be used as computers, wallet, camera, television, alarm clock, stop watch, calculator, address book, calendar, diary, newspaper, gyroscope, and navigation (Information and Communication for Development & World Bank, 2012).

The most popular feature on the mobile phone according to most studies is Short Message Service (SMS) (Hatt, Gardner, Wills, & Harris, 2013; TeleGeography, 2012; CAK, 2014; Information and Communication for Development & World Bank 2012). But the studies do not include modern applications for example *WhatsApp* and *Telegram* which is fast growing. Therefore, program officers have several options on

which features of the phone they can use to meet the information needs of dairy farmers, and which ones can be simpler to adapt to their target farmers.

Information Needs of Dairy Farmers

Informational needs of dairy farmers are those needs that arise from the dairy farming activities to which the farmers feel incompetent to address. Thus, the farmers require assistance from some other sources before taking a decision for action (Vigyan, 2015). Dairy farmers as they carry out their production function need information on a variety of topics and at different stages (Aker, 2011). The dairy farmers fill the gap through trial and error or rely on networks (Aker, 2011). Thus, the importance of information is not only important to the farmer as Aker points out, but also to the entire economy of the country. In fact, it is in the utilization of mobile phones for provision of vital information on agricultural practices that the problem of averting food crisis through can be tackled (Komen, 2012).

The Government of South Africa is well aware of importance of information to dairy farmer and has put in place an institution (referred to as Elsenberg) to provide information to dairy farmers in Western Cape Region of South Africa (Western Cape Government, 2016). This implies that access to agricultural informal is very important in enhancing productivity. Bhavnani, Chiu, Jankiram and Silarszky (2008) noted that access to information is essential in the emergence of global information and knowledge based economy. Bhavnani et al. (2008) further argued that access to information has the ability to empower poor communities, enhance skills, and link various institutions involved in poverty reduction.

The small-holder agricultural economy is in crucial ways information and service economy (McNamara, 2009). This means that the economic activities related

to small-holder farming including dairy farming rely on timely information and effective extension services. McNamara (2009) identified some information gaps by stating that small-holder dairy farmers lack information about input prices, available breed varieties, dairy production techniques, and methods of disease management—information that pertains specifically to local conditions. The smallholders also lack timely sources of information such as news reports or early warning communications about weather, pest outbreaks, and other seasonal risks, and about services that could help address such risks (McNamara, 2009).

Food and Agriculture organization (FAO) published a global level information pack that set standards in dairy farming titled *Guide to Good Dairy Farming Practices* (FAO, 2011). According to FAO, good farming practices for dairy production entails animal health, milk hygiene, food and water, environment and social economic management which is about managing risks associated with dairy farming (FAO, 2011). These guidelines by FAO are user friendly and contain relevant messages that program officers can disseminate by mobile phone to assist farmers to adopt good dairy farming Practice. However, the guidelines do not answer the questions of ‘how’ they can be operationalized to suit local environment. For example under animal health, the guidelines advises farmers to choose disease resistance breeds but no suggestions on how this can be done and which breeds are suitable for which geographical zones. This point to a gap that this study can fill by establishing specific information to assist farmers make decisions suited to their local environments.

The same guidelines of FAO (2011) are echoed by Technoserve, ILRI, Heifer International, and World Agro forestry Centre who are working together in a

consortium to improve dairy farming in Kenya and other East African countries. According to their 2008 unpublished report, dairy yields can be improved if farmers adhere to good dairy farming practises specifically poor and inadequate feeding and poor breeding practice (Technoserve, 2008).

According to Vigyan (2015), the past efforts for information dissemination are mainly supply driven rather than demand driven. Vigyan makes a plea to program officers to conduct information need assessment and prioritization studies especially well before developing any ICT based program. Therefore, to conclude this section on information needs, mobile phones can enable extension services to be more effective by sharing information or knowledge widely, enable dairy farmers to access information swiftly and improve dairy farming (Vigyan 2015). Existence of gaps in full utilization of mobile phones in the dairy farming implies that there are barriers that need to be addressed.

Barriers and Measures in Utilization of Mobile Communication in Dairy Production

As stipulated in the TAM, Behavioural intent is critical to adoption of mobile phone communication. There are two schools of thought that explain the relationship between mobile phone use (and any other information communication technology) and economic growth; Technophiles and Technophobe (Cleeve & Yiheyis, 2014).

The first barrier is the behavioural intent of the program officers – whether technophilic or technophobic. Technophiles are pro technology and believe that mobile applications will increase productivity, improve employment opportunities, upgrade the work of many occupations and help developing countries leapfrog stages

of development. Technophobes believe mobile applications may destroy more jobs than they create and that the gap between the rich and the poor, the urban and rural and the literate and the illiterate may widen

Behavioural intent may depend on which school of thought the program officers belong to and this will determine their likelihood to confidently use mobile phone communication in their dairy farming programs. But with uses and benefits of mobile phone communication highlighted in earlier section and the considering the purpose of this study, it is hoped that Program Officers will adopt a technophile approach and develop strong behavioural intent to adopt the mobile phone communication into their dairy programs. However, technophobic behaviour presents a barrier on use of mobile phone communication.

The second barrier is complexity of the mobile phone communication system which is one of the factors of the TAM – ease of use. According Brugger (2011), use of mobile phones in dairy farming projects vary in the complexity of technology used and agents involved, depending on the service offered. Brugger described a continuum of complexity from low to high complexity. Low complexity involves systems pushing one-way information that is generated automatically (e.g. price information, weather forecast) or offering information stored in a database. Medium complexity are systems that include location-based services for decision-support based on local climate and soil information (e.g. crop disease warnings). Content generation is more complex, but the systems still rely mainly on one-way communication. High complexity are two-way systems that provide individual feedback and advice (e.g. remote diagnosis), administer business processes and individual transactions (e.g. artificial insemination registration, individual information

for farmers on milk sales, quality, inputs, etc.) or enable user-generated content. These systems typically include the use of smart phones and intermediaries for the communication with farmers (Brugger, 2011)

A solution is proposed by a study by Hasan (2015) which highlights the aspect of TAM's ease of use. Mobile phone systems should be simple to use, fast and user friendly while the service should be standardized so that wherever the solution is used the farmer is familiar with the procedure followed (Hasan, 2015).

The third barrier has to do with content development, how relevant and timely and adaptable the content or is. This becomes even more complex if the content has to be localized to a particular geographical zone. According to Qiang et al. (2011), the issue of adaptability of content is critical since information can then be tailored for different contexts and locations. Content must be hyper local and tailored to user requirement even down to the village level (Qiang et al., 2011; Kuek et al., 2011).

A second approach to mobile communication is known as mFarming (Brugger, 2011). It explains further the issue of tailoring mobile information to local context). It involves individual decision-support systems and services based on localized contextual information. This is simply delivering location-specific (spatial) information based on microclimatic patterns, soil and water conditions throughout the cropping or breeding season, in order to inform decisions on dairy farming measures to optimize livestock growth. In essence, this is about making some key elements of precision farming available to small producers. M-Farming requires remote sensing instruments and GIS. It can also involve advice systems such as remote diagnosis of diseases by expert (Brugger, 2011). This system can however bring high level of complexity which may require extra attention to skills and capacity of users.

M-Farming is thus useful in that it can contextualize content which is important in making information useful to different context of dairy farmers in Kenya. This importance was stressed during a conference on mobile phone communication that was held in Maputo. The conference participants offered a solution to contextualization of mobile phone messages. The conference stated that it is critical to have information services developed by people who are working within targeted communities, so that the needs of those communities are clearly identified and local knowledge is used (World Wide Web Consortium, 2009).

This means that for mobile communication including mFarming to be adaptable to local situations, program officers need to interact with dairy farmers. This is a barrier which can turn into immense opportunity for growth if some innovative thinking is applied. A fact echoed by Hatt et al who proposes combination of mobile phone solutions by stating that while SMS/USSD based information in agriculture and transactional systems within mobile money are well established, services that combine these solutions are less prevalent providing further room for growth (Hatt, Gardiner, Wills, & Harris, 2013). Voice based mobile phone service especially the question and answer services can overcome the limitations of SMS platforms but they can be complicated to develop or require machines to use natural speech (Aker, 2011).

Use of mobile phone applications for agriculture and rural development (M-ARD apps) is another way with applications such as i-Cow and m-Farm available for use by program officers. These applications are SMS or USSD services and some are also voice based. They are packaged by mobile software developers and ready for use or they can be customized for dairy production program and to dairy farmers needs.

Kenya is a technological hub with over 500 mobile phone applications already developed and looking for programs to pilot and scale up their use (Information and Communication for Development & World Bank & World Bank, 2014).

As a disclaimer, new ventures are cropping up every day so dairy programs need to be on the lookout for current trends and latest development. On December 5 2016 Village Capital launched East Africa Agriculture Investment Market Place with funding from Schooner Africa Fund. A lot of agriculture start-ups based on mobile phone platforms were displayed and also documented. As with current trends, a hash tag was created and several people tweeted that organization like (Alliance for the Green Revolution in Africa (AGRA) and Africa Development Bank need to support such start-ups. All in all, this challenge offers immense opportunity for dairy program officers.

The final barrier is on roll out and sustaining the process. The challenge for programs officer is how to put into operation mobile phone communication for dairy farmers. Suggestions to put into operation mobile phone communication for dairy farming have been documented by various studies. Poblet (2011) who was talking about mobile for governance has ideas that can be used for in dairy farming. He proposes that the Program Officers should embed the mobile component into existing initiatives. The programs should use existing practises as starting point and focus first on basic skills (Poblet, 2011). This idea is complimented by Hellstrom who posits that the approach used by dairy programs should be evolutionary and not revolutionary (Hellstrom, 2011).

Hellstrom suggestions are in line with participatory processes in communication for development (C4D) which are old and tested and ones which

program officers should never lose sight of as they implement mobile phone communication into dairy farming. An empirical study that emphasizes on participatory communication is by (Kalugendo & McLeod, 2013) states that initiatives (such as use of mobile phones) should not be imposed on communities otherwise there will be no real engagement and change.

In his publication, Melkote (1991) highlights the evolution of C4D from pre-colonial ages to the 1980's. Though the ideas are dated, many are still very relevant today in the age of mobile phone communication. Kalugendo and McLeod (2013) focused their study on local community but in mobile communication, there are more stakeholders beyond local communities with varied interests for example the network operators and software developers whose aim is to make profit. Their need for profit can make rolling out use of mobile phone expensive and unsustainable. This is because communities do not have capacities to bear the costs and donor funding usually runs out.

It is important for program officers to consider carefully all the different development support organizations that are likely to impact on the mobile phone communication program for dairy farmers and then examine their communication needs, problems before planning intervention strategies (Melkote, 1991).

If program officers apply principles of communication for development as they implement mobile phone communication among the dairy farmers, the outcome can exceed those planned. For example farmers will use the mobile phones to fully participate in other development initiatives and demand accountability from those entrusted to manage development (Kalugendo & McLeod, 2013). Thus mobile phone communication should still be a mix of introducing the new without letting go of the

old. It is an opportunity for innovative community development that can lead to adoption of new community practises (even dairy farming practises) that respond to new circumstances and forges new linkages beyond the local levels (Goggin & Clark, 2009, p. 595). Use of participatory approaches and communication for development approach aids the ease of use of a technology as stipulated in the TAM.

With the theory of TAM, program officers need learn more and shift their attitude (Behavioural intent) so that they can be convinced first. Only then can they be fully prepared to rollout to dairy farmers or take initial rollouts to new levels. According to Goggin and Clarke (2009), mobile phone communication is an occasion (to Program Officers) for experimentation and opening up and rethinking community development practise.

Empirical Literature Review

A number of empirical studies on use of mobile phones with a focus on the farmers have been conducted. The studies that focus on farmers mostly recommend a system change in service delivery by government and other non-state actors so as to improve productivity through use of mobile phone. For example, a study by Mutunga and Waema (2016) targetting 442 small holder farmers and 50 key informants and 422 in Machakos County found that small holder farmers have challenges of using mobile phones. The findings indicated that 55% of farmers faced attitude problems on use of mobile phone, 30% lacked awareness on use of phone, 3% thought nature of information they needed cannot be obtained through mobile phones, 2% cited poor infrastructure, and 10% said they needed a champion so that they could become literate in mobile phone use.

One respondent (a dairy farmer extension worker) in Mutunga and Waema's (2016) study said, "Dairy farming is information intensive and requires round the clock real-time information. The information could only be accessed via mobile phone compared to crop farmers. I get more calls or SMSs at any time of the day from dairy farmers enquiring about the type of feed, how to eradicate ticks, preparation of fodder and where to get AI services among other things" (p. 76).

Mutunga and Waema's (2016) study made a strong single recommendation – for mobile phone use to go beyond receiving and making calls and be adopted as a tool for disseminating dairy information, government and NGOs need to create awareness of mobile phone applications. This would support rural livelihood and provide supporting infrastructure that could help to mainstream and integrate use of mobile phones into rural livelihood activities like dairy farming. This recommendation points to the gap of service delivery by NGOs and Governments that this study seeks to fill.

Adongo et al. (2013) did a study whereby data was collected from 100 dairy farmers in Kitui Kenya. From the findings, 99% of dairy farmers in Kitui use mobile phones. This finding implies that the trend of using mobile phones will continue as low cost handsets continue to emerge hence increasing mobile penetration. This explosion of mobile phone usage has the potential to improve service delivery in dairy farming by a massive scale (Mobile for Development, n.d p 2). Thus the study by Adongo et al. (2013) recommended that development agency to factor in costs of mobile use because currently their use among farmers is not optimal due to what the farmers term as high cost of operating the mobile phones.

Martin and Abbott (2011) conducted a study on the use of mobile phones in rural Uganda. They found that mobile phones can be used by dairy programs for the following purposes, which are referred to as Five Agricultural Mobile Phone Use Themes: to coordinate access to agriculture input, to provide market information, to provide agricultural emergency assistance, to monitor financial transaction and to provide consulting with expert advice. For the purpose of this study, the target population (program officers) who are tasked with improving dairy farming could be using these themes or may find these themes useful as they support dairy development in Kenya.

The Western Cape Government (2016) of South Africa commissioned consultants to conduct a diagnostic, formative evaluation of the research information needs of dairy producers in the Western Cape Programme. The focus was on producers in the Cape Winelands and Swartland regions. The study found out that there is indeed demand for dairy farming information which can be grouped into four themes – feeding, raising calves, cattle housing and reproduction (Western Cape Government, 2016). It is worth noting that South Africa dairy farmers are large scale farmers with 100 -1800 cows (Western Cape Government, 2016), whereas Kenyan dairy farmers are mostly small scale with 1 – 3 dairy cows (Wambugu, Kirimi & Opiyo, 2011). But the similarity is that a dairy farmer whether large scale or small scale have information needs that need to be met by either a government agency or NGO. So even though most of the empirical studies involve farmers, the recommendations seem to target government and other development agencies.

ChharChhar and Hassan (2013) in their study conducted an empirical study on the use of mobile phones by farmers in the third world context of Malaysia. The study

described the great benefits of mobile phones and recommended that the government of Malaysia and other related department should plan to reach the farmers and provide latest information about seed, weather and market on the time, as well as provide good price of their product.

Vigyan (2015) conducted a study in Karnal District, India on the information need to farmers. In the findings, Vigyan went a step further and prioritized the information needs from the most important to the least important. The study collected data from 60 farmers who were randomly selected from 3 villages in Karnal District of India. The ranking from the study was as listed in Table 2.1.

Table 2. 1: Ranking of Information Needs of Dairy Farmers in Karnal District, India

Particular Need of Farmers	Rank
Nutrition and feeding	1
Breeding and reproduction	2
General management e.g. milk hygiene, housing and sanitation	3
Healthcare management	4
Fodder production	5

Source: Vigyan (2015)

Prodhan and Afrad (2014) conducted an empirical study in Malaysia to find out what barriers agricultural support workers experienced as they attempt to use ICT in agricultural extension. The study sampled 90 out of 214 agricultural officers supporting farmers. According to the findings of Prodhan and Afrad's (2014) study, the barriers faced by the agricultural extension workers towards ICT utilization were conceptualized as consisting of four dimensions: organizational, personal, technological, and policy barriers. The study concluded that up to 80% of respondents had medium to high barriers towards ICT utilization. The study further recommended

better preparedness for the agricultural workers through higher training exposure, innovativeness and ensuring job satisfaction.

Conceptual Framework

The conceptual framework will look at the variables or conditions that have been put in place to achieve the purpose of the study which was to investigate dairy development programs utilization of mobile phone communication to support dairy farmers in Kenya. The conceptual framework illustrated in figure 2.2 borrows from the Technology acceptance model but adds some findings from the study that led to the use of mobile phones by program officers.

