

UNIVERSITY OF KWAZULU-NATAL

**Farmers' perceptions and attitudes to technology adoption in the
Ugu District of KwaZulu-Natal, South Africa**

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degree of Master of Commerce (ENTREPRENEURSHIP)**

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DECLARATION

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ABSTRACT

Agricultural entrepreneurship is essential for fostering economic development and feeding growing populations in most less developed countries. Unfortunately, some farmers are experiencing a decline in production and failure to sustain their businesses. The main challenge for these farmers is the failure to embrace new and advanced agricultural technology. Agricultural technology adoption is a powerful tool for farmers to increase productivity and maximize their profits. Agricultural entrepreneurs are, in some instances, conservative and prefer to stick to traditional methods of farming. Based on the literature, many farmers fail to take advantage of the advancement in technology and as a result, find themselves not being as productive as they ought to be. Agricultural technology adoption has the potential to deepen the market share of agricultural output through which the smallholder farmers' resource use and output diversification decisions could be guided increasingly by their objective of profit maximization. However, the major problem, according to literature, is that the new technology adoption rate by South African farmers is low.

This study sought to investigate farmers' perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal, South Africa. This study is descriptive in nature and thus qualitative research was conducted with the aim to gather the information that depicts the attributes of people, occurrences or circumstances. It also describes the technology adoption theory, which provided a theoretical framework for this study. Technology adoption theory examines the individual and the choices an individual makes to accept or reject an innovation.

Semi-structured interviews were conducted with seven farmers in Port Shepstone to collect the data in the study. Thematic analysis, which is the process of coding data and inducing of categories and themes, was used to analyse data. The study found that there are various factors such as lack of financial resources, lack of adoption by neighbouring farmers, perceived usefulness and size of the business contribute to farmers' decision to adopt new agricultural technology. Farmers believe that technology is more expensive in early stages adoption but after that, it can help one grow their business and production. It was revealed that commercial farmers are more likely to adopt new technology than small-scale farmers.

Keywords: Agricultural entrepreneurs; Agricultural technology; Technology adoption; Profit maximization; Productivity

TABLE OF CONTENTS

Contents

DECLARATION	i
ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	x
LIST OF FIGURES	xi
APPENDICES	xii
ABBREVIATIONS	xiii
CHAPTER ONE	1
INTRODUCTORY CHAPTER	1
1.1 Introduction	1
1.2 Background to the Study	1
1.3 Problem Statement	3
1.4 Research Objectives	4
1.5 Research Questions	5
1.6 Rationale of the Study	5
1.7 Research Methodology Synopsis	5
1.7.1 Research Approach	6
1.7.2 Research Design	6
1.7.3 Sampling Technique	6
1.8 Data Collection Method	7
1.9 Limitations of the Study	7
1.10 Outline of the Chapters	7

1.10.1 Chapter One	8
1.10.2 Chapter Two.....	8
1.10.3 Chapter Three.....	8
1.10.4 Chapter Four	8
1.10.5 Chapter Five.....	8
1.10.6 Chapter Six.....	8
1.11 Conclusion	8
CHAPTER TWO	10
LITERATURE REVIEW	10
2.1 Introduction.....	10
2.2 What is Agriculture?	10
2.3 The Role of Agriculture in Economic Development	10
2.4 Innovation and Entrepreneurship	11
2.5 Agricultural Entrepreneurship.....	12
2.6 Effectiveness of Technology Adoption in Agriculture	12
2.7 Factors Influencing Farmers' Decision of Technology Adoption.....	13
2.8 Technology Adoption Impediments in Developing Countries	15
2.9 Traditional Agriculture	16
2.9.1 Traditional Agriculture Practices	16
2.10 Advantages and Disadvantages of Technology Adoption	18
2.10.1 Advantages of Technology Adoption	18
2.10.2 Disadvantages of Technology Adoption.....	19
2.11 Theoretical Framework.....	21
2.11.1 Introduction.....	21
2.11.2 Diffusion of Innovations	22

2.12 Technology Acceptance Theories	25
2.12.1 Theory of Reasoned Action	26
2.12.2 Theory of Planned Behaviour	27
2.12.3 Technology Acceptance Model	29
2.12.4 Technology Acceptance Model 2	31
2.12.5 Technology Acceptance Model 3	32
2.12.6 Unified Theory of Acceptance and Use of Technology	35
2.12.7 Social Influence.....	35
2.12.8 Perception of External Control	36
2.13 Conclusion	36
CHAPTER THREE.....	38
RESEARCH METHODOLOGY	38
3.1 Introduction.....	38
3.2 Research Approach	38
3.3 Research Design.....	39
3.4 Research Objectives	40
3.5 Research Questions	41
3.6 Study Site	41
3.7 Population and Target Population.....	41
3.8 Sampling Technique	41
3.9 Sample Size.....	42
3.9.1 Criteria for Selecting Respondents	43
3.10 Data Collection Method	43
3.10.1 Data Collection Tools	43
3.10.2 Semi-Structured Interviews.....	43

3.11 Data Analysis	45
3.12 Inductive and Deductive Approach.....	46
3.13 Data Quality Control	46
3.13.1 Validity and Reliability	46
3.13.2 Trustworthiness Issues	47
3.14 Ethical Considerations	48
3.15 Conclusion	49
CHAPTER FOUR.....	50
RESEARCH FINDINGS	50
4.1 Introduction	50
4.2 Demographics of the Participants	50
4.2.1 Section A: Biographical and Demographic Details	52
PRESENTATION OF RESULTS	54
4.3. Section B: What are farmers’ views on new technology adoption?	54
4.3.1 What are your views on new agricultural technology?	54
4.3.2 Do you prefer to stick to traditional methods of farming or do you like moving with time? Please explain.....	55
4.3.3 Does your farm have or use new agricultural technology? Why?	56
4.3.4 Do you perceive new agricultural technology to be a useful tool in performing your Activities? Yes or No. And why?	57
4.3.5 In your opinion should Ugu district farmers adopt new agricultural technology? Why?	59
4.4 Section C: What are factors that influence a farmer to adopt new technology?	60
4.4.1 How familiar are you with new agricultural technology developments? Please explain.	60

4.4.2. Are neighbouring farmers adopting new agricultural technology (from small to large)? And why?	61
4.4.3 What do you think are advantages of adopting new agricultural technology?	61
4.4. 4 What do you think are disadvantages of adopting new agricultural technology?	62
4.4.5 Do you think adopting technology would have an impact in your business or production? How?	64
4.5 Section D: Is there any form of external assistance that farmers are getting towards technology adoption?	65
4.5.1 Does government assist farmers on new agricultural technology adoption? Please explain.....	65
4.5.2. Are there any workshops where farmers are shown or taught about new agricultural technology? Please explain.	66
4.6 Conclusion	67
CHAPTER FIVE.....	68
RESEARCH DISCUSSION	68
5.1 Introduction	68
5.2 Biographic Data	68
5.3.1 RESEARCH OBJECTIVE 1: To explore farmers' views on new technology adoption.	69
5.3.2 RESEARCH OBJECTIVE 2: To examine what factors that influence a farmer to adopt technology.....	71
5.2.3 RESEARCH OBJECTIVE 3: To determine if there is any form of external assistance that farmers getting towards technology adoption.....	72
5.4 Conclusion	72
CHAPTER SIX	73
RECOMMENDATIONS	73
6.1 Introduction	73
6.2 Recommendations	73

6.2.1 Demographics of the Research Participants.....	73
6. 2.2 What are the farmers’ views on new technology adoption?	73
6.2.3 What are factors that influence farmers to adopt technology?.....	74
6.2.4 What form of external assistance are the farmers getting towards technology adoption?	75
6.3 Implication for Further Research	76
6.4 Limitations of the Study.....	76
6.5 Conclusion	77
REFERENCES.....	78
APPENDICES	111
APPENDIX A: Ethical clearance: University of KwaZulu-Natal	111
APPENDIX B: Ethical Clearance: Department of Agriculture & Rural Development	112
APPENDIX C: Research Interview Schedule	113
APPENDIX D: Letter to Department of Agriculture.....	117
APPENDIX E: Consent Form.....	118

LIST OF TABLES

<u>Table 4.1 Biographic Data</u>	51
<u>Table 4. 2 What are your views on new agricultural technology?</u>	54
<u>Table 4. 3 Do you prefer to stick to traditional methods of farming or move with time? Please explain</u>	55
<u>Table 4.4 Does your farm have or use new agricultural technology? Why?</u>	56
<u>Table 4.5 Do you perceive new agricultural technology to be a useful tool in performing your activities? Yes or No? And why?</u>	58
<u>Table 4.6 In your opinion should Ugu district farmers adopt new agricultural technology? Why?</u>	59
<u>Table 4.7 How familiar are you with new agricultural technology developments? Please explain</u>	60
<u>Table 4.8 Are neighbouring farmers adopting new agricultural technology? And why?</u>	61
<u>Table 4.9 What do you think are advantages of adopting new agricultural technology</u>	62
<u>Table 4.10 What do you think are disadvantages of adopting new agricultural technology</u>	63
<u>Table 4.11 Do you think adopting new technology would have an impact in your business or production? How?</u>	64
<u>Table 4.12 Does government assist farmers on new agricultural technology adoption? Please explain</u> ..	65
<u>Table 4.13 Are there any workshops where farmers are shown or taught about new agricultural technology? Please explain</u>	66