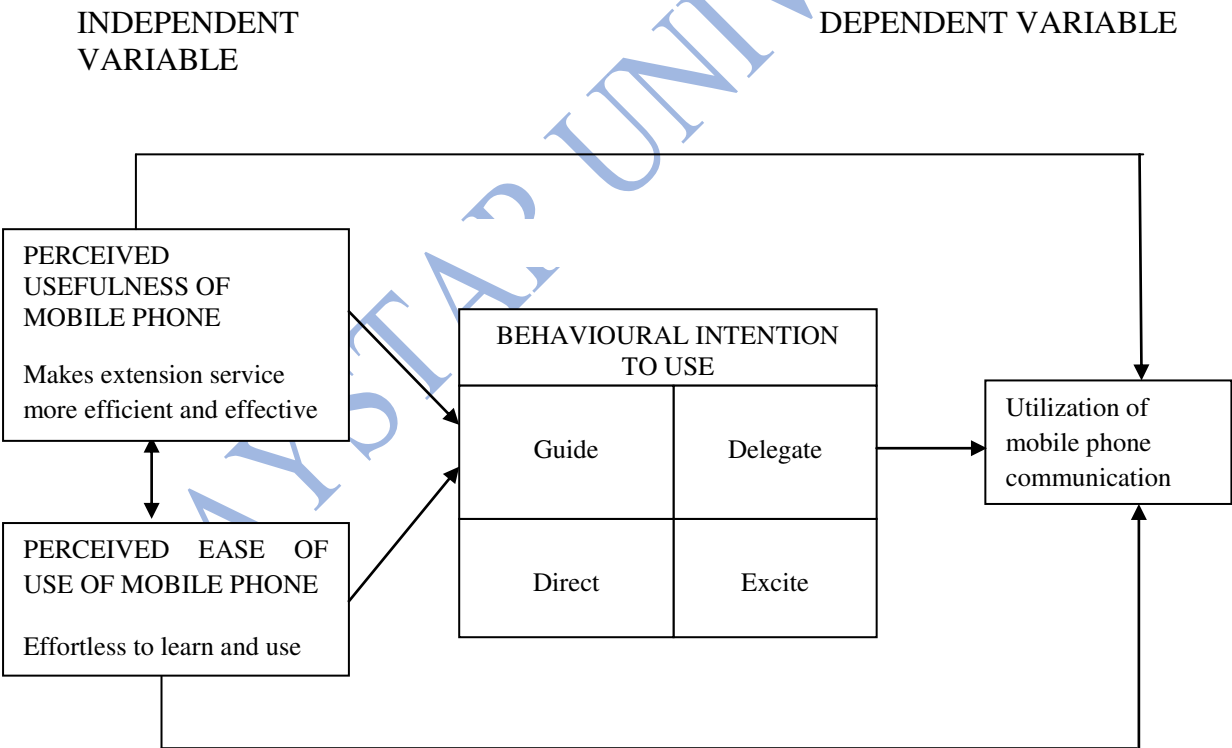


Figure 2. 2: Conceptual Framework adopted from TAM
Source: Author (2019)

Discussion

As shown in Figure 2.2, the main concepts are perceived usefulness and perceived ease of use, which together make up the independent variable. These are explained in detail under the theoretical framework. This study has established that mobile phone communication improves extension service delivery and program management and is thus useful not only to the program and organizations they serve but is useful to the farmer as well. The premise is that program officers as well as farmers will only use mobile phone communication if they consider it useful. The ease of use requires that the mobile phone communication be of low complexity so that using it or learning to use it is effortless. If a system is self-guiding so one can learn how to use it on their own, that is a true definition of effortless.

Behavioural intention is a measure of strength of one's intention to perform a specified behaviour. The relationship represented in TAM implies that all else being equal, people form intention to perform behaviours towards which they have positive affect (Davis et al., 1989). If the other parameters of ease of use and usefulness are in place, a user namely the dairy development program is then ready to make the final decision of using the mobile phone. Before reaching this final decision, the user has to pause and assess their strength or capacity to use the mobile phone communication system. This strength/capacity considers their individual attitude as well as their operational environment for example network availability. This pause before final decision to use is referred to as Behavioural intention to use.

This self assessment can be a barrier to using mobile phone communication. To overcome the barrier, a program has to categorize its users according to their willingness and ability to use mobile phone communication as discussed in figure 4.1

in Chapter 4. Four actions can then be prescribed – guide – for those with high will and low ability, direct for those with low will and low ability, excite for those with low will and high ability and delegate – for those with high will and high ability. For example, older people may need to be guided or directed and young people may need to be excited through showing them value. Those under delegate can be promoted to lead dairy farmers or advisors to other farmers.

Summary

This chapter has discussed relevant literature to this study which has confirmed that the ground for mobile phone communication is ripe for higher level communication, for example, for offering support to dairy farmers. The chapter has further revealed, through reviewed literature, that there are still gaps to be filled by development workers to ensure that mobile phone communication is relevant and suitable to local context of dairy farming and to assess their preparedness to address the gaps. The next chapter will provide the research methodology utilized in the study.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter presents the process the study has used to solve the research problem. It describes the type of research the study used and the corresponding data collection methods. Additionally, the population from which the data was generalized, as well as the actual sample that provided the required data is described. The chapter ends with ethical considerations and permissions that were required during data collection.

Research Design

This study applied descriptive and qualitative research design. Descriptive research design is useful for searching accurate information regarding the characteristics of the phenomenon of interest (Oladipo, Ikamari, Kiplang'at, & Barasa, 2015). Descriptive research design is appropriate for the description of a phenomenon, a situation, a group of people, or a community (Chandran, 2004). The characteristic under investigation is utilization of mobile phone communication. The phenomenon of interest was the program officers who support dairy farming in Kenya. The study conducted in-depth interviews with senior program staff leading dairy development programs in Kenya. The Senior Program staffs and the program they work for were the main units of analysis. The unit of analysis is the major entity that is being analysed in a study. It the 'what' or 'who' that is being studied (Igwenagu, 2016). To complement the data from program officers and their

programs, some farmers supported by the programs and the program officers were also interviewed.

Qualitative research seeks to find out the experience or view of a person or group of people so as to unearth the meaning and significance of human behaviour (Oladipo et al., 2015). In other words, it is a type research design that does not produce discrete numerical data. (Mugenda & Mugenda, 2003). The kind of information collected in this research was in words rather than numbers hence the qualitative nature of the study. Such information is best when describing the behaviour of utilization of mobile phone which cannot be quantified.

Population

The population for this study were dairy development programs in Kenya. According to the Kenya Dairy Board there were 15 organizations focusing on dairy farming in Kenya (Kenya Dairy Board, 2015). All except one dairy development programs are based in Nairobi. Though the focus of this study was dairy development programs, the researcher also sought to hear the opinion of dairy farmers. Therefore, the study population also included all small-scale dairy farmers in Kiambu County. The researcher did not find recent credible numbers on how many dairy farmers are in Kenya. A study that was done in 2011 by Food and Agricultural Organization found that there were more than 1 million small-scale dairy farmers in Kenya. Since then, there is no any other documented credible information on the number small-scale dairy farmers in Kenya.

Target Population

The target population in this study was 15 dairy development programs in Kenya accredited by Kenya Dairy Board. This is because Kenya Dairy Board is the authority given the mandate through the laws of Kenya to regulate dairy industry in Kenya (Kenya Dairy Board, 2018). The study focused only on those organizations that work under this mandate. In addition, this study targeted dairy farmers working under the 15 dairy development programs. However, the total number of dairy farmers working under the 15 targeted registered dairy development programs is not available because many dairy farmers are supported by more than one dairy development program. Adding up the number of dairy farmers under each program would not provide accurate information on the number of dairy farmers. For example, farmers supported by Sidai Africa were the same farmers supported by other programs. From the analysis of this research finding, the target population was approximately 637,100 dairy farmers.

Sample Size

The study carried out a census enquiry of dairy development programs. A complete enumeration of all items in population is known as census enquiry (Kothari, 2004). From the target population above, obtained from Kenya Dairy Board, the 15 organizations were within the capacity of the researcher to carry out the census. This implies that the entire target population of the study participated in this study. Budget limitations, organizational constraints, and/or lack of resources are just a few of the key issues to consider when deciding whether to opt for a sample or a census survey (Parker, 2011). With only 15 organizations and all based in Nairobi except one, which

was relocated from Nairobi to Nakuru, there was no constraint of resources thus the researcher had the capacity to carry out the census enquiry of the entire population.

For the farmers supported by the dairy development programs, purposive and convenient sampling was used. This was a qualitative study and the aim was to gain in-depth understanding of a group of dairy farmers. Dairy farmers are usually invited for meetings organised by the dairy development programs, thus during data collection, the researcher purposively sampled 10 farmers to participate in the FGD out of a total of 24 who were invited for dairy farmers' meeting in Gakui ACK Church Kiambu County.

Sampling Technique

For the program officers, census technique was adopted targeting all organizations registered with Kenya Dairy Board. A census is an attempt to list all elements in a group and to assess one or more characteristics of those elements. A census can provide detailed information on all or most elements in the population, thereby enabling totals for rare population groups or small geographic areas (Lavrakas, 2008). Use of census was appropriate for this study since it was a qualitative study and the researcher targeted only 15 representatives of the 15 dairy development programs

For the farmers supported by the dairy development programs, the study adopted purposive and convenient sampling techniques. The two sampling techniques were appropriate because the study was purely qualitative and the aim was to gain in-depth understanding of a group of dairy farmers. The techniques also allowed the researcher to select dairy farmers that have the required information with

respect to the objectives of the study. The criteria for selecting the dairy farmer was that the farmer who participated in this study must have been receiving support from the dairy development organization under this study, owned a mobile phone, and used the mobile phone to get extension support on dairy farming from the organization under study. The researcher chose a meeting organized by Sidai Africa which is a social enterprise that provides extension services as well as selling of dairy inputs. Sidai Africa targets farmers are usually supported by other dairy development program and therefore the invited farmers were already sampled from the target population of dairy farmers. Out of the 24 farmers invited for the meeting, the researcher purposively and conveniently selected 10 who volunteered to participate in the focus group discussion.

Data Collection Instrument

The study used in-depth interview schedule (See appendix C) to collect data from program officers. While in-depth interview schedule may have pre determined questions, these are not fixed and the interviewer did not have to follow a certain order in posing the questions (Oladipo et al., 2015). The researcher developed a semi structured interview schedule to collect the information. The interview enabled the researcher to obtain in depth information from the 15 targeted respondents under this study. Unlike a questionnaire that does not involve probing and clarification, the interview method enabled the researcher to clarify and get accurate information. Use of semi structured interview guide enabled the researcher to use both structured questions and with some open ended questions (Mugenda & Mugenda, 2003) and this enabled the researcher to steer the interviewees towards the research objectives. To

triangulate or compliment data from the Program officer, the study used one focus group discussion guide for the farmers. This tool is appropriate like in the case of this study when there are limited resources and the group dynamic of the farmers may provide more insights (Oladipo et al., 2015). The researcher did not use a tape recorder to record the interviews but used as a notebook and typed notes on the computer and also took to memory some information through non verbal cues.

Type of Data

The data collected was mostly qualitative information from the interviews and one focus group discussion for farmers. The researcher also collected secondary data from program documents and websites which contributed towards the research objectives.

Data Collection Procedure

In-depth interviews with the dairy development program officers were done using face-to-face method at various places that were convenient to the dairy development program officers and acceptable to the researcher. The researcher did not use any research assistant but solely collected all the data. In case dairy development program officers were away and were not available for face-to-face interviews, the interviews were conducted via phone calls and responses recorded. The researcher followed the guideline by Mugenda and Mugenda (2003) to establish a friendly relationship with the respondent prior to the interviews. The researcher strove to create an atmosphere of trust and confidence (Kothari, 2004).

To triangulate the information from dairy development program officers, the researcher collected data from farmers through one (1) focus group discussion. The

location of the FGD was picked by the program officers who were custodians of the farmers and meet them regularly in different locations. According to Oladipo et al. (2015), the recommended number of respondents is between 8-10 persons. The study focused on 10 farmers for the focus group discussion because researcher had access to 24 farmers and so could go for a higher limit.

Using the semi structured interview guide for in-depth interviews and focus group discussion guide, the researcher interviewed and facilitated discussions. She listened, observed and analysed while recording the data using physical notebook/electronic notebook. The electronic notebooks were laptop and mobile phone notepad.

Pretesting

The interview schedule for the program officers was pretested using one of the 15 respondents. With a census enquiry, there was no other respondent in the sample for the researcher to carry out a pre-test with. Qualitative research especially where in-depth interview is used as opposed to survey questionnaire allows for pilot feedback to be included in the main study (Holloway, 1997). Holloway (1997) argues that pre-test or pilot test could only be necessary if the researcher is not confident or is a novice. Further, contamination of data is less likely in a qualitative research according to Holloway and other proponents this argument. This is a debatable topic which calls for the researcher to make a judgement. The judgement in this study to include pre test results into analysis was made based on the fact that the same methodology has been followed in subsequent interviews so as to strengthen the findings of the main study. It is part of accountability to ensure the best possible use

of research results (Crosswaite & Curtice, 1994). The dairy program for pre testing was based on availability of the respondent and the Program Officer that responded first carried out the pretesting.

Reliability and Validity of Research Instruments

According to Bui (2004), reliability refers to ensuring that the research instruments are consistent and reliable to enable one produce the same results whenever they will be used. Therefore to check the reliability of the research instruments (interview guides) for this study, pretesting exercise was conducted. The pretesting ascertained whether the research instrument was reliable prior to actual data collection. If any errors were noticed, it was corrected before actual data collection.

Validity is used to determine whether research measures what it envisioned to measure and to approximate the truthfulness/confidence of the results (Field, 2005). For this study, content validity approach was applied to determine the validity of the interview guides whereby responses of the subjects from pretesting were checked against the objectives.

Data Analysis Plan

The qualitative data was analysed through visualization and grouping the information into topics guided by the research questions. Visualization is when researchers read through raw text from respondents and find themes or issues that recur in the data. (Kigongo and McAfee n.d). This requires creativity, discipline and systematic approach. All analysis were guided by the research questions and organized according to the research questions. Oladipo et al. (2015) stated that data

analysis can be done manually if the data set is not large. Since the total population was a small number of 15 interviews for program officers and one focus group discussion, the data was analysed manually through paraphrasing the responses and quoting respondents directly. There several pages of scattered written notes and the researcher read the notes thoroughly and understood the responses before starting to write the report. This is in line with Oladipo et al suggestion that the data should be systematically reviewed to identify patterns and explore ideas to explain the patterns (Oladipo et al., 2015).

Ethical Considerations

Ethics are social norms which focus on the behaviour that a person is expected to uphold in a particular situation in this case research (Akaranga & Makau, 2016). Research ethics is important in our daily life research endeavours and requires that researchers should protect the dignity of their subjects and publish well the information that is researched (Fouka & Mantzorou, 2011). The ethical considerations that this study will observe are as discussed here in after.

Prior to data collection, the research proposal was submitted to the University's Ethical Review Board (ERB) which checks whether the researcher has observed all research ethics. The ERB issued a report which was used to seek permission from National Council of Science, Technology and Innovation (NACOSTI). The researcher presented both the ERB report from the University and the Research Permit from NACOSTI to the respondents to show that the research is for academic purposes only.

Professional ethics were upheld by seeking permission to use any electronic recording device. Respondents were assured of their privacy and confidentiality. The researcher kept all information collected confidential and only used it for the intended purposes. This study was for academic purposes and not commissioned by any organization and this fact was made known to all respondents. All respondents voluntarily responded and no fee was paid out to any respondent. The researcher will avail research report to the respondents as several showed interest in reading it.

The researcher observed neutrality in the conduct of the study by not getting into the respondents' personal life. The opinion of each respondent was be respected without any alteration. The data obtained from the respondents was analysed and presented without any bias.

Summary

This chapter has provided the research methodology that was adopted to ensure that adequate data for this study is obtained. A descriptive qualitative research design was adopted and a census approach was used during data collection. A total of 15 respondents provided data for this study through interviews and a group of farmers also provided information through a focus group discussion. From the research methodology adopted, this research is practical, achievable, and was professionally carried out hence the objectives were met. The next chapter will provide the study findings by presenting, analysing and interpreting them.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

Introduction

This chapter provides the presentation, analysis, and interpretation of the primary data that was obtained from the field through in-depth interviews with program officers and farmers of dairy development programs. The data was analysed through understanding of the responses as they were being given out, reading of the responses and grouping the responses into various themes. The data is presented in qualitative form through words and few numbers to understand the frequency of the responses given. The data presented include the response rate of the respondents, their demographic information and a presentation of findings against each objective of the study.

Response Rate

The study targeted a census of 15 key informants from 15 dairy development programs registered under the Kenya Dairy Board. The exact number of key informants who were interviewed was 15 making the response rate at 100% including the respondent for the pretest exercise. The researcher did not alter the interview guide after pretesting but rather changed the way of controlling discussions, paraphrasing questions and clarifying for easy understanding. Thus, the guide used during the pretesting was similar to the one that was used for the other 14 respondents. According to Mugenda and Mugenda (2003), for generalization, a response rate of 50% is adequate for analysis and reporting, 60% is good and a

response rate of 70% and over is excellent. Therefore, the response rate of 100% in this study was excellent.

Presentation, Analysis, and Interpretation

This section presents the analysis and interpretation of the data that was obtained from the field during in-depth interviews with program officers working for organizations registered under the Kenya Dairy Board. The findings of the focus group discussion with farmers are also outlined in this section. Areas covered include: the background information of the respondents and type of the organizations they worked for; the extent of use of mobile phone communication by the organizations; the type of information dairy development programs disseminated to dairy farmers through use of mobile phones; barriers encountered by dairy farmers and programs in the use of mobile phone communication to improve dairy farming; and measures that could be put in place by dairy development programs to overcome barriers to the use of mobile phone communication to improve dairy farming.

Background Information of the Respondents

The study was interested in the position the respondents held in their respective organizations that were registered under the Kenya Dairy Board. The findings indicated that three of the respondents were managing directors or CEOs, two were heads of business, two were consultants in dairy farming, two were monitoring and evaluation managers, two were strategic advisors, one was an E-learning manager, and one was a regional program support manager. These findings show that the respondents of this study held different positions in their organizations thus the findings obtained were from different perspectives. This also means that the

dairy development officers who were respondents in this study were senior enough to provide credible and useful information. For ease of reference and confidentiality purposes, this study refers to all respondents as ‘Program Officers’ and each was given a code to differentiate them (see appendix A). This is because they were all officers from the dairy development programmes irrespective of their different positions in their respective organizations.

Nature of Organizations and Dairy Development Program Description

The study sought to outline the name of the organizations where the respondents were drawn from, the specific dairy development programs implemented by the organization, the duration the dairy development programs have been in existence, and the number of beneficiaries for each dairy development program. Table 4.1 presents the findings.

Table 4. 1: Name of Dairy Development Program, Description of the Program, Number of Beneficiaries, and Duration in Place

Name of Dairy Development Program	Program description	No. of beneficiaries	Duration of program
East Africa Dairy Development Program II(EADD)	A flagship dairy program implemented in Kenya and other 3 countries funded by Gates Foundation and implemented by a consortium of partners with different roles. The program worked to improve dairy production among small scale farmers through animal health, breeding technology, research and nutrition.	200,000	9 years Kenya program has closed in 2018 but regional office in Nairobi still operational to close in 2019.
HEIFER International	Runs various programs including Accelerated Value Chain Program works with Dairy Cooperative to improve dairy farming. They also the lead organization in EADD	60,000	5 years ongoing
Centre for Agriculture and Biodiversity International (CABI)	A knowledge management international organization that works with 22 County Governments in Kenya to improve extension services. They collect data using mobile devices given to extension workers.	18,000,000 globally	9 years winding up 2019

Name of Dairy Development Program	Program description	No. of beneficiaries	Duration of program
Technoserve	Agribusiness Development Program focuses on technology and innovation. Works with farmers to increase production, quality of milk and promote small scale dairy agribusiness.	110,000	10 years
Netherlands Development Organization (SNV)	Kenya Market Led Dairy Program seeks to improve markets for small scale dairy farmers. Dairy farmers are guided to produce for market and not for domestic consumption only.	100,000	10 years
Land O Lakes	Feed the future Kenya Innovation Engine was supporting dairy farming technology start-ups to make them competitive while also assisting farmers to improve productivity through technology and innovations.		5 years and wound up in 2018
Performer	Provides business development services to farmers specifically advisory services on food and nutrition, breeding and cows comfort.	300 directly and 100,000 indirectly	Ongoing Continuous program
Tenelope	Provides business development services to farmers especially dairy start ups or farmers who want to upgrade their dairy farms. Promoter of the smart cow mobile application	300	Ongoing continuous program
Dairy Africa	Provides business development services in breeding and dairy farming technologies that improve herd management.	1500	Ongoing continuous program
International Fertiliser Development Centre	2Scale Project Implements a dairy program that promotes use of dairy technology in Meru County Kenya. Gender component is important in the project especially empowerment of women farmers.	25,000	5 years
Micro Enterprise Support Program Trust	AGRIFIN PROGRAM -Financing the dairy value chain (among other selected value chains) – both farmers and processors or both (farmers who need to add value to their produce.	10,000	5 years
Kenya Market Trust	Phasing out the dairy Program that promoted informal milk markets by campaigning for hygienic practises promoting local informal standards of milk hygiene.	58,000	5 years – closed
Sidai Africa	Works with small scale farmers using the hub model to promote feed and nutrition. They manufacture dairy	250,000	Continuous support

Name of Dairy Development Program	Program description	No. of beneficiaries	Duration of program
	feeding supplements and support farmers who buy their products. The support is mainly through information sharing through capacity development.		
Small Holder Dairy Commercialization Program	Promotes agribusiness in dairy production among small-scale farmers in Kenya.	70,000	10 years
Kenya Market Led Dairy Program2 Kuresoi	Aid to trade project supported by SNV - The programs aims at making dairy farming profitable among dairy farmers by sensitising farmers on business side of dairy farming.	2000	5 years winding up 2019
Gakui Dairy Farmers group (This is a farmer group supported by SIDAI Africa)	A group of farmers who keep dairy and poultry and come together for ease of extension service provision, training and financing. Most are members of the local Anglican church which has opened a village bank for the farmers.	N/A part of Sidai Africa Beneficiaries	N/A

Source: Author (2019)

The researcher noted that most of the dairy programs deal with small scale farmers. But a bit of commercialization and agribusiness has been added to these programs thus some farmers are middle scale farmers with over 20 cows. All the programs just engage dairy farmers to improve food security at household level. Some engage dairy farmers to increase income through productivity of each dairy animal they keep. Hence the name of the dairy programs embrace such terminologies as “Commercialization”, “market led”, “competitiveness” “agribusiness” “innovation” and all buzz words that signify and mean that it is not business as usual in the dairy development programs.

The study further established that the main focus of the dairy development program was to change the attitude of the dairy farmers in a manner that they perceive dairy farming not only as a source of milk, but also as a source of income. This in

turn affected the type of information that dairy farmers were required to receive. For instance, one program officer had this to say during the interview;

Some of the farmers we engage kept dairy animals just to feed the children with milk without caring about the cost of keeping such an animal or the productivity. As long as the children are having enough milk to drink that was enough for them. (Program Officer 15, August 2018).

All the dairy development program officers interviewed explained that dairy development programs have a secretariat and work throughout the country through partnerships and collaborations with other agencies in the agricultural sector. The dairy development programs in Nairobi have deployed field staffs that are directly in touch with dairy farmers who are organised in groups, cooperatives or dairy companies. Some of the programs, for example Heifer International work through cooperatives and have spearheaded the formation of Kenya Dairy Farmers Federations (KDFF) which is a group of cooperatives in Kenya. Sidai Africa organization has created hubs in various parts of the country and has registered farmers through those hubs. The hubs serve as the main centres for information dissemination and trainings. One program officer was quoted saying this during the interviews;

Information to dairy development program is relayed through the cooperatives, the farmer group, the company or the federation which is in touch with the staff in the field dealing directly with farmers. Information from the farmers is relayed to the dairy development program secretariat through cooperatives, the farmer group, the company or the federation channels. However, this does not stop the individual farmers from joining and getting information from the various social platforms which they join or leave at will. (Program Officer 03, September 2018).

The nature of dairy development programs, how the programs are organized and who they work is important to because it determines how the information flows from the dairy development programs to the dairy farmers. The partnerships also

imply that dairy development programs are not experts in all things dairy. Partnerships and collaborations therefore create synergy in extension service delivery.

Duration of Implementation of the Dairy Development Programs

The researcher sought to know the duration of implementation of the dairy development programs registered by Kenya Dairy Board. Table 4.1, indicates duration of the programs, which range from 5 years to 10 years. Some of the programs are ongoing while two have closed. These findings show that the programs under this study had all existed for 3 years or more thus have some experience on mobile phone communication.

Number of Beneficiaries of the Dairy Development Programs

Beneficiary means the dairy farmers that utilize the dairy development program outputs. They are the persons that the programs aim at empowering by giving development assistance with funding from donor organizations. The study sought to know the number of beneficiaries of the dairy development programs in Kenya. The findings are illustrated in Table..... The number of beneficiaries range from 10,000 – 200,000. This means that the number of beneficiaries in this case dairy farmers is high compared to the extension workers and program staff who support them.

The program officers further explained that commercialization of the dairy development programs has led to a growing number of beneficiaries who are not active farmers. This has led to the coining of the terminology “dairy investor” to replace dairy farmers. A dairy investor is someone who has taken the risk and put in

some money for dairy farming with the hope of getting profit. One program officer had this to say during an interview;

Many modern dairy development programs deal with dairy investors by absorbing new ones or converting dairy farmers to dairy investors. These dairy investors are in most cases not full time in the farm. They have other engagements or are in full time employment and only engage in farming in the evenings or weekends only. However, whether dealing with dairy farmer or dairy investor, the goal is for the dairy farming to be run as a business. (Program Officer 09, November 2018).

Further, the study established that dairy farmers (beneficiaries of dairy development programs) are of different type based on their roles. The first category comprise of those who stay full time in the farm and do all the work with occasional casual labourers. These are mostly women who choose to stay at home to take care of their households and combine their productive and reproductive roles. The second category includes those who have full time jobs elsewhere and work with farm hands or casual labourers. They tend to visit their farms in the mornings and evenings and over the weekends. The third category includes those who stay away from the farm and have family or farm worker(s) who attend to their livestock and farm activities. They do what is commonly referred to as telephone farming, which is, calling the people in the farm to give instructions and to clarify if certain things have been done. They travel back home regularly to check on their investment.

All the three categories are usually small-scale farmers with 2 – 10 cows. The last category is pure investors. They invest heavily in dairy farming and hire farm managers (not farm workers) to handle everything in the farm. These are mostly middle to large-scale farmers with 50 to 100 cows and some have up to 1000 animals with many acres of farmland too. Dairy development programs normally deal with the first three categories. But there are several private companies that are running

programs targeted at the large scale farmers mostly selling systems, accessories and solutions that aid farm management and herd management including mobile phone solutions. The interpretation to this is that a development program has to be conscious on categories of dairy farmers. Those on the farms may not be experts at all and know very little on dairy farming. Technical experts on dairy farming are rarely on the farm according to one of the respondents.

Use of Mobile Phone Communication by Dairy Development Programs

The first objective of this study was to explore the extent of use of mobile phone communication by dairy development programs that are carried out by organizations registered with Kenya dairy Board. To achieve the objective, the study first sought to identify the specific features of the mobile phone that dairy development programs used in supporting farmers in Kenya. The findings show that all the program officers and all farmers who participated in this study indicated that dairy development programs use voice calls and short message services (sms) as the most popular feature of the mobile phone. A focus group discussion (FGD) with the farmers also revealed that the mobile phone features farmers find it easy to use include voice calls, short message service (sms) and M-pesa.

Further, 10 program officers out of a total of 15 that were interviewed for this study also indicated that camera is a frequently used mobile feature among dairy development programs, nine program officers identified Whatsapp, while seven identified facebook as a mobile feature utilized by dairy development programs. The findings show that voice calls and sms are the most popular and most basic mobile phone features utilized by dairy development programs, followed by Whatsapp, and then facebook. Least popular but upcoming feature is telegram which is capable of

hosting millions of people under one group. CABI is the only program that has indicated use of telegram as a platform for supporting farmers. This finding implies that easy to use text features are popular and there are emerging mobile phone platforms like WhatsApp and Telegram which are gaining popularity among dairy development programs and farmers. The emerging features incorporate use of camera and video which makes them practical in sharing dairy farming information.

The program officers from Performeter and SNV, EADD, Dairy Africa, Tenelope, CABI indicated that their dairy development programs in partnership with software developers have developed mobile phone applications to enhance communication with the beneficiaries. Such mobile phone applications include Smart Cow, Digicow, M-farm, and Usomi Lulu. These applications were all used to monitor milk productivity for each cow, record keeping on dairy farm data for example duration and amount of feed, calving cycle and veterinary appointments, amount of milk sold and other expenses.

In summary, the study established that the following are the major mobile phone applications that dairy development programs in Kenya use for communication to support dairy farmers: Ngombe Planner, EasySacco, Smart Cow, ArgoForce, DigiCow, Dairy-nomics, CowSoko, Digifarm, Mio, and Easyma. These applications work differently but commonly, they are used to monitor finances including farm expenses and milk sales, animal feed, veterinary appointments, cow milk productivity, calving cycle, and calf management. Ngombe planner for example is a mobile application and the farmer inputs information related to dairy production and milk yield. The application is lined to the monitoring and evaluation computer system in the program office. The Ngombe planner is then able to provide quarterly report that

helps the program officer intervene at farm level to improve the productivity of the dairy farmers or to encourage the farmer to keep up good practices. Figure 4.1 gives description of AgroForce while Table 4.1 provides a description of easyma.

This finding further show that apart from popular m-pesa, there are other mobile value addition services available through mobile applications (Apps). Mobile apps do much more than just relaying and receiving messages to include assisting in management and decision making by identifying gaps in dairy farming.

Secondly, the program officers were asked to explain the extent to which dairy development programs use mobile phone features for communication. Majority numbering 13 program officers generally explained that dairy development program use sms based system to send various alerts to dairy farmers on production, processing, and consumption of the dairy farming products. For instance, one program officer was quoted saying;

We use sms based system to send various alerts to dairy farmers on issues such as the amount of milk delivered daily, cumulative amount of milk delivered, how conversion of milk metrics from kilos to litres is done, notice of meetings, notice of new dairy inputs into the market, notice of discounts and sales for various dairy inputs, sale of animals, announcements about dairy open days and exhibitions among others. (Program Officer 04, September 2018).

The mobile phone features that emerging as popular and increasingly used by dairy development programs is whatsapp. Whatsapp is a free to download messenger app for smart phone. Whatsapp uses internet to send messages, images, audio or video. The service is very similar to text messaging except that whatsapp uses internet.

Whatsapp has revolutionised in sharing of information among dairy farming stakeholders. Dairy development program officers explained that Whatsapp feature

was used by dairy development programs to share information among dairy farmers, between dairy farmers and dairy development program staff, between input suppliers and farmers, between input suppliers and cooperatives, between cooperatives and farmers, between training program cohorts and any other group. Whatsapp can hold up to 256 mobile phone numbers in one group. This limits a group whatsapp group to 256 and any group with more than that number has to find another platform.

One program officer explained that many program staff are in whatsapp groups with dairy farmers and dairy investors. The whatsapp is used to share all kinds' information as what is shared is not regulated. Farmers in the whatsapp groups boast about how well they are doing, they ask questions in a sort of peer to peer education, they post pictures of their sick animals for advise on treatment, they post pictures of silage to get views on quality, they share information on calving stages of their animals, they recommend solutions that have worked for them and those that did not work, they name and shame suppliers and products that operated below expectations, they show off their cow sheds, they use it as a platform for selling and buying goods and services that support dairy farming like cow shed construction, sell of feeds and any feed supplements. In short, all things regarding dairy farming and related information are shared in WhatsApp platforms which are accessed via mobile phone.

The study also established that to some extent, dairy development programs made use of facebook application to disseminate information. Program officers interviewed in this study explained that facebook is accessible through mobile phones as well as personal computers and laptops and many dairy programs and dairy farmers belong to facebook groups. The study found that there are over 11 major dairy

farming facebook groups for Kenya that have quite a number of members. The most popular dairy development facebook pages as at 13th November, 2018 include Dairy Farming Kenya with a total of 268,324 members, Dairy Farmers Kenya with about 213,888 members, Dairy Ventures Kenya with about 31,000 members, Dairy Nation with about 4,166 members, among others. Unlike Whatsapp groups, facebook group administrator can regulate information and decide what to publish and can even stop discussions on a particular topic. For facebook groups, everyone can provide expertise in the group and this is an opportunity that is open to dairy programs in terms of relaying credible information on dairy farming.

Findings from a focus group discussion (FGD) with farmers revealed that use of mobile phones for dairy farming is not as prevalent as use of mobile phones for everyday life. Close to half of the 10 farmers who participated in the FGD indicated that they did not use mobile phone communication in dairy farming directly. They considered it as a tool of communication to call and text everyone including the dairy development program extension agents. Even the farmers who indicated that they did not use mobile phones in dairy farming said that they were generally fed with information about dairy farming from people who owned and used mobile phone as a source of information. Further, the study established that there was a group of digital dairy farmers, dairy investors and youthful dairy farmers who had recognised mobile phones as a critical tool for obtaining information on dairy farming. The focus group discussion among farmers had three farmers with smart phones and they indicated that they used Google search engine to get information on dairy farming.

From the analysis of this study, the researcher identified ten themes from the first objective of this study. The objective focused on extent of use of mobile phone

communication by dairy development programs to provide extension service to dairy farmers.

Some dairy development program officers interviewed indicated mobile phone communication was critical in enhancing service delivery in dairy development programs. One development program officer said this;

Dairy development programs are in daily engagement with their farmers by communicating with them using mobile phones through voice calls, sms or social media platforms. These daily communications does not involve all the farmers at all times, but it involves selected farmers for relationship building and informal updates on the state of affairs especially on the ground. (Program Officer 04, October 2018).

Some of the programs especially those that interact directly with farmer explained that the frequency of the communication varies with seasons. The programs use mobile phone communications with the farmers on a need basis. It can be scheduled on a weekly, monthly, quarterly or seasonal basis depending on the program's communication schedules. They responded that sometimes there could be so much need that the mobile phone communication is done almost on an hourly basis.

Study findings also revealed that dairy development programs to inform and mobilise farmers on various farming events such meetings, trainings, open forums among other events use mobile phone communication. For instance, one program officer was quoted saying as follows;

We use mobile phones to make calls and send texts to stakeholders especially to our farmers to inform and invite them for our events including meetings, dairy farming trainings, and dairy farming open forums among others. These are informative events, which are very critical for farmers to participate. (Program Officer 15, October 2018)

Findings from the FGD with farmers also confirmed that farmers get sms from dairy development programs alerting them on various events. When asked whether

they received support from dairy development programs via mobile phones, one farmer said;

Yes, we get sms to alert us on dairy development programs' events. Also, we can call when we are stuck with a decision we have to make with regards to our dairy farming activities and processes. Also we usually call and seek advice on some of the products or inputs we should buy. (Dairy Farmer, November 2018).

Further, the study established that mobile phone communication was utilized by dairy development programs to coordinate supply of inputs such as fertilizers, veterinary services, feeding supplements, and livestock accessories. For example, one dairy development program officer said;

We use mobile phones in our dairy development programs to communicate availability of farm and livestock inputs such as drugs for various crop and livestock diseases, fertilizers, food supplements for livestock, and modern farming methods. We further inform farmers of our discounts and offers on certain inputs to encourage farmers to take advantage and buy during the offer periods so they can save money. Our mobile phone applications like 'easyma' has incorporated input suppliers into the software thus enabling the mobile phone to be a one stop shop for farming inputs. (Program Officer 07, August 2018).

The study findings revealed that mobile phone communications among dairy development programs averts conflict by improving transparency. Lack of transparency is one of the major causes of conflict between farmers and their cooperatives specifically transparency in milk delivered. One program officer was quoted saying;

Sometimes we do receive complaints from our dairy milk farmers that the amount of milk they supply does not tally our records thus affecting payments. This can be as a result of genuine human error but also as a result of unscrupulous practices by cooperatives which are meant to swindle farmers of their milk income. For this reason, we designed a computer-mobile phone system called Ngombe Planner whereby upon delivering milk, the amount of the milk is entered into a computer and the farmer receives an immediate sms alert on quantity of milk delivered. The mobile phone system also contains conversion of milk from kilogram to litres thus providing accurate weight/quantity. (Program Officer 04, October 2018).