LIST OF FIGURES

<u>Figure 2.1: Theory of Reasoned Action</u>	27
<u>Figure 2.2: Theory of Planned Behaviour</u>	29
<u>Figure 2.3: Technology Acceptance Model</u>	31
<u>Figure 2.4: Technology Acceptance Model 2</u>	32
<u>Figure 2.5: Technology Acceptance Model 3</u>	33
<u>Figure 2.6: Unified Theory of Acceptance and Use of Technology</u>	35
<u>Figure 3.1: Steps in the Research Process</u>	40

APPENDICES

APPENDIX A: Ethical clearance: University of KwaZulu-Natal

APPENDIX B: Ethical clearance: KwaZulu-Natal Department of Agriculture and Rural
Development

APPENDIX C: Research Interview Schedule

APPENDIX D: Letter to Department of Agriculture

APPENDIX E: Consent Form

ABBREVIATIONS

AID	Authority Innovation-Decision
CID	Collective Innovation-Decision
CIMMYT	Centre of Internacional de Mejoramiento de Maíz Y Trigo
DARD	Department of Agriculture & Rural Development
DOI	Diffusion of Innovation
FIR	Fourth Industrial Revolution
LDCs	Least Developed Countries
OID	Optional Innovation-Decision
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
R & D	Research and Development
SEU	Expected Utility theory
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UDM	Ugu District Municipality
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE

INTRODUCTORY CHAPTER

1.1 Introduction

The agricultural sector is at the heart of the economies of the Least-Developed Countries (LDCs) (United Nations, 2015; Food and Agriculture Organization, 2002). Agricultural entrepreneurs play a fundamental role in economic growth, provision of food security, reduction of unemployment and subsequently poverty in rural areas. Farmer-entrepreneurs are defined as individuals who are market-oriented, forward-looking and amenable to taking calculated risks, creating new products, adapting new technologies, and innovating in their practise Estahbanaty (2013). According to Faria, Mixon, and Upadhyay *et al.*, (2016), farmer-entrepreneurs are new type of farmers who are always looking for new opportunities to grow, improve, expand their businesses and adopt new technologies to farming, and are willing to take calculated risks to make their farms profitable and their businesses grow because they view their farms as a business and means of earning profits. However, agricultural entrepreneurs encounter numerous barriers in their businesses such as, low production growth and business failure (Rezaei-Moghaddam and Izadi, 2019). These barriers hinder the growth and development of the rural economy.

The main aim of this study was to record Ugu farmers' views regarding the adoption of new agricultural technology. This study sought to contribute to answering three main questions of the study which are; what are the farmers' views on new technology adoption, what are the factors that influence farmers to adopt new technology and what form of external assistance are the farmers getting towards technology adoption. This chapter introduces the study by outlining the background of the study, states research problem, critical questions and objectives. Furthermore, this chapter discusses the significance of the study, synopsis of the methodology and delimitations. Lastly, this chapter will state the outline of chapters respectively.

1.2 Background to the Study

Ugu District Municipality (UDM) has a diversified economy, with key economic contributors being tourism, agriculture, manufacturing, mining, trade, and commerce. Agriculture is the second key sector in economic growth after tourism which is the main contributor. Agriculture does not only provide food and raw materials, but also employment opportunities to a large proportion of the population in the

municipality. Agriculture has strong linkage with the local economic growth and employment-generating potential (Mbatha and Masuku, 2018).

The main agricultural activities in UDM include stock farming, tea, and timber planting; the growing of macadamia nuts; sugar cane and banana-with the latter two dominating in terms of economic output. UDM has a well-developed banana distribution network and a well-established agricultural export market for macadamia products (Ray Nkonyeni Municipality, 2017). The municipality is predominantly rural, with traditional authorities having significant control in rural communities, particularly. Tribal land is used for subsistence farming of maize growing, amadumbe, sweet potatoes and beans (Ugu District Municipality, 2017). Agriculture plays a huge role in economic development in rural areas because of its contribution to the food supply, foreign currency earnings, provision of employment, supply of raw materials to other sectors and its role as a market and contributor to the gross domestic product (GDP) (Van Zyl, Nel, and Groenewald (1988) as cited by Greyling (2012). The value of agricultural production in South Africa increased by 4,7 percent and was estimated at R281 370 million in 2017/18, while its contribution to the GDP was estimated to be R90 458 million at nominal prices in 2017 (Department of Agriculture, Forestry and Fisheries, 2018). According to Majola (2019) the agriculture sector in KwaZulu-Natal, South Africa's second largest province contributes around 4 percent to the province's GDP. Agriculture contributes a relatively small share of the total GDP. However, it has a strong backward and forward linkages into the economy. The primary agricultural sector contributes over 7, 5 percent to the total employment across all districts in KwaZulu-Natal (Department of Agriculture and Rural Development, 2015). In the 2012 National Development Plan 2030 (NDP), agriculture, forestry and fisheries were identified as key sectors to drive inclusive growth in rural economies with significant job creation opportunities (Bureau for Food and Agricultural Policy, 2018).