Further, the study found that mobile phone communication monitors dairy cow productivity through use of some mobile phone application for dairy herd management. The application phone is used to monitor productivity of a cow and compare it with some standards set. This comparison between current productivity and set standards highlights good practices or gaps which then can act as lessons for dairy program intervention. These records are not only relayed to the farmer but also to the dairy development program that are able to have cumulative report on cow productivity among the dairy farmers under their program. For example, one program officer explained as follows;

For us, if a cow is supposed to produce 25 litres per day and is only producing 15 as recorded in our mobile application called Smart Cow app, our dairy development program staff will pay close attention to that farmer by calling or texting him/her and invite him/her to our offices or alternatively visit the farmer. (Program Officer 10, October 2018).

The researcher learned Smart Cow mobile application has about 1000 subscriptions that he directly supports according to one of the respondent who has been promoting its use. With this app, a development practitioner is able to plan interventions that can improve cow productivity and cost management at the dairy venture. One program officer explained;

Smart Cow mobile phone communication application records the time of milking a cow and the amount of milk the cow produces. It also records the feeding system of a cow referred to as total mixed ratio (TMR). The application also captures the weight of a cow, lactation of a cow, physiological scale of a cow vis a vis the milk production. Further, the Smart Cow store information on cows to be inseminated after 90 days and the cost, and monitors the fee and interprets it for the farmer at a cost of Ksh. 200 per month. Also, Smart Cow is able to monitor the growth of a calf e.g. the calf should attain 60% of mothers' weight before insemination. The application is also able to calculate profit or loss per animal. (Program Officer 10 interviewed on October 2018)

Some dairy development program officers indicated that mobile phones were utilized in their respective programs as tools of knowledge management. For example, one program officer from EADD indicated that the organization has developed content on dairy farming that is available on mobile phones. CABI in their response also indicated that they are experts in generating content that provides solutions to farmers. The content is not directly available to farmers but the field officers on the ground have access to it and can download it and disseminate to feed into the existing information needs of the dairy farmers. Other findings indicated that other organizations like Sidai Africa are also in the process of developing an online knowledge portal for all livestock stakeholders including program staff and even dairy farmers that can be accessed through use of mobile phone.

Further, the study established that dairy development programs to provide financial advisory had used mobile phones. There are credible financial records on how much a farmer has earned from milk based on the cumulative information stored in mobile phone systems. The program officers explained that this kind of information can be presented to the bank to access loans. In addition, it is used by input suppliers to advance inputs to farmers on credit. In other words, the credit worthiness of dairy farmers can be determined through the data that is stored in the mobile phone system.

The study also established that dairy development programs utilize mobile phone communication for efficient and effective program management. For instance, one program officer was quoted saying;

Without mobile phones, one is forced to travel frequently to various locations or post messages on radio. But with bulk short message service, one can send thousands of messages at the click of a button. There is more interaction and

peer to peer learning which improve overall dairy development program outcomes even when a program officer is not physically present (Program Officer, November 2018).

With the ability to relay information quickly without moving around, the program is able to save time and other resources while realising the results it desires.

The study also found that mobile phone communications provides immense benefits to the entire dairy value chain. Dairy development programs use mobile phones because the benefits accrue to all stakeholders in the dairy value chain from input supplier to the consumer. One program officer was quoted saying the following during interview;

Use of mobile phone in communication has provided the grease that eases information flow back and forth along the dairy chain. Our members of staff who are dairy value chain facilitators provide communication linkages that facilitate the flow of information between the secretariat, the field officers and the farmers. We have a mobile phone application called 'agroforce' whereby our entire dairy value chain is connected on one platform (Program Officer 12, November 2018).

Figure 4.1 shows how an 'agroforce' mobile phone application provides ease of information flow in the entire dairy development chain.

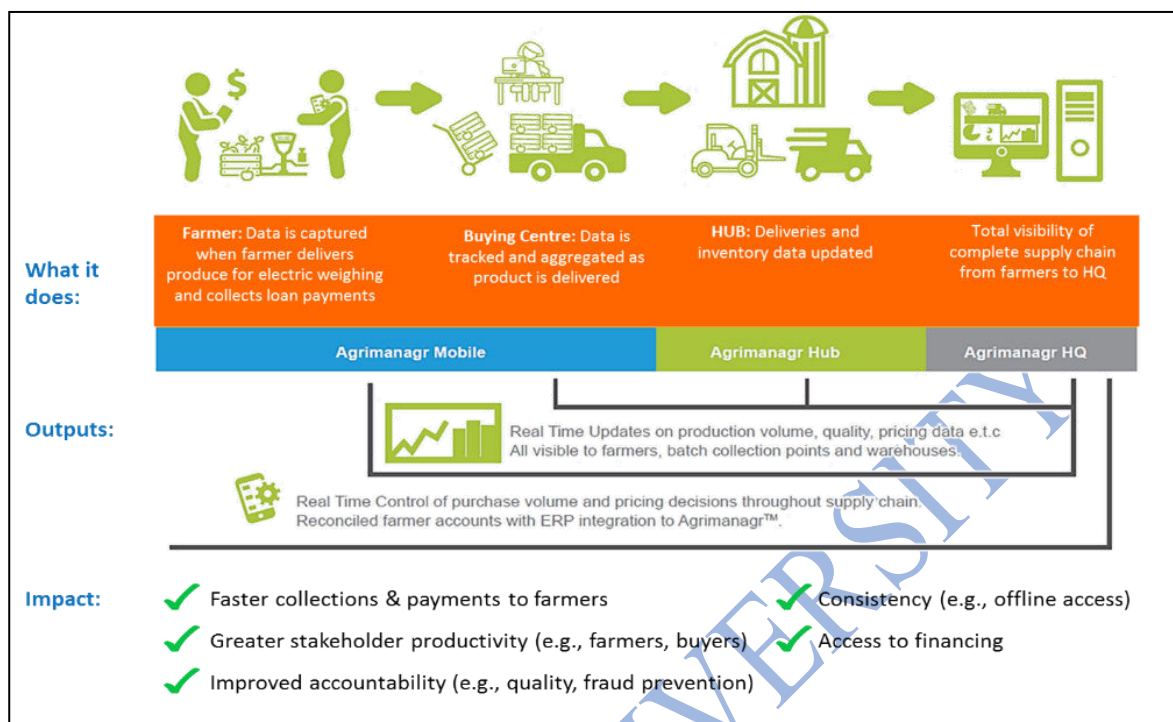


Figure 4. 1: Information Flow in Agroforce Mobile Phone Application

Source: www.virtualcity.co.ke

The study through secondary information provided by one of the Program Officers further found that the agroforce mobile phone application is applicable to dairy farmers as well as other type of farm produce. Its immense benefits include 15% increase in net attributable income, 5% reduction in rejection of produce from sampled farmers, 5% increase in volume traded, 10% increase in annual turnover, cost of inputs vs. income drop from 64% to 13% over 1 year, and nearly 800 farmers have received loans attributed to different uses by the farmers of the application (Virtual City, 2018).

Another mobile phone communication application used by dairy development programs as indicated by respondents is Easyma. Table 4.1 shows the description of Easyma, one of the products that was promoted by USAID's feed the future Kenya Innovation Engine that was implemented by Land O' Lakes Kenya.

Table 4. 2: Description and Impact of Easyma Mobile Phone Communication Application

Eastma: It's a comprehensive Dairy Management System that has been tailored to track all the farmers' details, payment details, sales, Agro vet solutions. It also has SMS functionality and Insurance premium tracking. It's been implemented and deployed in over 30 SITES in Kenya with over 288,000 registered farmers

Summary of impact of Eastma: By providing a one-stop automated supply chain solution to improve transparency and record-keeping within the dairy value chain, Amtech Technologies Ltd.'s EASYMA 6.0 is transforming dairy farmers' lives in Nandi and Bomet Counties. Developed and tested using seed funding and technical assistance from USAID via Feed the Future Kenya Innovation Engine, the innovation is enabling almost 11,000 members of Kabiyet and Siongiroi dairies to access extension services, financial products, and even livestock insurance through several state-of-the-art modules incorporated into this web and mobile-based system. Improved access to extension services and farmers' growing confidence in the weighing and payment processes has also led to a rise in productivity and enhanced delivery to dairy plants

Source: Land O'Lakes (2016)

Table 4.2 shows the list of the benefits as were provided by the respondents of this study (Program Officers).

Table 4. 3: Benefits of Easyma Mobile Phone Communication Application

To dairy development program	To dairy farmer/investor
<ul style="list-style-type: none"> - Helps in Program reporting. Ngombe Planner generates 3 months reports - Cow productivity monitoring – to know what interventions one can plan to support the farmer - Transparency in milk delivery and payment - Provide answers to questions asked by farmers - Peer to peer learning - Quality program outcomes 	<ul style="list-style-type: none"> - Follow up clarification of dairy farm decisions concerning health, inputs and processes especially after training. - Cow productivity monitoring – to know best practise to keep up and bad practise to avoid - Transparency in milk delivery and payments - To ask questions to be answered by program dairy experts - Peer to peer learning - Quality assurance of dairy inputs and milk - Creditworthiness is checked for easy access to formal financial products

To summarise on this objective, mobile phone communication is used on a need by need basis ranging from hourly to quarterly to enhance service delivery. The service delivery is enhance because mobile phone is used to; mobilise farmers for events, coordinate supply of dairy inputs, avert conflict by improving transparency, monitor dairy cow productivity, manage knowledge, provide financial advisory,

efficiently and effectively manage dairy development programs, serve the entire value chain and not just farmers.

The Information Needs of Dairy Farmers

The second objective of this study was to find out the type information the dairy programs need to disseminate to dairy farmers through use of mobile phones. First the study sought to know the importance of dairy information to farmers. All respondents agreed that information is critical in dairy farming. During an interview, one program officer said, “Now that dairy farming is a business and an investment, dairy farmers need information to assess cost of dairy inputs vis a vis returns from sale of milk” (Program Officer 01, October 2018).

Another program officer said this;

There is a big information gap among dairy farmers. That is why dairy development program are busy using mobile phones to disseminate information to dairy farmers. Dairy farmers don't know the farming issues affecting them. For example, you find that professional farmers don't know basic concepts in dairy farming like 'dry matter'. In addition, some of the dairy farmers are illiterate and semi-illiterate thus they know little (Program Officer 09, September 2018).

Another program officer added;

Information is lacking in the dairy farming sector hence the need to provide information in the sector. There is a lot of data and research in other sectors compared to the dairy sector. The government doesn't have information on milk production in Kenya hence the need for information for planning purposes because if you cannot measure, you cannot control it. (Program Officer 10, October 2018).

The study further established that dairy farmers needed practical information that they could apply to improve production. Dairy farmers milk twice a day and sell milk daily so a lot of information is needed in this intense farming activity. This information is best provided using mobile phone communication applications such as

Whatsapp, Telegram, YouTube and Facebook. The program officer from Performeter Organization had this to say;

Whatsapp messages show dairy farmers live practical information that they can use to yield more milk. This is quite easy and cheaper compared to going to televisions and talk on how to improve dairy production. Farmers looking for consulting services on practical information on how to improve dairy production and Whatsapp videos have really helped in providing such information (Program Officer 09, September 2018).

These findings have shown that information is of great importance to dairy farmers hence the need to communicate efficient and effective information on productive dairy farming. Secondly the program officers were asked to explain how dairy farmers operated if they did not have information. Findings indicated that without information, dairy farmers operated with the little traditional information they had thus low production. One program officer said, “Without information, the dairy farmers will go back to their old ways where cost of production is so high, productivity is very low, eventually they will give up on dairy farming and the sector will collapse.” (Program Officer 04, September 2018). Another program officer added that, “Without information, diseases will kill the cows because the farmers will not know what to do when the cow is sick” (Program Officer 03, September 2018).

Another program officer added;

Without information, the farmers will not maximise on the potential of their animals for example, a cow with potential to produce 20 litres will only produce 5 litres. Many will keep cows just because culture demands it. In addition, the income level of farmers will be low and we will not hear of stories such as a farmer being able to pay school fees and take care of other household needs using sales from milk (Program Officer 04, October 2018)

A program officer from Kuresoi, who is also a consultant in dairy farming, was also quoted saying;

It is a taboo not to have cows even if they make losses for the household. The families somehow find income from other sources to sustain their loss making

dairy ventures. So many households have low income and are poor without knowing that they can use the same cow to make some income. So we use information to change the attitude of the farmers towards cows so that they can turn it into some profit venture (Program Officer 15, September 2018).

A program officer, who is also a dairy expert, had this to say in relation to information needs,

I have supported dairy farmers and this is the information they need: feeding, young stock management, cow housing and comfort, milking –hygiene and procedure and quality, quality of foliages, quality of the herd (body condition, handling of cows and how they appear, breeding and fertility, skills and supervision required for farm managers and dairy workers, records – recording management technical records and financial records, waste management and manure, risks and security – from thieves and diseases. (Program Officer 09, September 2018).

Based on the study findings as reported by the program officers and the farmers, the researcher summarised the information needs of the farmers as presented in Table 4.4.

Table 4. 4: Information Needs of the Farmers

Information Need	Explanation
Information on Inputs	This involves proactive things the farmer can get to keep the cow healthy, comfortable and relaxed. Includes input on animal health like vaccines, cow shed construction, equipment for cow comfort and security and latest varieties of inputs in the market
Information on feeds and nutrition	This is information on nutritional supplement, feed and feeding system, fodder production, making silage, preserving silage.
Information on Calving Cycle	Breeds and breeding technology, Artificial insemination, calf rearing, duration of milking before calving, drying a cow, calf rearing
Information on milk handling and hygiene practises	Cows must calve to produce milk and the lactation cycle is the period between one calving and the next
Market information	Standards of hygiene required for quality milk, milk storage, treating a cow teats and treatment for the teats
Environmental conservation	Price of milk, supply vs. demand of milk
Information on credibility of service providers	Conservation methods to mitigate climate change e.g. tree planting and use of bio gas, making organic manure.
	Dairy farmers have been conned and they need information on credible products and services.

Source: Author (2019)

From Table 4.3, the information needs are vast and varied and dairy development programs may not be experts in all information needs. This, according to one of the program officer who is also a founder of a dairy development program, is the reason why there is partnerships and collaborations so different programs can handle different areas of information. For example, Kenya Market Trust focuses on milk marketing but at policy level. East Africa Dairy Development Program is a consortium that consists of experts in different areas; Heifer International are experts in Animal Health, ABS are experts in Breeding technology, ICRAF are experts in feeds and feeding system, ILRI are experts in research and development and Technoserve in milk marketing program.

These responses from the program officers imply that with dairy farming, the thirst for information is so high and sometime it is only mobile phone that can relay the information needed. Relaying required information in the dairy farming sector through mobile phones can bridge the information gap thus phasing out the usual way of doing things and adopt recommended modern ways of doing dairy farming. These findings further mean that the nature of information that dairy farmers need is driven by the need to shift from the cultural way of farming to having a business mindset on the farm. It is informed by the need to increase productivity of the cow and to maximise potential of the available resources needed for dairy farming for example land. Through sufficient and effective information, farmers are also able to make their voice heard. According to responses, the farmers complain about bad products, poor services from dairy service providers, poor management by their cooperatives, complain of government services and also complain about the weather. So it is not only about the information they receive but also the feedback they give.

From the whatsapp groups and facebook pages, the researcher found as was already stated that dairy farmers are in search of new information that they can use to improve their milk yield. It is this information gap that has led to emergence of private companies who are specialised in providing consulting services to dairy farmers at a fee. Many of these companies promote use of technology like mobile phone to productively manage a dairy farm. For example, smart cow is promoted by one of the dairy consulting agencies. They run successful businesses by filling in the information gap.

The study further sought to understand the source of standards for information in dairy development. Responses from dairy development program officers indicate that various dairy development programs are using different agencies to provide standards of the information that should be availed to dairy farmers. But in summary, the study established that the following bodies were identified as the source of standards of the information that should be availed to farmers: Ministry of Agriculture of Kenya, International Fund for Agricultural Development, Dairy Farming Research Organizations, and Internal Standard Operating Procedures of respective organizations. Whereas it is generally agreed on the type of information needed by dairy farmers, specific standards on certain details are not clear for example cow infrastructure. One program officer said, “I was shocked when I looked at a cow shed that a farmer spent a lot of money constructing having been guided by a major stakeholder in the dairy industry. It is such a bad cow shed that cost a lot of money.” (Program Officer 10, September 2018). The program officer added;

Middle to large scale farmers use international standards from Ireland, Netherlands and South Africa and calibration of the mobile technology they are using is based on these standards. But there is a general lack of locally

available standards. So this means that farmers can receive information without having a credible body to check the validity of the information (Program Officer 10, September 2018)

The Kenya Dairy Board which is the government organ mandated with matters dairy is focused on milk and milk hygiene but provides little else in terms of dairy husbandry. There are also foreign based standard from Ireland which provide critical performance indicators in numbers of in dairy husbandry. One of the program officers gave the following as the key issues that dairy farming information look at based on Irish standards which are also locally applied: dairy farm production, conception rates, days to first heat, first heat, days open – after calving, calving interval, serving per conceptions, mortality rate, feed conversion rates, and profitability index. The indicators and standards to these dairy farming issues are constant and should be uniform everywhere. There is slight variation on the standard between the various breeds of dairy animals. The standards should be uniform but it is the management style that changes based on local resources available to support dairy farming. For example, a heifer is supposed to be on first heat after 12 months and this should not change whether a calf is in Garissa or Limuru, Kenya. The feeding system however greatly varies between the two locations.

Respondents were asked to rank the dairy information needs. The findings revealed that feed and nutrition was the most important dairy information need for dairy farmers as ranked by dairy development program officers and by the farmers. This was followed closely by fodder production, breeding and reproduction to complete the top three needs. The top two most important dairy information needs, that is, feed nutrition and fodder production have to do with feeding the cow. So it can be concluded that to know what a cow feeds on is the top need of a dairy farmer.

Some respondents thought the issue of ranking the information needs not useful. One program officer was quoted saying “We need all information pillars to support the development of cows and all information needs to be applied wholesome. It is like a three-legged stool.” (Program Officer 04, October 2018).

Barriers Encountered when Using Mobile Phone Communication in Dairy Farming

The third objective of this study was to identify barriers encountered by dairy farmers and program officers in the use of mobile phone communication to improve dairy farming. First, respondents were asked whether they considered themselves technophiles or technophobe when it comes to use of mobile phones in the dairy development program projects.

Out of the thirteen dairy development program officers who were interviewed, eleven of them considered themselves as technophiles while two did not provide valid answer because they felt they do not belong to either extreme. The farmer groups during the focus group discussion also did not categorise themselves as either technophile or technophobe. Many of them said “if we are taught how to use the mobile technology, we will use it”. It was therefore inconclusive to categorize the farmers as either technophile or technophobe. Through observation during the focus group discussion, the researcher noted that 3 farmers had smart phones and one of the program officers gave an estimate that up to 30% of the farmers owned smart phones. It is no wonder then the main mode of communication is sms or voice.

The study established that there are various barriers program officers and dairy farmers face in using mobile phone communication in dairy production. The first barrier the study found was human capacity and behaviour in using mobile phone

communication to enhance dairy productivity. This includes age of the farmer and attitude towards their age. One program officer had this to say during interview, “Many of the dairy farmers are above 60 years. At that age, they are used to earlier extension officers who went to see them face to face.” (Program Officer 07, August 2018).

All the other program officers also mentioned age as a barrier in using mobile phone communication technology to improve dairy productivity. For example, one program officer said in an interview;

All the farmers in our data base are above 45 years. Due to their age, they do not embrace mobile phone technology as fast as youthful farmers or as they are referred to – digital farmers. The digital farmers are youthful and they are the ones in the Facebook and WhatsApp groups exchanging ideas (Program Officer 01, October 2018).

In FGD with farmers, one farmer quipped;

We ask the young people to get us the information we need from their smart phones and then they explain to us. This is simply because most of us in our advanced age don't know how to use digital mobile phones to get the information we need about dairy farming especially on feeding and diseases affecting our dairy animals. The phones we have are for calling, sms and Mpesa. But if you teach us how to use those phones with brains (smart phone), we will use them (Dairy Farmer, November 2018).

This finding indicates that these older farmers though challenged have found out a way of going round the problem-asking young people to read and interpret the messages for them. Thus the farmers have discovered a workable model for them by forging relationships that enable mobile phone messages to be understood by some older farmers. One of the program officers noted the following during interview;

Some farmers are old, feel old and are not interested in mobile phone communication technology. Not because of age but because of their attitude towards their age. With this, it is possible some feel old at 50 years while others feel like they are just getting started with learning new things (Program Officer 06, November 2018).

The above response from Program Officer 06 implies that age and how old one feels is an attitude issue.

Irrespective of age, this study established that there are other human capacity barriers mostly relating to skills required to use the mobile phone communication in dairy farming. For more advanced mobile phone applications, certain skills are needed and many farmers and even program staff do not have the required skills. One program officer said that the dairy management mobile phone applications like Smart Cow and Easyma requires one to interpret the data from the mobile communication system, understand it, and be able to explain the implication and what next course of action should be. The absence of these skills among farmers and some dairy development program staff makes adoption rate of such mobile phone communication applications to be low. For example, Smart-Cow has only 1000 subscribers. Where there is massive campaign to educate and impart skills, the number of subscribers is higher, for example Easyma has 280,000 subscribers but it is not clear whether all these are farmers or just program staff or officials of the dairy cooperative.

The study further established that attitude is not just about age, but it is mostly brought about by how a mobile communication system was introduced to the farmers and the timing of it all. Some attitude issues are personal and caused by individual challenges but others are communal. One of the program officers said this:

We introduced a mobile phone communication application which was easy to use but the timing was all wrong and we have derived lessons from that. We introduced the application during Kenya's political campaign period. Everything that was being introduced that time was looked at from a political perspective and adoption of the application by the farmers became a problem. In addition, we did not have a lead person among the farmers to champion the adoption and use of the mobile phone application. Armed with lessons, we are now planning to re-introduce some mobile phone technology that will ease training and information transfer to the farmers (Program Officer 01, October 2018).

The second barrier that the study established is internet and network failures. This barrier is technological and infrastructural in nature. The respondents reported that rural farmers do not have access to fast and affordable internet thus it is difficult for them to use applications like smart cow and easyma which require faster and reliable internet. Despite efforts by communication authorities to avail network in all parts of the country, there are still some rural areas where mobile network availability is a challenge. This hinders mobile phone communication in such areas. In addition, the study found that there is an issue with power supply in many parts of the country despite the on-going rural electrification by the government of Kenya.

The third barrier that is also technological and infrastructural in nature is that that some phones owned by Program Officer and farmers have limited features and storage space thus becomes difficult to download needed information. Downloading of mobile application takes up mobile storage and one needs to invest in a more expensive smart phone to enjoy all the features that accrue from dairy farming mobile applications. One program officer asserted that;

Some farmers do not see the need to invest in an expensive phone. They find it difficult to enter data into the mobile phones. They feel that dairy development programs are asking for too much information which they do not find useful. They do not know that the data can assist them in managing their dairy livestock better for improved productivity (Program Officer 04, October 2018).

The study also sought to know the perceived difficulties of using the mobile phone communication. Therefore respondents were asked to highlight what they find difficult about use of mobile phone communication to support dairy farming. The farmers said the reason they find it difficult to use mobile phone communication is because they think it denies them personal touch with program officers/staff since to some extent technology is replacing face to face interaction. This is because in Africa,

social lives and regular interactions have been entrenched in the traditions and culture. Mobile phone communication inhibits such face to face interaction and this acts as a barrier towards embracing mobile technology by farmers.

Further findings of the study indicated that there are barriers of using mobile phone communication arising from betrayals that farmers experienced. For example, it was established that not all stakeholders of a dairy development program are honest. One program officer said that the mobile communication digital space has been invaded by conmen and copy cats. Farmers become vulnerable to such unscrupulous people and it takes one person to be conned then spread the word around increasing level of mistrust with this technology.

All the dairy development program officers who participated in this research explained that they were not part of the dishonest practices. However, their efforts to promote dairy production are being affected by conmen thus leading to farmers having trust issues with their mobile phone applications. In addition, trust issues were as a result of low exposure to modern mobile phone technology. Low exposure means that farmers do not trust the technology especially where the technology is replacing cash. One of the program officers said the following during interview;

Due to trust issues, we introduced a system whereby farmers' cash was transferred to their phones and to their banks. However, several farmers rejected the system instead preferring to stand in a queue to receive payment in cash. The only cash payment system they use is Mpesa but again they try as much as possible to avoid it. Most of our farmers love receiving money in cash and any attempt to introduce a new technology that replaces cash payment is treated with a lot of suspicion (Program Officer 14, October 2018).

The study also established that lack of frequent training of farmers is a barrier in embracing mobile phone communication in support of dairy production. Findings indicated that farmers need training on use of any new mobile phone technology even

if the technology seems to be easy and simple to understand. All the dairy development program officers interviewed pointed out that their development programs have a component of training farmers and other stakeholders in their program activities. One of the program officers interviewed was an e-learning manager tasked with promoting e-learning platforms including use of mobile phone as a source of information. He said;

Without training farmers frequently, they will not accept any mobile phone technology that is introduced to improve dairy production. They need to be trained and they understand the purpose of the technology and how it will help them increase productivity. This does not apply to farmers only, but it also applies to program staff as well who need higher level training to be able to interpret and explain implications of the mobile phone communication technology to farmers. (Program Officer 01, October 2018).

The findings imply that any dairy development program that does not work out an effective training program for farmers and its staff before introducing a mobile phone communication technology will encounter challenges in convincing the users to adopt the technology. The training should not only target farmers and dairy development program staff, but also any other stakeholders relevant to the adoption process, for example some select dairy cooperative staff members. A program officer from Heifer International Organization said that their organization “is specifically building skills among dairy cooperative officials so that they can support our farmers. It is through these trainings that the cooperatives working with us have adopted use of mobile phone communication applications like Easysacco.” (Program Officer 03, September 2018). Another program officer added;

When program staffs are not trained on how to use mobile phone communication technology, they will experience information overload which can happen due to poor searching of information depending on the application being used from the mobile phone. Too much information is not practical to a farmer who is searching for a very specific solution. (Program Officer 06, November 2018)

Another barrier established by the study in using mobile phone communication in supporting dairy farming is how dairy development programs generate content for its diverse groups of beneficiaries from different locations, different cultures and different climatic condition. Some respondents indicated that standards for dairy farming are uniform thus no need to contextualize. For instance, one program officer reported that it is only the style of management that changes depending on location but the standard on what needs to be achieved is the same irrespective of location.

Further findings indicated that, there is mobile phone communication applications translated to Kiswahili for Swahili speaking users. For example, the program officer from the East Africa Dairy Development Program indicated that the program designed a mobile phone application and translated some of their content into Kiswahili for the Tanzania dairy stakeholders.

In terms of taking into consideration culture of various dairy farmers from different locations, a program officer from Sidai Africa said;

We deal with a lot farmers from different communities and different regions. Their culture is not the same. Because of that, the organization has operational hubs in the pastoralist areas of Kenya as well as the wetlands of Kenya. In each hub, we offer different services and products based on the needs of that community/region/zone. Since the organization is in the process of developing e-learning materials for its farmers, staff and livestock stakeholders, we would have different content for different areas. (Program Officer 01, October 2018)

The study also established that there was a programmatic barrier in using mobile phone communication by dairy development programs to support dairy farmers. This is all about the timing and how dairy development programs roll out their mobile phone communication process. From the respondents' feedback, there seemed to be a general agreement that programs make the decision to implement new

innovations on mobile phone communication. It is therefore within their prerogative to decide the timing and rollout mechanism. One program officer said that it is their responsibility to innovate mobile phone communication. The innovations the program officer added address the issues that have already been raised by farmers. The program officer from Sidai Africa Organization added;

We operate through several hubs spread throughout the country. The hubs help us easily interact with farmers all the time and through constant communication we get to know what exactly the farmers need. The farmers may not directly ask us to use mobile phone but we know they need solutions and they will use mobile phones if the user interface is friendly. (Program Officer 01, October 2018).

The study further established that financial constraints and sustainability was another barrier program officers and farmers experienced in embracing mobile phone communication to improve dairy farming. One program said;

One of the questions farmers ask when I introduced the concept of mobile phone communication and trying to explain what I am looking for was 'how much it will cost?' Such question tells us that cost is a constraint to farmers. But it is also a constraint to dairy development programs since it always raises issues of how sustainable a mobile phone communication technology is and whether it will continue beyond the dairy program cycle. (Program Officer 06, November 2018).

One of the program officers gave a good example of how mobile phone communication technology is constrained by limited finances. The officer said:

Smart cow costs Ksh 200 per month to use the program charges Ksh150 to monitor and interpret monthly data. The total cost of having smart cow is Ksh350 per month and this excludes cost of internet. This can be expensive to most of the farmers especially those practicing small scale dairy farming friendly. (Program Officer 03, September 2018).

During the FGD with the farmers, one of the farmers said in relation to cost,

Some of the mobile phone communication applications are very expensive. It will have been nice if we could pay something like Ksh 100 per month. Paying as much as Ksh 200, or Ksh 250. Or Ksh 300 or more than Ksh 300 per month is very expensive for us. Even the amount we get after selling our milk is not

adequate to use the mobile phone communication applications frequently.
(Dairy Farmer, November 2018).

But the farmers were very hopeful during the focus group discussions and willing to learn something that will help them increase milk production.

Most of the farmers who participated in the FGD argued that short message services (sms), Whatsapp and Facebook applications were affordable, convenient and effective. They said that sms are sent for free and joining Whatsapp groups and Facebook groups is also free. The only cost incurred is airtime for sms and cost of internet when downloading messages from Whatsapp and Facebook groups. This implies that cost of managing some mobile phone applications is barrier in embracing mobile phone communication technology.

Another barrier established by this study was that of continuity and sustainability of mobile phone communication in the long run. The question raised is that ‘Will the farmers want to depend on something that is not sustainable?’ The study found that many of the mobile phone applications used by dairy development programs were donor funded and some were run purely on private sector initiative. Some take the model of impact investment where donors support a start up with the hope that it will pick up.

One such model was by Land O’Lakes and it is called “Feed the Future Program” where they were supporting various start up mobile applications to scale up and support farmers. As explained by their program officer, Land O’Lakes assessed the potential of the mobile phone communication applications and set targets and conditions for support of the start-ups. Unfortunately, the program came to an end after running its full course and has not been renewed to date. In another interview

with another program officer, it was revealed that the private sector companies have taken over selling the applications to beneficiaries and one of the companies doing that is AMTECH. AMTECH combines support with donor partnership as well as selling their products in the free market. These findings have demonstrated that dairy development programs and farmers encounter quite a number of barriers in their efforts to use mobile phone communication to enhance dairy farming in Kenya.

Measures to Overcome Barriers to the Use of Mobile Phone Communication to Support Dairy Farming

The fourth and last objective of this study was to establish measures that could be put in place by dairy development programs to overcome barriers to the use of mobile phone communication to support dairy farming. Therefore, program officers and farmers were asked to give their thoughts and opinions on the measures that would be put in place to overcome barriers to the use of mobile phone communication to promote dairy farming. The measures the respondents provided were cross cutting thus one measure could address one or more or all the barriers. The study established that the process of finding a solution to barriers is a learning process and all program officers interviewed confirmed that their dairy development programs were putting various measures in place to improve dairy farming in Kenya.

As a measure to improve dairy farming, all the program officers asserted that they were using the most basic feature of mobile phone namely short message service (sms) and voice calls to improve communication between them and dairy farmers. One program officer said, “Despite having some limitations, use of sms and voice calls provides basic communication and helps us inform farmers of events, discounts, and even communicate risks in dairy farming.” (Program Officer 03, October 2018).

Another program officer added, “Use of sms and voice calls is step forward in improving communication with our dairy farmers. However, the aspect of the farmers’ attitude is difficult to tackle since we cannot force them to use sms and voice calls” (Program Officer 14, November 2018).

The Tech Savvy program officer also said, “We use the will and skill matrix to group our farmers and come up with strategies that can help them have positive attitude to the mobile phone technology or any other technology we introduce to enhance dairy farming” (Program Officer 07, August 2018).

Figure 4.2 shows was an illustration given by Program Officer 07 on how they work to categories the farmers and stakeholders when introducing mobile technology in dairy farming. The program officer indicated that he uses this matrix to strategise on how to assist farmers to adopt the use of mobile phones and other innovations.

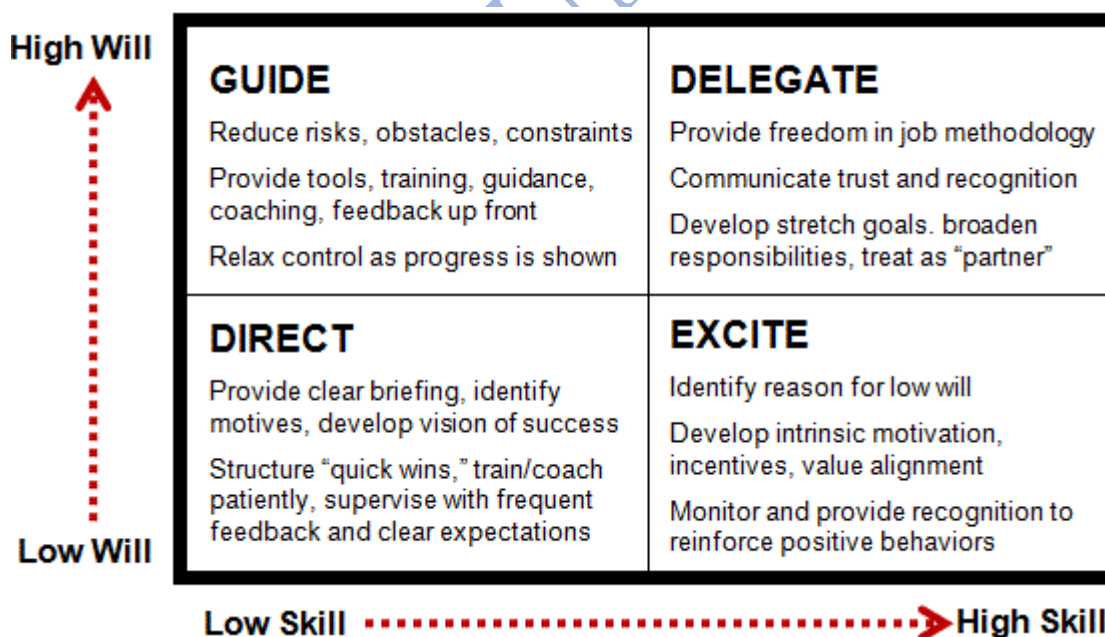


Figure 4. 2: Strategies to Increase Use of Mobile Phone

Source: Program Officer 07 (2019)

Figure 4.2 is a description of how farmers can be categorised based on their willingness to use mobile phone and their capacity (skills). Each of the four sections provides a strategy a program officer can use based on a farmers willingness and capacity. The program officer can either guide the farmer who is willing but has low capacity. They can direct a farmer who is not willing and also has low capacity. They can excite a farmer who has high capacity but is unwilling and they can delegate to a farmer who has both high skill and high capacity. According to this program officer, the program assessed that most farmers fall within the first column requiring them to be “guided” and “directed” as shown in Figure 4.2. The ones falling on second column that require delegation are “lead farmers” which is a method used by EADD who use the lead program approach to develop dairy farming capacity of other farmers. The program creates lead farmers who are then delegated to so they train and advise other farmers.

Another measure that was cited by all the program officers that would enhance use of mobile communication to improve dairy farming was education and training of development program staff at the secretariat level, those at the field (field officers), and the famers. One program officer said;

Proper education and training of program staff and farmers on the use of mobile phone communication applications is one of the measures we have taken to address multiple barriers we experience. The education and trainings address challenges such as low capacity of our staff, age of the farmers, low attitude by the staff and farmers, difficulty in using mobile technology among staff and farmers, and financial constraints. (Program Officer 01, October 2018).