Agricultural entrepreneurship is essential for fostering economic development and feeding growing populations in LDCs (New Partnership for Africa's Development, 2013). However, Africa is still producing too little food and value-added products and productivity has been broadly stagnant since the 1980s (Alliance for a Green Revolution in Africa, 2018). The main challenge for the UDM farmers is the reliance on traditional agricultural practices, which fail to embrace the new and advanced technology (Ugu District Municipality, 2017). More and more people around the world need food security and there is hope that the Fourth Industrial Revolution (FIR) can help farmers grow more crops and enjoy high profits (De Clercq, Vats, and Biel *et al.*, 2018). Speed and range of technological change holds promise for

accelerating inclusive agriculture and rural development, leading to more rapid structural transformation from agriculture to high productivity manufacturing and other sectors (Barrett, Christiansen, Sheahan, and Shimeles, *et al.*, 2017). Developed countries such as the United States of America and Japan are trying to solve agricultural issues through mechanization, automation, and modernization because FIR will serve as the opportune time to accelerate the scale and commercialization of agriculture (Sung, 2018). This suggests that the adoption of new agricultural technology by commercial farmers will have an impact on production and business development.

A very large body of literature on the adoption of agricultural innovations concentrates on identifying the characteristics of farmers who are likely to adopt (Conley and Christopher, 2010; Howley, Donoghue, and Heanue, *et al.*, 2012; Mwangi and Kariuki, 2015). This study aimed to explore farmers' perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal, South Africa. Understanding farmers' perceptions and attitudes towards technology adoption is essential because they influence their decision to adopt or not to adopt. Adoption of a new technology starts with farmers holding more positive prior beliefs about the usefulness and profitability of the new technology (Jogo, Karamura, Tinzaara, Kubiriba, and Rietveld, *et al.*, 2013). Therefore, understanding UDM farmers' perceptions and attitudes towards technology adoption was crucial.

1.3 Problem Statement

Technology adoption generally refers to the process by which innovative technology is selected for use and then incorporated into daily use by an individual or an organization (Cascio and Montealegre, 2016). Agricultural technology adoption is a powerful tool for farmers to increase productivity and maximise their profits. Agricultural entrepreneurs are, in some instances, conservative and prefer to stick to traditional methods of farming. According to Ntshangase, Muroyiwa, and Sibanda *et al.*, (2018), older farmers are reluctant to change from their own ways and experiences of farming. Based on the literature, many farmers fail to take advantage of the advancement in technology and as a result, find themselves not being as productive as they ought to be. Adoption of improved agricultural technologies is fundamental to transformation of sustainable farming system, and a driving force for increasing agricultural productivity (Obayelu, Okuneye, Shittu, Afolami, and Dipeolu *et al.*, 2016). However, the major problem is that the new technology adoption rate in developing countries is low (Bergoeing, Loayza, and Piguillem, *et al.*, 2010; Ejiaku 2014; Yeboah-Boateng and Essandoh, 2014).

According to Cavane and Donovan (2011), in Mozambique, maize crop is important for the provision of food and income to the rural poor, yet adoption of improved seed and chemical fertilizers to boost production is still limited. Rehman, Jingdong, Khatoon, Hussain and Iqbal, *et al.*, (2017) argued that, in the world's developing countries where smallholder farmers are responsible for eighty percent of the food, they have not benefitted from new technologies. They further argue that, "the majority of these farmers containing women, lack access to many modern tools needed to be successful, such as, crop management products, modern irrigation practices, fertilizers, postharvest loss solutions, improved seeds, mobile technology, as well as access to information and extension services." (Rehman, *al.*, 2017:71). Like most developing countries South Africa is having difficulties adopting the new agricultural technology. According to Maragelo (2008), in South Africa, most rural farmers rely on available natural resources and indigenous knowledge to successfully produce food crops and sustain their livelihoods. Jayne, Haggblade, Minot, and Rashid *et al.*, (2011) mention that smallholder farmers commercialization is a crucial feature of the structural transformation process considered by most development economists to be the major pathway from a semi subsistence agrarian society to a more diversified and food secure economy with higher general living standard.

Today's business leaders understand that technology adoption is the cornerstone of their business's future success. Unfortunately, in developing countries, some farmers do not have access to modern technology needed for successful agricultural practices (Alexandratos and Bruinsma, 2012). This then result in low agricultural productivity, as these farmers end up relying on traditional agricultural technology in their activities. Therefore, exploring farmers' perceptions and attitudes on technology adoption is fundamental in an attempt to address the problem.