Another program officer advised that there should be continuous training to show value (of the mobile technology). The program officer added that is what all dairy development programs have to do, i.e. show value. Apart from training, one

program officer suggested that dairy development programs should ensure that they simplify the mobile technology for ease of use by the farmers. The officer said,

There should be a continuous effort to simplify (the technology) so that both the literate, semi-illiterate and illiterate farmers and staff can easily understand and make use of them. By so doing, the programs will solve the problem of low attitude towards advanced mobile phone communication technology. (Program Officer 07, August 2018).

The study further established that the technology and network barrier could be addressed using various measures. One program officer suggested that, the government should subsidize cost of internet so that dairy farmers who are subscribed to applications like smart phone can have free internet. In addition, more efforts should be made by government and other stakeholders to ensure there that is electricity and sufficient network coverage throughout the country.

In order to addresses the barriers experienced at the dairy development program level, the program officers interviewed suggested that there should be a program design that is clear on standards and operations under the agreed legal framework. All the program officers used in this study are approved by Kenya Dairy Board which is mandated in dealing and supporting dairy farmers. One program officer said, “Farmers have no way of verifying credible program officers that provide credible and accredited information. However, an accredited program design should publish for them a list of development programs and their officers who they can receive help from” (Program Officer 12, November 2018).

Another program officer who was earlier quoted in this study talking about substandard cow shed said;

The work on the cow shed was shoddy and substandard. This is the reason why I insist that dairy development programs should be on the lookout on who is out there trying to con hard working farmers and use the authority they

have to stop the conmen through the criminal justice system. (Program Officer 10, October 2018).

Some program officers suggested that program designs developed should also contain enough training and communication to cover all possible gaps experienced by farmers. One of the program officers said;

There is a mobile application with a list of credible suppliers that farmers can use and this is a positive step in enhancing transparency and eliminating conmen who cause mistrust. If the program design does not plan for such trainings, then there will not be enough resources to fill the gaps. (Program Officer, November 2018).

The researcher observed that through secondary literature some of the program officers interviewed had in-house capacity to roll out all trainings but many of them outsource to service providers. Some combine both in-house and outsourced capacity. Whatever the case, the program officers suggested that the dairy development programs should ensure there is financial and human resources to carry out the program tasks pertaining to technology especially communicating and providing knowledge to dairy farmers.

Program officers suggested that the rolling out of mobile phone communication applications should be done gradually. This will allow adoption and effective use of the technology. Some programs automatically use mobile phone because it is available but for some, use of mobile phone communication is a strategic move. Gradual rolling out of the technology enables the implementers to learn lessons and allow for the feedback loop to carry out changes needed for roll out of second, third or fourth phase.

As was indicated earlier in this section, one of the Program Officers said the farmer has to see value in the use of mobile phone communication and programs have to continuously communicate value. The communication of value should have the

analysis of “cost effectiveness of the mobile phone communication” especially use of the apps that have cost implication. This means there should be value explained to a farmer who spends, for example Ksh. 350 for an application and Ksh.2000 per month for internet to support the application. A farmer willing to spend money to keep an application running can solve problem of sustainability as the application developer can remain in business without donor funding.

Some of the more sophisticated solutions for financial and sustainability challenges are tailored for farmers with larger herds of cows and some solutions, for example, the mobile communication solutions are for small scale dairy farmers. For effectiveness, the study established that some farmers have to increase the number of cows for the benefits to make business sense. Small scale farmers with 5 cows have been able to maintain acceptable margins of profit while also paying for the mobile phone applications.

The study also established that sustainability challenge comes in when a mobile communication system goes beyond the life cycle of the program. The measures on how to achieve sustainability include the aspect of strengthening partnership with private sector. This was evident as program officers explained that they have partnerships with other development programs or organizations. The private sector businesses that were mentioned to be in partnership with the dairy development programs include AMTECH, DAIRY PESA, and Virtual City among many others. In fact, the mobile phone solutions have been developed by private software companies or individuals. These private sector companies have also partnered with major companies like Safaricom to receive support to scale up their products and services.

Safaricom has incorporated some of the solutions into their services and they benefit when one pays for airtime.

Finally, the respondents suggested that dairy development programs should try to achieve sustainability by not only working with private sector but by facilitating formation of federations. For example, the study established that Heifer International and East Africa Dairy Development have facilitated the formation of Kenya Dairy Farmers Federation which is comprised on all interested cooperatives. It is a membership organization and the aim is that they continue to do the work of supporting cooperatives and in the end farmers when EADD winds up, there will be continuity in supporting farmers. Such a federation can continue to promote any best practise initially carried out by dairy development programs including promoting use of mobile phone communication.

Summary of Key Findings

1. The study established that dairy development programs mainly use voice calls and short message services (sms) features in their communications. Other mobile phone applications widely used include Whatsapp and Facebook. Telegram was used too but to a small extent.
2. The study established that the following are the major mobile phone applications that dairy development programs in Kenya use for communication to support farmers: Plantwise, Ngombe Planner, EasySacco, Smart Cow, ArgoForce, DigiCow, Dairy-nomics, CowSoko, Digifarm, Mio, and Easyma.
3. All the 13 program officers generally explained that dairy development program use sms based system to send various alerts to dairy farmers on production,

processing, and consumption of the dairy farming products. In addition, Whatsapp and facebook are used to some extent in disseminating dairy farming information.

4. Through FGD, farmers revealed that use of mobile phones in dairy farming is not as prevalent as use of mobile phones in everyday life. Close to half of the farmers who participated in the FGD indicated that they did not use mobile phone communication in dairy farming directly. Even the farmers who indicated that they used mobile phones in dairy farming were generally fed with information from people who were exploiting mobile phone as a source of information.
5. The study found that mobile phone communication was utilized by dairy development programs for the following: enhance service delivery; inform and mobilise farmers on various farming events such meetings, trainings, open forums among other events; coordinate supply of inputs such as fertilizers, veterinary services, feeding supplements, and livestock accessories; avert conflict by improving transparency; monitoring dairy cow productivity through use of some mobile phone application for dairy herd management; as tools of knowledge management; to provide financial advisory, and for efficient and effective program management.
6. The study established that the following are the information needs of dairy farmers that dairy development programs need to provide through mobile communication: information on cost of dairy inputs vis a vis returns from sales; farming issues affecting farmers, information on milk production in Kenya for planning purposes; practical information that they could be applied to improve production; young stock management; cow housing and comfort; milking – hygiene and procedure and quality; quality of the herd (body condition, handling

of cows and how they appear, breeding and fertility); skills and supervision required for farm managers and dairy workers; records – recording management technical records and financial records; waste management and manure; and risks and security – from thieves and diseases.

7. Without mobile phone communication, the study established that: dairy farmers operated with the little traditional information they had thus low production; diseases would kill the livestock because the farmers will not know what to do when the livestock is sick. There would be no maximizing on the potential of the animals, and most dairy farmers will rear animals for the sake of it.
8. The study established that the following bodies were identified as the source of standards of the information that should be availed to farmers: Ministry of Agriculture of Kenya, IFAD, Dairy Farming Research Organizations, and Internal Standard Operating Procedures of respective organizations and foreign based dairy institutes from South Africa and Ireland. However, there is a problem with local implementation of the said standards as there is lack of consistency and coordination among the various bodies of standards.
9. Barriers program officers and dairy farmers faced in using mobile phone communication include: human capacity and behavioural barriers of dairy farmers in using mobile phone communication due to their age, gender. Lack of required skills to use the mobile phone communication in dairy farming, negative attitude towards mobile communication systems introduced to the farmers and the timing of introduction, internet and network failures especially in rural areas, some phones having limited features and storage space thus becomes difficult to download needed information, dishonesty among some stakeholders of a dairy

development program, lack of trust from the farmers due to presence of conmen who take advantage of low exposure of farmers, lack of frequent training of farmers and dairy development program staffs, how dairy development programs generate content for its diverse groups of beneficiaries from different locations and cultures, financial constraints and sustainability among program officers and farmers in embracing mobile phone communication to improve dairy farming, and continuity and sustainability of mobile phone communication in the long run.

10. Measure to improve mobile phone communication in dairy farming include: use of the most basic feature of mobile phone like short message service (sms) and voice calls to provide basic communication between program officers and dairy farmers, education and training of development program staff at the secretariat level, those at the field (field officers), and the famers on use of mobile phone communication applications, ensure simplicity of the mobile technology used for ease use by the farmers, the government should subsidize cost of internet so that dairy farmers can easily access information on mobile phone communication applications, design of a program that is clear on standards and operations under the agreed legal framework and contain enough training and communication to cover all possible gaps experienced by farmers, and gradual rolling out of mobile phone communication applications. Dairy development programs should try to achieve sustainability by not only working with private sector but by facilitating formation of federations.

Summary

This chapter has presented the study findings that were obtained during in-depth interviews with dairy development programs' officers and focus group discussion with famers' groups. The findings presented include background information of the program officers in terms of their positions in their respective development programs and the nature of the development programs. In addition, the chapter presented findings on the extent of use of mobile phone communication by dairy development programs, type of information the dairy development programs need to disseminate to dairy farmers, barriers encountered by dairy farmers and program officers in the use of mobile phone communication to improve dairy farming, and measures that can be put in place by dairy programs to overcome barriers to the use of mobile phone communication to improve dairy farming. The next chapter will provide a discussion on the key findings, conclusions, recommendations, and areas for further research.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter provides a discussion of the study's key findings in relation to relevant literature review as provided in Chapter two of this study. The discussion is done based on the study's objectives. In addition, the chapter provides the conclusions, recommendations of the study, and areas of further research.

Discussion of the Key Findings

The discussion of the key findings is based on the study's objectives which were to explore the extent of use of mobile phone communication by dairy development programs, find out the type information the dairy programs need to disseminate to dairy farmers through use of mobile phones, identify barriers encountered by dairy farmers and program officers in the use of mobile phone communication to improve dairy farming, and establish measures that can be put in place by dairy programs to overcome barriers to the use of mobile phone communication to improve dairy farming.

Extent of Use of Mobile Phone Communication to Support Dairy Farming

Mobile phone communication has been adopted and implemented in dairy farming to improve dairy production. This study established that dairy development programs in Kenya mainly use voice calls and sms to enhance communication with the farmers. In addition, Whatsapp and Facebook mobile phone applications were also found to be widely used to support dairy farming. These findings agree with Hatt et al. (2013), TeleGeography (2012), CAK (2014), and Information and Communication

for Development and World Bank (2012) who also found that voice calls and sms are the most popular mobile phone features used by most development programs to disseminate information to program beneficiaries. This finding is also in line with the Technology Acceptance Model and corresponds to ease of use component. Perceived ease of use refers to the degree which the prospective users expect the technology to be free of effort (Davis, Bagozzi, & Warshaw, 1989). Short message service, whatsapp, voice calls, facebook are easy to use and do not require much effort to learn.

Besides, World Bank (2012) found that organization in the farming sector are widely using mobile phone cameras as a means of communication through collecting and sharing important and practical information required by farmers and other stakeholders. However, most of the previous studies did not establish that social media mobile phone applications like Facebook and Whatsapp are widely used by organizations to disseminate information to beneficiaries thus improving service delivery. The social media is easily accessible via mobile phone and it has become a channel through which all dairy farming stakeholders interact and share information.

In addition, various mobile phone applications have been developed by organizations to enhance communication with their clients which in turn improves service delivery. Organizations and development programs in the dairy farming sector have not been left behind. This study established that the following are the major mobile phone applications that dairy development programs in Kenya use for communication to support farmers: Plantwise app, Ngombe Planner, EasySacco, Smart Cow, ArgoForce, DigiCow, Dairy-nomics, CowSoko, Digifarm, Mio, and Easyma. These applications are locally developed thus they are home-grown solutions

as supported by Bright and Hrubry (2015) who posited that Kenya has a positive environment which has been referred to as ‘Silicon Savannah’ and is home to many successful technological organizations which incubate ideas that can benefit dairy farming (Bright & Hrubry, 2015). Hart, Gardiner, Willis and Harris (2013) predicted more growth and solutions that combine various technologies and this prediction is true according to this study. The use of such applications and mobile systems to improve service delivery corresponds to the Technology Acceptance Model explained in Chapter 2. The component of the TAM that corresponds to these apps is mobile application is “perceived usefulness” which is defined as the prospective user’s subjective probability that using mobile phone communication will increase his or her own job performance (Davis, Bagozzi, & Warshaw, 1989).

The study by Qiang, Kuek, Dymond, and Esselaar (2011), listed 92 mobile phone applications applied in the agricultural sector in Africa to improve communication thus promoting agricultural productivity. This study provided a totally new list of mobile applications which do not match in names to the list of 92. Due to the time lapse, new applications have improved or replaced old applications or they could have totally rebranded the names of applications.

Study findings revealed that mobile phone communication has been used by dairy development programs in Kenya to send various alerts to dairy farmers on production, processing, and consumption of the dairy farming products. It has also been utilized to enhance service delivery in various ways: informing and mobilising farmers on various farming events such as meetings and trainings; coordinate supply of inputs such as fertilizers, veterinary services, feeding supplements, and livestock accessories; avert conflict by improving transparency; monitoring dairy cow

productivity through use of some mobile phone application for dairy herd management; used as tools of knowledge management; and providing financial advisory.

In support of these findings, Torero and Minten (2013) also noted that the use of mobile phone applications improves and eases communication. Abrams (2006), and Cassaburi et al. (2014) adds that mobile phones provide personalized agricultural information at low costs, as well as help the farmers to coordinate with buyers and secure inputs from suppliers more efficiently. Consequently, Mutunga and Waema (2016) found that dairy farming is information intensive and requires round the clock real-time information which is always availed by mobile phones through use of various communication applications such as Ngombe Planner and Smart Cow. In terms of mobile phone applications offering financial advisory solutions, the findings agree with Martin and Abott (2011) who found that mobile phones are used to monitor financial transaction including transactions by dairy farmers. In addition, Vodafone (2015) mapped Kenya as number one in terms of mobile phone financial solutions through its flagship product M-pesa which provides revolutionized financial services in Kenya and this innovation is currently spreading globally.

The Technology Acceptance Model reflects in all the findings for this first objective which sought to find out extent of use of mobile phone communication to support dairy farming. The study established that the programs used mobile phone communication because they perceived the technology useful (improved their service delivery effort) and easy to use (little effort). This also explains why features that are easy to use are more widely used compared to those that require more effort for example an expensive smart phone and internet services.

Dairy Farmers' Information Needs

Information is critical and without information, the dairy sector would perform poorly. Without information, the traditional dairy husbandry methods which work but do not maximise on productivity will be used. This study established that dairy farmers need information on cost and quality of dairy inputs vis a vis returns from sales of milk, calving/lactation cycle, practical information that they could apply to improve production, young livestock management, cow housing and comfort, milking – hygiene and procedure and quality, quality of the herd (body condition, handling of cows and how they appear, breeding and fertility), skills and supervision required for farm managers and dairy workers, records – recording management technical records and financial records, waste management and manure, and finally risks and security in terms of diseases and thieves. The South African Government simply categorised the needs into four namely feeding, raising calves, cattle housing and reproduction (Western Cape Government, 2016).

The information needs listed in this study also go with those provided by FAO (2011) which provide detailed guidelines on information that dairy farmers need. Technoserve (2008) who were also respondents in this study also emphasised the need to provide information especially those pertaining to food and nutrition of dairy animals. This study also established that there are organizations/bodies that are accredited as the sources of standards of the information that should be availed to dairy farmers in Kenya. They include Ministry of Agriculture of Kenya, IFAD, Dairy Farming Research Organizations, and Internal Standard Operating Procedures of respective organizations. The study found out that enforcement of the standards is still a challenge. This means that the standards are still way below globally acceptable

standards hence farmers sometimes receive conflicting feedback on an issue for example how to construct a dairy cow shed. None of the respondents quoted FAO as a source of standards for dairy information as is indicated in literature which shows the need for localised standards that small holder farmers can identify with.

On matters of ranking, the study ranking matched with Vigyan (2015) that food, feeding and nutrition is a top ranked need for dairy farmers. This does not mean other needs are less important as was established in this study. Wholesome information is needed for a dairy farm to be managed effectively and efficiently.

Barriers in Using Mobile Phone Communication to Improve Dairy Farming

Generally, development programs encounter challenges or barriers during implementation. Some of the challenges are as a result of communication channels used among the stakeholders especially when utilizing mobile phone communication. This study too found that dairy development programs' officers and dairy farmers in Kenya encounter barriers in their efforts to use mobile phone communication to support dairy production. The barriers include human capacity and behavioural barriers by dairy farmers in using mobile phone communication due to their age, gender, lack of required skills to use the mobile phone communication in dairy farming, negative attitude towards mobile communication systems introduced to the farmers and the timing of introduction of new innovation. Other barriers were internet and network failures especially in rural areas, some phones that are affordable to farmers have limited features and storage space thus becomes difficult to download needed information, dishonesty among some stakeholders of dairy development programs, lack of trust from the farmers due to presence of conmen who take

advantage of low awareness of farmers, lack of frequent training of farmers and dairy development program staffs, how dairy development programs generate content for its diverse groups of beneficiaries from different locations and cultures, financial constraints and sustainability of the programs that promote mobile phone communication.

These study findings corresponds with the technology acceptance model (TAM) with particular focus on the component of “behavioural intent.” Behavioural intention is a measure of strength of one’s intention to perform a specified behaviour. The relationship represented in TAM implies that all else being equal, people form intention to perform behaviours towards which they have positive affect (Davis et al., 1989). This study established various barriers some which have to do with attitude of the user towards mobile technology and some to do with the perceived difficulty of using the technology. The study’s interpretation of behavioural intention is therefore those factors that weaken ones intention (barriers) to use a mobile phone technology or strengthen (measures to overcome barriers) the intentions to use the same. Although this study was not qualitative, the findings correspond with Mutunga and Waema (2016) who found out that 55% of farmers faced attitude problems when using a mobile phone.

According to the findings of Prodhan and Afrad’s (2014) study, the barriers faced by the agricultural extension workers towards ICT utilization were conceptualized as consisting of four dimensions: organizational, personal, technological, and policy barriers. This agrees with this study which has provided a list of barriers but which can easily fit into the four dimensions advanced by Prodhan and Afrad (2014).

Cleeve and Yiheyis (2014) also supported the behavioural (personal) barriers by categorising users into technophobe and technophiles. The authors argued that barriers to communication exist depending whether program officers and farmers are technophiles (love and embrace technology) or technophobe (fear and reject technology). This study established that all program officers thought of themselves as technophiles but up to 70% of the farmers were technophobes. This is a reduction from the 80% that was established by the Prodhan and Afrad's study of 2014.

The barriers established in this study are also supported by Brugger (2011) who elaborated on complexity of use ranging from low complexity, medium complexity and high complexity. This study established that farmers find it difficult to use smart phones not because it is complex but because they are yet to learn how it is used. So complexity still boils down to attitude as explained by Cleeve and Yiheyis (2014). Farmers interviewed in as this study explained that they were ready to learn how to use smart phones and this attitude of learning can turn what was initially considered high complex into middle complex or low complex. Waema and Mutunga (2016) found out that only 10% of farmers needed champions so they could become literate. However, this study discovered that farmers actually use the younger generation and relatives as champions and are ready to learn mobile phone use. Thus it is a much bigger percentage than 10% that need champions if the findings from the focus group discussion are anything to go by. This study also ascertained that there exist barriers to do with location, context and cultures. The assertion is supported by Quiang et al. (2011) who explained location, context and cultures as a barrier especially if any communication is not localised. But this study found out that standards of raising a cow for milk are constant and uniform irrespective of location

or context. Further, some of the practises in management style may vary between locations even as every dairy farmer strives to meet common standards.

Generally the findings in this study on barriers support previous literature except for one barrier which this study refers to as ethics and trust barrier. With so much information available from mobile phones, farmers have been misled and conned making it difficult for some program officer to convince them of the reliability of information available through this device. Dairy farmers need to trust the information they received and even though the study established that this practise is not yet widespread, farmers who have heard about the unethical practises are now sceptical in using mobile phone communication.

Measures to Improve Mobile Phone Communication in Dairy Farming

From findings, there are various measures that can be put in place by dairy development program officers to ensure that mobile phone communication is effective in improving dairy production in Kenya. This from the interpretation of the technology acceptance model (TAM) provides measures to strengthen the behavioural intention to use mobile phone communication. The measures include use of the most basic feature of mobile phone like short message service (sms) and voice calls to provide basic communication between program officers and dairy farmers, providing education and training of development program staffs and farmers on how to use mobile phone communication applications, and ensuring simplicity of the mobile phone technology used for ease use adoption by the farmers.

In addition, the study found that the government should subsidize cost of internet so that dairy farmers can easily access information on mobile phone communication applications. Further, development programs should design a program

that is clear on standards and operations under the agreed legal framework and contain enough training and communication to cover all possible gaps experienced by farmers. Also, there should be gradual rolling out of mobile phone communication applications. Last but not least, dairy development programs should try to achieve sustainability by not only working with private sector but by facilitating formation of federations that will outlive the funded programs. The ease of use which is a component of the TAM is supported by Hasan (2015) who posits that mobile phone systems should be simple to use, fast and user friendly while the service should be standardized so that wherever the solution is used the farmer is familiar with the procedure followed (Hasan, 2015).

The measure of how to roll out programs that have component of mobile technology is also proposed by program officers. They propose that dairy program should embed the mobile phone component into existing initiatives. The programs should use existing practises as starting point and focus first on basic skills (Poblet, 2011). This idea is complimented by Hellstrom who posits that the approach used by dairy programs should be evolutionary and not revolutionary (Hellstrom, 2011). This study established that principles by Poblet and Hellstrom were adhered to as discussed in Chapter 4 under nature of the development programs that were under study. Under Chapter 4, this study described the hub model and collaboration with local extension agents or employing field staff as a way of ensuring constant interaction between farmers and the dairy programs. With such interaction, the communication is considered effective and roll out of mobile phone use would be evolutionary and not an imposed revolutionary concept that would likely be rejected by users.

The issue on sustainability is a finding that this study intended to add to existing literature. These are well highlighted in the findings which are specific to dairy sector in Kenya and from the perspective of the program officer. One key word to ensure sustainability is partnerships and collaborations as well as creating information institutions and communication systems that will outlast program funded cycle. This study established strong partnerships existed between donors, the implementing partners, private sector including software developers and government agencies including county (local) governments.

Conclusions

Based on the findings of this study, the researcher concludes that utilization of mobile phone communication generally improves service delivery in extension service and makes dairy program management more efficient and effective. This is because the findings revealed that without mobile phones, dairy farmers would be forced to travel frequently to various locations to access information on dairy farming practices or post messages on media houses like radio and wait for responses from agricultural experts or consultants which do not guarantee immediate feedback. But with voice calls, bulk short message services, and other mobile phone innovations like mobile apps, Program Officers are able to send thousands of messages at the click of a button. Dairy programs are also able to receive feedback on status and productivity of a dairy farm thus acts appropriately to improve dairy production. Therefore mobile phones enhances interaction and peer to peer learning which improve overall dairy development program outcomes even when a program officer is not physically in touch with the farmers on the ground.

Secondly, the study concludes that there is availability of cutting edge mobile phone technology that dairy farmers and dairy programs can use to improve dairy farming at large. However, the study established that small scale farmers are yet to fully exploit the use of mobile phone technology because of technophobic behaviours related to age and attitude. Also lack of local standards and mistrust on type of information provided limits full use of mobile technology. In addition, environmental and economic barriers, for example availability of internet, cost of internet, and cost of smart phones makes use of technology prohibitive especially to older farmers. Youthful farmers use the mobile technology more and are the majority in digital forums on social media.

Finally, information is critical in dairy farming, more so, if it is timely and relevant. Without information, the dairy sector would perform poorly as farmers would resort to traditional methods that do not maximise on dairy productivity. Mobile phone communication is just a way to relay information efficiently. Thus, Kenya still leads with cutting edge innovations in mobile technology in dairy farming and other sectors. With increasing incorporation of mobile phone use in programs, dairy farming will in future be digitized thus upcoming farmers should be ready to embrace this innovation to maximize yields of dairy farming.

Recommendations of the Study

Based on the study findings, this study recommends the following:

1. The government should set up a dairy information centre which can serve several purposes. First, the centre can be the source of dairy information for all stakeholders. Secondly, the centre can serve as a body which regulates standards

on matters pertaining to dairy husbandry. This can be a department in the Kenya Dairy Board which to great extent has focused only on milk quality and neglected the husbandry part, or it can be a new independent institution. The proposed centres can be benchmarked from South Africa which has an operational information centre of dairy farming. Dairy programs and bilateral donors can contribute towards this recommendation

2. To increase use of digital mobile phone applications, dairy development programs should establish models of partnerships and collaborations that will lead to sustainability of mobile phone communication. Exclusive donor funded dairy development projects create a scenario of success that is short-lived. It is commendable that many programs under this study have put in place sustainability measures and some of the mobile phone applications are sustained by free market forces for example smart cow. Some successful partnerships with Safaricom as also in place to ensure all Safaricom subscribers have access to the mobile phone service on dairy farming. Partnership is also not for sustainability only but will also ensure the content generated is practical, relevant and easy to follow through collaboration between professionals in the field of development communication, software development and dairy consultants.
3. Education and training through developing capacities should target all stakeholders in the dairy value chain. Farmers should be trained on how they can exploit use of mobile phones while extension agents should be trained on the same plus more complex applications. Improving overall capacity of dairy farmers and other stakeholders that encompass knowledge, skills, attitude and promoting good

practises in dairy farming should continue and should be funded and supported by government and donors.

4. With increased capacity of small scale farmers, there should be deliberate effort to upgrade small scale dairy farmers to medium scale dairy farmers and eventually to large scale dairy farmers. Kenya as a country cannot get stuck at small scale level but there should be encouragement and enabling policies to enable upgrading to higher scale farmers who will make even better use of mobile phone communication technology. Even though it was beyond the scope of this study, there are was some very practical and interesting innovations that use mobile phone communication to manage larger herds where one can for example get an alert on the phone when a cow is on heat, or when a pregnant cow is about to deliver. The possibilities are endless and dairy programs funded by donors and governments should upgrade farmers who will further be able to exploit such technologies.
5. Programs should encourage and deliberately recruit youth to get into digital dairy farming as the digital aspect can be exciting as well as a source of employment. Involvement of youth will increasingly put into use the cutting edge mobile phone technologies whose use are not maximised because majority of dairy farmers are old and are comfortable with voice calls and short message service.
6. With dairy farming now being stable and milk production improved, donors are now phasing out of dairy farming. The biggest dairy development program EADD has closed shop among other programs. The government should therefore take up more interest in the dairy industry and come up with policies that will improve

price of milk for the farmer as well as reduce cost of production. Removing monopolistic tendencies in the milk processing and setting up dairy meal factory for affordable feeds are just some of the ways the government can support the sector.

Areas of Further Research

1. With the evolving and very dynamic nature of mobile telephone communication to support agriculture, the study recommends a further research on how mobile telephone communication is used in other key produce that affects the country's economy. For example, "domestic horticulture" which includes groups of produce like tomatoes, peas, capsicum, onions etc. These are critical products that form the core of food security in the country just like dairy products.
2. The study recommends a further research on the government's efforts to improve policy environment that can ease communication in support for farmers and other agricultural actors.
3. A further research is also recommended on how to improve private-public partnerships through effective communication between these actors. Collaboration and partnership is key in developing key areas of Kenyan economy especially agriculture but the PPP model (i.e. Private Public Partnership) is still being reviewed. A study on how communication can be used to promote this PPP is therefore an area of research that can be explored.

4. There should be communication models that promote cross generational information exchange (between youthful and older dairy farmers) and their role in succession of family run dairy enterprises.

DAYSTAR UNIVERSITY

REFERENCES

- Aboh, C. (2008). Assessment of the frequency of ICT tools usage by agricultural extension agents in Imo State Nigeria. *Journal of Agriculture and Social Research*, 8(2), 1-7.
- Abraham, R. (2006). Mobile phones and economic development: Evidence from the fishing industry in India. *Information and communication technologies and development*, 4(1), 48-56.
- Adongo, M., Wesonga, P., & Mugivane, F. (2013). The role of mobile phone communication of dairy goat rearing in Mutonguni Kitui County Kenya. *Journal of Agricultural Information and Communication Management*, 2013, 12-14.
- Agunga, R., Aykut, G., & Bostan, B. (2013). Communication for development as a strategy to enhance agricultural extension performance in Turkey. *Journal of Agricultural Extension*, 17(2), 190-199.
- Akaranga, S., & Makau, B. (2016). Ethical considerations and their applications to research: A case of University of Nairobi. *Journal of Educational Policy and Entrepreneurial research*, 2(6), 1-9.
- Aker, J. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics* 42(10), 631-647.
- Aker, J., & Mbiti, I. (2010). Mobile phones and economic development. *Journal of Economic Perspective*, 24(3), 207-232.
- Alomary, A., & Woolard, J. (2015). *How is technology accepted by users? A review of technology acceptance models and theories*. London: The Institute of Research Engineers and Scientists.
- Bhavnani, A., Chiu, R., Janakiram, S., & Silarszky, P. (2008). *The role of mobile telephones in sustainable rural poverty reduction*. New York: World Bank.
- Binswanger, H. (2003). Scaling up community driven development: Theoretical underpinning and program design implication. *World Bank Policy Research Working Paper*, 30(39), 1-43.
- Board, K. D. (2015). *Milk intake*. Nairobi: Kenya Dairy Board.
- Bore, K., Owuoche, M., & Mutai, N. (2015). Assessing Benefits and challenges smallholder dairy farmers experience in using ICT tools to source information on insemination services and breeding. *Journal of Agriculture and Veterinary Science*, 8(7), 6-10.

- Bright, J., & Hrubry, A. (2015). *The rise of the Silicon Savannah and Africa's tech movement*. Retrieved from TechCrunch: <http://techcrunch.com/2015/07/23/the-rise-of-silicon-savannah-andafricas-tech-movement/>
- Brugger, F. (2011). *Mobile application in agriculture*. Basel, Switzerland: Sygenta Foundations.
- CABI. (2014). *CABI and mobile*. Retrieved from www.cabi.org
- Cassaburi, L., Kremer, M., Mullainathan, S., & Ramrattan, R. (2014). *Harnessing ICT to increase agricultural production: Evidence from Kenya*. Retrieved from <http://www.jblumenstock.com/files/jsde/kremer.pdf>
- Chandran, E. (2004). *Research methods: A quantitative approach with illustrations from christian ministries*. Nairobi: Daystar University.
- ChharChhar, A., & Hassan, S. (2013). The use of mobile phone among farmers for agricultural development. *International Journal of Scientific Research*, 2(6), 95-98.
- Cleeve, E., & Yiheyis, Z. (2014). Mobile telephony and economic growth. *Thunder Bird International Business Review*, 56(6), 547-562.
- Communication Authority of Kenya. (2014). *CAK quarterly sector statistics report: Fourth quarter of the financial year 2013/2014*. Nairobi: Communication Authority of Kenya.
- Communication Authority of Kenya. (2014). *Quarterly Sector Statistics Report*. Nairobi: Communication Authority of Kenya.
- Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), 982-1003.
- Demombynes, G., & Thegeya, A. (2012). *Kenya's mobile revolution and the promise of the mobile saving*. Washington, DC: World Bank.
- Development, M. O. (2011). *Kenya national dairy master plan*. Nairobi: Government Printer.
- Duncombe, R. (2012). *Mobile phones for agriculture and rural development: A literature review and future research directions*. Manchester, UK: Institute of Development Policy and Management.
- Duncombe, R. (2014). Understanding the impact of mobile phones on livelihood and in developing countries. *Development Policy Review*, 32(5), 567-588.

- Field, A. (2005). *Discovering statistics using SPSS*. London: sage.
- Fisk, P. (2010). *People and planet and profit*. London Philadelphia New Delhi: Kogan Page.
- Food and Agriculture Organisation. (2011). *Guide to good farming practice: Animal production and health guidelines*. Rome: FAO.
- Fouka, G., & Mantzorou, M. (2011). What are the major ethical issues in conducting research? Is there a conflict between the research ethics and the nature of nursing? . *Health Science Journal*,1(7), 3-14.
- Galvin, M., & Iannotti, L. (2014). Social enterprise and development. *International Society of Third Sector Research*, 24(4), 1-21.
- Gates, B., & Gates, M. (2015). *Gates annual letter: Our biggest bet for the future*. Retrieved from <https://www.gatesnotes.com/2015-AnnualLetter?page=0&lang=en>
- Gichamba, A., & Lukandu, I. (2012). A model for designing mAgriculture application for dairy farming. *The African Journal of Information Systems*, 4(4), 119-136.
- Goggin, G., & Clark, J. (2009, June). Mobile phone and community development: A contact zone between media and citizenship. *Development in practice*, 19(4-5), 585-597.
- GSMA Intelligence. (2013). *Scaling mobile for development*. Washington DC: GSMA Intelligence.
- Hasan, M. (2015). Mobile phone:An instrument of disseminating requisite agricultural information for the agricultural development of Bangladesh. *International Journal of Research in Engineering and Technology*, 4(4), 523-534.
- Hatt, T., Gardner, C., Wills, A., & Harris, M. (2013). *Scaling mobile for development*. London: GSMA Intelligence.
- Hedge, N. (2017). *Dairy Extension for transfer of technologies*. Pune: BAIF Development Research Foundation.
- Hellstrom, J. (2011). *Mobile governance: Applications, challenges and scaling up*. In M. Poblet, Conflict management: Online dispute resolution, governance and participation (p. 159-179). Belfast: Springer Science.
- Holloway, I. (1997). *Concepts for qualitative research*. Oxford: Blackwell Science.
- iCow. (2015). *What is iCow*. Retrieved from www.iCow.co.ke:<http://icow.co.ke/>

- ICT Authority of Kenya. (2013). *The national broadband strategy: A vision 2030 flagship project*. Nairobi: Ministry of Information, Communication and Technology.
- Igwenagu, C. (2016). *Fundamentals of research methodology and data collection*. Riga Latvia: Lambert Academic Publishing Ltd.
- Information and Communication for Development & World Bank. (2012). *Maximizing mobile*. Washington, DC: World Bank.
- Information and Communication For Development & World Bank. (2013). *Mobile usage at the base of the pyramid: Research findings from Kenya and South Africa*. Washington DC: World Bank.
- International Telecommunication Union. (2014). *The world in 2014-ICT facts and figures*. Geneva: International Telecommunication Union.
- Johnson, D., & Gardner, J. (2007). The media equation and team formation: Further evidence for experience as a moderator. *International Journal of Human-Computer studies*, 65(2), 111-124.
- Jureddi, D. N., & N.Brahmaiah. (2016). Barriers to effective communication. *Journal of English Language and Literature*, 3(2), 114-115.
- Kalugendo, J., & McLeod, P. (2013). Creating participatory communication model of engagement of local communities to enhance development effectiveness in Tanzania. *African Journal of Communication*, 1(1), 105-130.
- Kimenyi, M., & Ndungu, N. (2009). *Expanding the financial services frontier: Lessons from mobile phone banking in Kenya*. Washington DC: Brookings Institute.
- Komen, L. (2016). M-pesa: A social economic assemblage in rural Kenya. *Networking Knowledge*, 9(5), 1-12.
- Kothari, C. R. (2004). *Research Methodology: Methods and techniques* (2nd ed.). Delhi: New Age International (P) Ltd Publishers.
- Lai, P. C. (2017). The literature review of the Technology Adoption Models and theories for the novelty technology. *Journal of Information Systems and Technology Management*, 14(1), 21-38.
- Lavrakas, P. (2008). *Encyclopaedia of survey research methods*. California: Sage.
- Littlejohn, S., & Foss, K. (2008). *Theories of human communication* (9th ed). California: Thomson Wadsworth.