In line with the problems highlighted in the problem statement above, the researcher's overall aim was to explore farmers' perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal, South Africa. In relation to the research aim, this study is undertaken with the following objectives:

1.4 [Research Objectives](#)

The objectives of this study are:

- 1) To explore farmers' views on new technology adoption.
- 2) To examine the factors that influence a farmer to adopt new technology.

- 3) To determine if there is any form of external assistance that farmers getting towards technology adoption.

1.5 Research Questions

In line with the aim and objectives, this study seeks to answer three questions underpinning this study, which are:

- 1) What are the farmers' views on new technology adoption?
- 2) What are the factors that influence farmers to adopt new technology?
- 3) What form of external assistance are the farmers getting towards technology adoption?

1.6 Rationale of the Study

The study was inspired by current issues faced by the agricultural sector. The rationale for conducting this research is current technology adoption levels in South Africa. Since early the 2000s, South African government has been encouraging technology adoption in the agricultural sector and had a number of initiatives to support adoption. Farmers are constantly blamed for sticking to traditional methods of farming and low levels of technology adoption without considering the challenges faced when they adopt the technology. The purpose of conducting this study was influenced by the need to understand farmers' views on technology adoption.

In this evolving world, it is important for agricultural entrepreneurs to incorporate technologies into their businesses. Agribusiness leaders perceived adoption of modern technological advancements in agriculture along the value chain as a major element of an enabling business (Alliance for a Green Revolution in Africa, 2018). The use of agricultural technologies affects the rate of increase in agricultural output and also determines how the increase in agricultural output impacts on poverty levels and environmental degradation (Muzari, Gatsi, and Muvhunzi, *et al.*, 2012). FIR is looming and it promises high profits using relatively little labour therefore, how can farmers get the most out of that?

1.7 Research Methodology Synopsis

Dawson (2011) defines methodology as a philosophy or the general principle that will guide the research. Streubert and Carpenter (2011) stipulated that research methodology provide methods, techniques, and procedures to be used in the process of research design.

1.7.1 Research Approach

De Vos, Strydom, Fouche, and Delport *et al.*, (2011) state that there are three types of research approaches namely; qualitative quantitative and mix methods. This study uses a qualitative research method. According to Harwell (2011), qualitative research methods provide an understanding of the thoughts and experiences of participants; therefore, it is based on opinions and perceptions. Qualitative research is focused on trying to represent consumers and their world as accurately as possible and in the process help decision-makers in policymaking (Karimi, 2013). The researcher intended to investigate farmers' views on new technology adoption through interviews. According to Jamshed (2014); (Hoy and Adams) 2015, using mainly qualitative research methods, one is able to collect relevant data through the use of interviews. Therefore, a qualitative research approach was deemed suitable for this study. Contrary, quantitative research is utilized to quantify the issue by creating numerical data or information that can be changed into useable statistics.

1.7.2 Research Design

Research design is a strategy for a study that specifies research methods and procedures for collection, measurement, and analysis of data (Sileyew, 2019). There are three common designs, namely; descriptive, exploratory, and casual study. Descriptive studies are frequently intended to gather the information that depicts the attributes of people, occurrences or circumstances, information was gathered on farmers' perceptions and attitudes to technology adoption (Sekaran and Bougie, 2013). For the purposes of this study, descriptive research design was employed. Descriptive the research design was used to gather information about farmers' views on the impact of technology adoption. The use of a descriptive paradigm in this study allowed the participants to share their understating, experiences and views on the impact of technology adoption. This assisted the researcher gain insight into farmers' behaviours, understanding, and experiences about the topic

1.7.3 Sampling Technique

Probability and non-probability sampling are two types of sampling methods. Probability sampling is a method in which every individual in a population gets an equal opportunity to be part of a sample. Conversely, a type of sampling where each member does not have a known non-zero chance of being included is called non-probability (Blumberg. Cooper, and Schindler *et al.*, 2008). Different types of non-probability sampling include convenience sampling, purposive sampling, quota sample, snowball sampling, systematic sampling and double sampling (Hibberts, Johnson, and Hudson *et al.*, 2012).

Convenience and purposive sampling techniques were two types of non-probability sampling methods employed in this study. Convenience sampling involves choosing the nearest individuals to serve as participants (Cohen, Manion, and Morrison *et al.*, 2011). Through using convenient sampling, the researcher was able to find farmers nearby where the researcher resides; in that way, logistic problems were avoided and traveling costs were saved. Purposefully sampling is a process of selecting individuals based on their possession of particular characteristics suitable for research questions (Cresswell, 2012; McMillian and Schumacher, 2010). The participants were operational farmers ranging from inexperienced to experienced. It was vital for the researcher to have participants with operational farms. This ensured that participants that were selected were knowledgeable and familiar with the farming business hence they were able to generate relevant and rich data.

1.8 Data Collection Method

Data can be obtained from primary or secondary sources. According to Sekaran and Bougie (2013), primary data is the original information obtained first-hand by the researcher on the variables of interest for the specific purpose of the study. Sources of primary data include interviews, questionnaires, focus groups and panels (Denscombe, 2010). Contrary, secondary data is information that has been collected previously for purposes other than the problem at hand. Primary data for this research was collected using individual face-to-face semi-structured interviews. This research method was selected with the purpose of enhancing trustworthiness of the study and easy data analysis.

1.9 Limitations of the Study

This study is produced for the master's degree with limited financial resources to expand the study into various locations in relation to the topic. Time restrictions for conducting a master's research works were also a problem. Keeping the time limitation in mind the researcher employed convenient and purposive sampling. This was to ensure that participants are knowledgeable and accessible to the researcher.

1.10 Outline of the Chapters

This research study entitled Farmers' perceptions and attitudes to technology adoption in the Ugu District of KwaZulu-Natal, South Africa is presented in six chapters. The chapters are briefly outlined below:

1.10.1 [Chapter One](#)

Chapter one of this research is the introductory chapter. The first chapter discusses the research problem, background, problem-statement and the aim of conducting this research study.

1.10.2 [Chapter Two](#)

Chapter two examines the existing literature. Different sources of literature will be consulted to explore the views of other researchers regarding technology adoption in the agricultural business. The chapter will also pay great attention to technology adoption theory, a framework underpinning this study.

1.10.3 [Chapter Three](#)

Chapter three presents the research methodology and design. It specifies research design, the population and the sample, sampling procedures, research instruments, data-collection procedures, presentation of the data, and the analysis procedures. Trustworthiness issues are discussed under this chapter as well as ethical considerations of the study.

1.10.4 [Chapter Four](#)

This chapter presents research findings. This chapter provides data and research results. Results of this study are presented with the aid of tables of the data collected from respondents.

1.10.5 [Chapter Five](#)

In this second last discussions of the findings are provided. The researcher links the findings of the study with the literature provided. The discussion is presented to meet the objectives of the study.

1.10.6 [Chapter Six](#)

The last chapter provides a general summary of the study, the recommendations of the study in relation to farmers' perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal, South Africa.

1.11 [Conclusion](#)

This chapter introduced the investigation of the discussed topic by presenting the background and rationale of this study. The chapter further provided the purpose of the study, research objectives as well as the research questions. Other key aspects such as research paradigm and approach, research style, sampling,

data generation methods, and analysis were also briefly discussed. The following chapter will present a literature review in relation to the topic.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review placed the topic into perspective and provided an appropriate context within which the topic revolves. The literature review is a significant aspect of most research because it seeks to synthesize published study results that relate to the topic of interest (Snyder, 2019). The literature was organised according to common themes and provided insight into the relationship between agriculture and technology. Lastly, it summarised the important aspects of the existing body of literature, evaluate the current state of the literature reviewed, and identify significant flaws or gaps in existing knowledge.

2.2 What is Agriculture?

According to Harris and Fuller (2014:2), “the English word agriculture derives from the Latin *ager* (field) and *colo* (cultivate) signifying, when combined, the Latin *agricultura*: field or land tillage.” Singh, Abhineet, and Kumar *et al.*, (2019) define agriculture as art, science, and business of producing crops and livestock for economic purposes. Agriculture as art is knowledge of the system to carry out the processes of the farm in a competent manner. Agriculture is very important because no one can exist without food (Food and Agriculture Organization, 2014). Agriculture as science utilizes all technologies developed on scientific principles such as crop breeding, production techniques, economics to maximize the yield and profits (Gama, 2017). Agriculture as business aims at maximum net return through the management of land labour, water, and capital. Agriculture is one of the oldest activities that people have used to feed themselves and trade with others. Therefore, agriculture plays a crucial in economic development and the existence of people.

2.3 The Role of Agriculture in Economic Development

Agriculture plays a crucial role in the economic development of least developed countries (United Nations, 2014). It is the backbone of their economic system. According to Pfunzo (2017); Cervantes-Godoy and Dewbre (2010), agriculture makes contribution to economic development in a number of ways which includes providing food, employment opportunities, raw material for manufacture, it is a business opportunity for rural people as they sell marketable surplus and it provides valuable earning of foreign exchange through export for agricultural entrepreneurs. For example, the South Africa sugar industry makes an important contribution to the national economy, given its foreign exchange earnings and

employment (South African Sugar Association, 2019). The South African Sugar industry is amongst the most cost-competitive producers of sugar cane in the world.