- Martin, B., & Abbott, E. (2011). Mobile phones and rural livelihoods: Diffusion, uses and perceived impacts among farmers in rural Uganda. *Information Technology and International Development Journal*, 7(4), 17-34.
- McNamara, K. (2009, April). Improving agricultural productivity and markets: The role of information and communication technologies. *World Bank Agriculture and Rural Development Notes*, 1(47), 1-4.
- Melkote, S. (1991). *Communication for development in the third world*. New Delhi: Sage Publication.
- Mobile for development. (n.d). *Reaching the unreached*. Gurgaon: ZMQ and Mobile for Development.
- Mugenda, O., & Mugenda, A. (2003). *Research methods*. Nairobi: Acts Press.
- Muriuki, H. (2011). *Dairy development in Kenya*. Rome: FAO.
- Mutunga, I., & Waema, T. (2016). Context of mobile phone use and its effects on smallholder farmer's livelihood. *International Journal of Scientific Research and Innovative Technology*, 3(4), 121-136.
- Nakasone, E., Torero, M., & Minten, B. (2013). The power of information: The ICT revolution in agricultural development. *Annual Review of Resource Economics*, 6(1), 1-41.
- Nassiuma, D., & Njoroge, N. (2013). *Milk production and marketing in Kenya*. Nairobi: KDB, KNBS, MOALF, SNV, HPI, KAPAP.
- Ngeno, E. (2013). Analysis of existing agricultural information systems for post harvest management among small holder farmers in Bomet County. *Journal of Agricultural and Communication Management*, 22(2), 83-94.
- Nicholls, A. (2008). *Social entrepreneurship: New models of sustainable social change*. Oxford: Oxford University Press.
- Ochieng, C. (2007). Revitalizing African agriculture through innovative business models and organizational arrangement: Promising development in the traditional crop sector. *The Journal of Modern African Studies*, 45(1), 143-169.
- Ojina, E. (2017, February 17). I run my dairy farm on mobile app. *Daily Nation*, p. 26.
- Oladipo, R., Ikamari, L., Kiplang'at, J., & Barasa, L. (2015). *General research methods*. Nairobi: Oxford University Press.
- Omoro, A., McDermott, J., Muriuki, M., & Thorpe, W. (1998). *Small holder herd management in Kenya*. Nairobi: International Livestock Research Institute.

- Parker, S. (2011). *Sampling vs Census: A comparative analysis*. Lake Zurich: Talyor Nelson Sofres (TNS).
- Pearce, K. (2013). Phoning it in: Theory in mobile, media and communication in developing countries. *Mobile Media and Communication*, 1(1), 76-82.
- Prodhan, F., & Afrad, S. (2014). Barriers and preparedness of agricultural extension workers towards ICT utilization in Gazipur District Bangladesh. *International Journal of Extension Education*, 10(1), 1-9.
- Qiang, C., Kuek, S., Dymond, A., & Esselaar, S. (2011). *Mobile application for agriculture and rural development*. Washington DC: World Bank.
- Quadir, I. (2010). *Mobile technology: One core lesson, many possible solutions*. Washington, DC: Development Outreach World Bank Institue.
- Reeves, B., & Nass, C. (1998). *The Media Equation: How peple treat computers, television and new media like real people and places*. California: Cambridge University Press.
- Reeves, B., & Nass, C. (2014). *The media equation: How people treat computers, television, and new media like real people and places*. Chicago: University of Chicago Press.
- Semkwiji, A. H. (2011). *The role of mobile phones on sustainable livelihoods*. Dar es Salaam: Economic and Social Research Foundation.
- Sharma, S., & Chandel, J. (2013). Technology acceptance model for the use of learning through websites among students in Oman. *International Arab Journal of e-Commerce*, 3(4), 21-38.
- Shibairo, S. (2012, January 12). Message from the Dean. *Agricullture Information and Communication Management Newsletter*, p. 1.
- Silva, H., & Ratnadiwakara, D. (2008). *Using ICT to reduce transactional costs in agriculture through better communication: A case study from Sri Lanka*. Ottawa: International Devopment Research Centre.
- Smith, D. (2001). *Creating understanding*: California: Sage Publication.
- Smollo, J., Githaiga, B., & Barasa, M. (2017). Influence of utilizing milk market information through mobile phones on milk yield among small holder dairy farmers in Njoro Sub County Kenya. *Agriculture Research and Technology Open Access Journal*, 5(5), 1-6.

- Social Enterprise Alliance. (2015). *What is social enterprise?* Retrieved from www.se-alliance.org/https://www.sealliance.org/why#whats-a-social-enterprise
- Technoserve. (2008). *The dairy value chain in Kenya*. Nairobi: East Africa Dairy Development.
- United Nations Children Program. (2015, April 17). *Communicattion for development*. Retrieved from www.unicef.org/www.unicef.org/cbscl/
- United States Agency for International Development. (2013). *Scaling up mobile technology: Applications for accelerating progress on ending preventable maternal and child dearh*. Nairobi: USAID.
- Vigyan, K. (2015). Information needs assessment and prioritization of dairy farmers. *Indian Journals*, 4(1), 51-55.
- Vodafone. (2015). *What is M-Pesa?* Retrieved from [www.vodafone.com:http://www.vodafone.com/content/index/about/aboutus/money_transfer.html](http://www.vodafone.com/content/index/about/aboutus/money_transfer.html)
- Wambugu, S., Kiriimi, L., & Opiyo, J. (2011). *Policy and development productivity trends and performance of dairy farming*. Nairobi: Tegemeo Institute of Agricultural Policy and Development.
- Western Cape Government. (2016). *Evaluation of the research information needs of dairy producers in the Western Cape with a focus on producers in Cape Winelands and Swarlands regions*. Cape Town: Western Cape Department of Agriculture.
- Williams, M., Mayers, R., & Minges, M. (2011). *Africa's ICT infrastructure: Building on the mobile revolution*. Washington DC: World Bank.
- World Wide Web Consortium. (2009). *W3C mobile web for social development: The role of mobile technologies in fostering social and economic development*. Maputo: World Wide Web Consortium (W3C).

APPENDICES

Appendix A: List of Respondents

The following is the list of dairy development programs that were respondents for this study. All the listed are partners with the dairy regulatory body in Kenya – the Kenya Dairy Board

Name of Dairy Development Program	Title of the Respondent	Respondent's Interview Code
1. Sidai Africa	Administrator	Program Officer 01
2. Netherlands Development Organization (SNV)	Agriculture Advisor	Program Officer 02
3. HEIFER International	Program Manager	Program Officer 03
4. East Africa Dairy Development Program II(EADD)	M&E Manager	Program Officer 04
5. Kenya Market Trust		Program Officer 05
6. Centre for Agriculture and Biodiversity International (CABI)	Program Manager	Program Officer 06
7. Technoserve	Strategic Advisor	Program Officer 07
8. Land O Lakes	M&E Manager	Program Officer 08
9. Performeter	CEO	Program Officer 09
10. Tenelope	CEO	Program Officer 10
11. Dairy Africa	Director	Program Officer 11
12. International Fertiliser Development Centre	Program Manager	Program Officer 12
13. Micro Enterprise Support Program Trust	Program Manager	Program Officer 13
14. Small Holder Dairy Commercialization Program	CEO	Program Officer 14
15. Kenya Market Led Dairy Program2 Kuresoi	Dairy Consultant	Program Officer 15
16. Gakui Dairy Farmers group (This is a farmer group supported by SIDAI Africa)	FGD	Farmers FGD

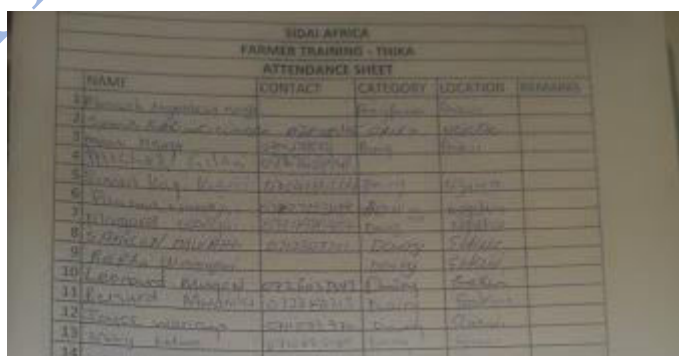


Image of registration list of Farmers who participated in FGD

Appendix B: Interview Guide for Program Officers

PART A: INDIVIDUAL, ORGANIZATION AND PROJECT DETAILS

1. Name of Respondent:
2. Position:
3. Organization:
4. Name of Dairy Project/program:
5. Duration of Project Program:
6. Project Start date:
7. Expected end date:
8. Number of beneficiaries:

(NB: The researcher can collect project brochure or project information fact sheet if available).

PART B: BASIC DATA ON USE OF MOBILE PHONE

9. Which feature of the mobile phone do you use in your program? Tick as many as necessary

MOBILE PHONE FEATURE	TICK IF IN USE	REMARKS ON HOW IT IS USED
Calls		
SMS		
Whatsapp		
Mobile app		Which app(s)
Any other mobile phone feature you use in the dairy program – please list e.g. camera, television, alarm clock, stop watch, calculator, address book, calendar, diary etc		
Telegram		

PART C: EXTENT TO WHICH DAIRY DEVELOPMENT PROGRAMS USE MOBILE PHONE COMMUNICATION

10. How do you use mobile phones in the dairy program?
11. Do the dairy farmers you serve possess mobile phones or you bought it for them?
12. How does the use of mobile phones in your dairy program affect service delivery to the dairy farmers?
13. What benefits does the dairy project derive from use of mobile phones?
14. Are you aware of dairy farming applications and innovations available in mobile phone technology? Please explain
15. How many/what percentage of your farmers own mobile phones
16. How frequently do you use mobile phones to communicate to your farmers
17. Look at the following uses of agriculture mobile use and explain if it applies to your program. Does your program use mobile phone to:
 - i. Coordinate access to dairy farming inputs? YES/NO
Explanation.....
 - ii. Provide market information? YES/NO
Explanation.....
 - iii. Provide emergency agricultural assistance? YES/NO
Explanation.....
 - iv. Monitor financial transaction? YES/NO
Explanation.....
 - v. Provide consulting with expert advice? YES/NO
Explanation.....

SECTION D: TYPE OF INFORMATION DAIRY PROGRAMS NEED TO DISSEMINATE TO DAIRY FARMERS

18. What is the importance of information to dairy farmers?
19. How will dairy farmers operate if they did not have information?
20. What kind of information do dairy farmers need?
21. Who provides standards on type of information to be availed to dairy farmers?

22. Please rank the following needs in the table below with 1 being the most important and 5 being the list important

Particular information required	Rank
Fodder Production	
Breeding and reproduction	
Health care Management	
General management e.g. milk hygiene, housing and sanitation	
Nutrition and feeding	
Add other information required	

SECTION E: BARRIERS ENCOUNTERED WHEN USING MOBILE PHONE COMMUNICATION TO IMPROVE DAIRY FARMING

23. When it comes to use of mobile phone in your program project, do you consider yourself a technophile or technophobe? (Researcher to explain clearly meaning of these two terms without bias to either of them)? Why?
24. Do you consider the dairy program to be making optimal use of mobile telephone technology? Why/why not?
25. How would you describe the ease or difficulty of using mobile phone in the dairy program? What technical difficulties do you experience?
26. How do you adapt use of mobile phone to suit local content?
27. How do you sustain or plan to sustain use of mobile phone into the dairy program?
28. Are there any other obstacles that you face as you use mobile phone in your dairy program?

SECTION F: SOLUTIONS DAIRY PROGRAMS HAVE PUT IN PLACE TO OVERCOME THE BARRIERS

29. For each of the above questions from No 23-28, what solutions has your dairy program put in place?
 - i. How to deal with technophobic behaviour
 - ii. Solution on making better use of mobile technology by overcoming technical difficulties
 - iii. Solution to localising content using mobile phone
 - iv. Solution to sustaining mobile phone use

30. What plans are in place to replicate and scale up use of mobile phone in the dairy program?
31. Who decided on use of mobile phone to support dairy farmers? What role did the farmers play in the decision? How did their role affect implementation?

SECTION G: GENERAL QUESTIONS

32. On a scale on one to 10, rate your preparedness on use of mobile phone with 1 being least prepared and 10 being fully prepared and implementing mobile phone use to its current fullest potential.
33. What recommendations do you have to improve preparedness on use of mobile phones by program officers and their institutions?

*******END OF THE INTERVIEW*******

Appendix C: Focus Group Discussion Guide for Dairy Farmers

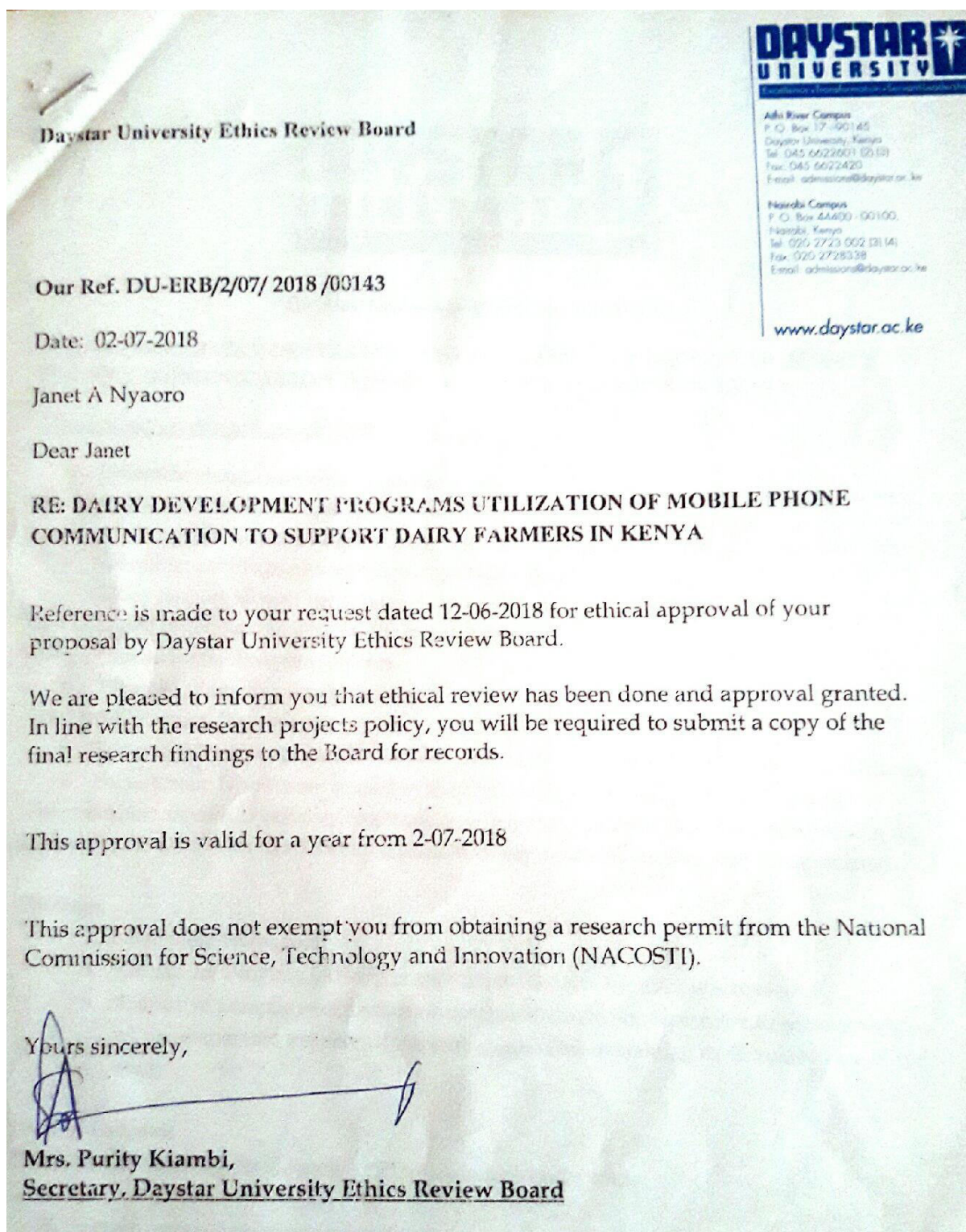
Introduction

(Introductions, where they practise dairy farming, objectives of research, input required from farmers for the research, seeking permissions and other preliminary discussions to create rapport)

Questions

1. Do you receive support from development programs via mobile phones?
What support and how?
2. What features of mobile phone do you find easy to use?
3. What features of mobile phone do you want to use but you are not able to?
4. Are you aware of any new innovation on use of mobile phones for dairy farming?
5. What type of information do you as farmers like to get especially through mobile phones?
6. What challenges and barriers do you experience in use of mobile phones? Please explain from your own perspective and also in relation to the support you receive on use of mobile phone.
7. What solutions do you propose to address the challenges and barriers on use of mobile phones to support your dairy farming initiatives?
8. What recommendations do you have that will improve mobile phone communication to support your dairy farming initiatives?

Appendix D: Ethics Clearance Report




Appendix E: Research Permit


THIS IS TO CERTIFY THAT:
MS. JANET ACHIENG NYAORO
of DAYSTAR UNIVERSITY, 0-100
NAIROBI, has been permitted to conduct
research in *Nairobi County*


Permit No : NACOSTI/P/18/82998/23987
Date Of Issue : 1st August, 2018
Fee Recieved : Ksh 1000

on the topic: *DAIRY DEVELOPMENT
PROGRAMS UTILIZATION OF MOBILE
PHONE COMMUNICATION TO SUPPORT
DAIRY FARMERS IN KENYA*

for the period ending:
30th July, 2019




Applicant's
Signature


Director General
National Commission for Science,
Technology & Innovation

DAYSTAR U

Appendix F: Anti-Plagiarism Report