Agricultural growth is essential in ensuring economic development and feeding growing populations in most less developed countries (Blanford, 2011). The strong forward and backward linkages of the agricultural sector and other sectors of the economy provide an added stimulus for growth and income generation. Unfortunately, the world's oldest industry has become a symbol of backwardness (Dunman, 1975; Kopsidis, Bruisch, and Bromley *et al.*, 2013). This is based on that agriculture is mostly practiced in rural areas where the majority of the population is believed to be illiterate and unskilled. Therefore, one can argue that the agricultural sector ensures a bottom-up economic development approach. Speed and range of technological change holds promise for accelerating inclusive agriculture and rural development, leading to more rapid structural transformation from agriculture to high productivity manufacturing and other sectors (Barrett *et al.*, 2017)

Agriculture accounts for large shares of national income, employment, and exports and can create patterns of development that are favourable for the poor. The agriculture sector is the backbone of an economy which provides the basic ingredients to mankind and now raw material for industrialization (Praburaj, 2018). The World Bank (2016) suggested that promoting agricultural and rural development is crucial to pro-poor growth in most developing countries. For agricultural development to take place, it is essential that farms become less and less subsistence and more and more commercial, producing increasingly for the market (Khapayi and Celliers, 2016). Adoption of improved agricultural technologies is fundamental to transformation of sustainable farming system, and a driving force for increasing agricultural productivity (Obayelu, Okuneye, Shittu, Afolami, and Dipeolu, *et al.*, 2016). Increasing the speed of technology adoption is a key requirement for enhancing food security, agricultural productivity, economic growth and reduction of poverty in economically vulnerable communities (Ndiritu. Kassie, and Shiferaw *et al.*, 2014).

2.4 [Innovation and Entrepreneurship](#)

According Tölücea and Yurtkurb (2016) an innovation is the critical driver of economic change. Schumpeter who is perceived as the godfather of entrepreneurship theories argued that an entrepreneur is the one who is innovative, creative and has foresight. United Nations Industrial Development Organisation (2012) considers innovation as being a specific tool by which entrepreneurs exploit opportunities. Innovativeness can be described as willingness and interest to seek original ways of action (Rita, Priyanto,

Andadari and Haryanto, *et al.*, 2018). Innovation occurs when an entrepreneur introduces new products, new production methods and opens new markets. Innovativeness assists entrepreneurs to recognize valuable opportunities and to search for new ways of task completion (Ward, 2004). Innovation adoption will mean the process of bringing inventions to use decisions (King, 2017).

2.5 Agricultural Entrepreneurship

To eradicate poverty, agricultural entrepreneurs need to adopt technology and improve productivity. According to Ciglovska (2018), an increase in agricultural production and the rise in per-capita income of the rural community, together with the industrialisation and urbanisation, lead to increased demand in industrial production. Agricultural technology and innovation increase production and productivity. This will result in the rise of employment of unskilled workers and an increase in employment will translate into an increase in wages, which could have benefits that cross the borders of the rural sector (Bresciani and Valdes, 2007).

Entrepreneurs are viewed as major role players in economic growth, reduction of unemployment and subsequently poverty and agricultural entrepreneurs are no different. An agricultural entrepreneur is defined as, an individual or group with the right to use or exploit the land or other related elements required to carry out agricultural, forestry or mixed activities (Hajong and Padaria, 2016). According to Faria *et al.*, (2017), farmer-entrepreneurs are passionate about their farm business and are willing to take calculated risks to make their farms profitable and their businesses grow because they view their farms as a business and means of earning profits. Agricultural entrepreneurs play an essential role in economic growth and poverty alleviation. Agricultural entrepreneurs employ unskilled labour which lives in rural areas and who are usually women (Soffer and Sa'ada, 2016; Food and Agricultural Organisation for United Nations, 2016).

2.6 Effectiveness of Technology Adoption in Agriculture

Agricultural technology refers to technology for the production of machines used on a farm to help with farming and it is designed practically for every stage of the agricultural process (Kalaitzandonakes, Carayanni, Grigoroudis, and Rozakis *et al.*, 2018). Agricultural technology has the potential to accelerate agriculture and rural development, promote food security and reduce poverty. It reduces time; used to supply water to the crops, useful in sowing the seeds, used in transportation, application of synthetic fertilizer and chemical pest control. New Agricultural technology increase price and demand of the product, better marketing and exposure to the price, improve the fertility of the soil, decrease the use of

water fertilizers which keeps the prices down, low run of chemicals and also waste materials into sea and water, reduce the impact on the ecosystem the (Food and Agriculture Organization, 2017).

Unfortunately, even in pre-modern times, when most sectors were embracing technological advancements agriculture was characterized by the continuous, though relatively slow, development of agricultural tools such as; machines, plants, animals, and husbandry practices (James and Awan, 2017). According to Pretty and Bharucha (2014), new agricultural technology has a direct influence on changing the lives of the poor, by improving agricultural productivity, raising incomes of farm households, creating employment for landless labourers and subsequently wages and lowering the price of food staples while creating food security. Technology can play a huge role in water security by providing data and information to monitor and improve water harvesting, supply, use, recycling and reuse across the farm, industry and domestic sectors (World Economic Forum, 2016). The main reason for encouraging the application of new technology in agriculture is that, currently agriculture globally faces several critical issues in terms of food security, climate change, ecosystem degradation, biodiversity loss and various effects on ecosystem services (Asfaw, Di Battista, and, Lipper *et al.*, 2014). Hence, an in-depth analysis of each of these issues is necessary.

Technological change can be land saving or labour saving depending on whether it increases the rate of change in the productivity of land or that of labour. Land-saving technology permits the substitution of technology (capital) for land in production and, as a result, increases in the level of yield (Food and Agriculture Organization, 2015). Labour-saving technology substitutes technology for labour and, thus, allows increased productivity of labour. Twenty-first century robotics and sensing technologies have the potential to solve problems as old as farming itself (Shamshiri, Weltzien, Hameed, Yule, Balasundram, Pitonakova, Ahmad, and Chowdhary, *et al.*, 2018; King, 2017). Researchers believe that by moving to a robotic agricultural system they can make crop production significantly more effective and more sustainable says Simon Blackmore, an engineer at Harper Adams University in Newport, United Kingdom (UK) (King, 2017). Modern technologies such as improved varieties and chemical inputs have helped spur yields among some farmers (Arellanes and Lee, 2003).

2.7 Factors Influencing Farmers' Decision of Technology Adoption

The factors that influence the adoption of new technology are diverse or complex making it hard for a farmer to try and explain factors influencing adoption and the patterns of adoption (Sunny, Huang and Karimanzira *et al.*, 2018). According to Ullah, Khan, Zheng, and Ali, *et al.*, (2018); Yu, Li, Li, Cheng,

and Mo *et al.*, (2018), the important factors influencing farmers' decision of technology adoption are the size of a farm, gender, age, marital status, level of education, wealth, availability of labour, years of experience and risks (production risk and uncertainty related to the use of a new technology).

The size of a farm is significant in the adoption of technology decisions. According to Teshome, Negash, and Shewa *et al.* (2019), larger farms are more likely to adopt improved technology compared to small farms. Larger farms have a greater ability to raise capital, to bear the cost of the innovations and to bear the risk of failure, they are likely to be less risk-averse compared to relatively small farmers and are more likely to make risky investments compared to smaller farmers (Kahan, 2013). It is assumed that large families provide the labour required for improved production practices. Hategekimana and Trant (2002) maintain that, smaller farmers might be more willing to take the risk and costs associated with early adoption as they are looking for new niches and opportunities.

Gender plays a key role in technology adoption. Women play a significant role in agricultural development mostly in developing countries (SOFA Team and Doss, 2011). Therefore, is important that technology adoption studies consider women farmers' perceptions and views about technology adoption. Authors state that women are generally discriminated against in terms of access to external inputs and information (SOFA Team and Doss 2011; Lohani and Konuma, 2013)

A farmer's age may influence adoption decisions in a number of ways. A younger farmer due to his or her education and exposure to technology might more likely to adopt innovations early in his life cycle (Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), 1993) as cited by Rattey, Shorter and Chapman, *et al.*, 2011). On the other hand, an older farmer with a low level of education might prefer to stick to traditional methods of farming which may be related to the ability to judge opportunities to innovate (CIMMYT, 1993). On the contrary, a well-experienced and well resources older farmer might be willing trying new technology. Unlike older farmers, younger farmers have greater flexibility in accepting new ideas and a high appetite for risks (Khapayi, and Celliers, 2016)

Marital status plays an important role on whether a farmer adopts or rejects the new technology (Food and Agriculture Organization, 2017). Small commercial farmers have limited resources and their farms are part of their lifestyle. Production decisions are made by the head of the household, individual family members have very limited input in adoption decisions. For instance, the husband might be the one who makes decisions about the farm on behalf of his wife and children (Ullah *et al.*, 2018).

Access to information as well as the capacity to understand the technical aspects related to modern technology may influence crop production decisions (Food and Agriculture Organization, 2017). Farmers that are more educated are typically assumed better able to process information and search for appropriate technologies to alleviate their production constraints. Education gives farmers the ability to perceive, interpret and respond to new information much faster than their counterparts without education (Aldosari, Al Shunaifi, Ullah, Muddassir and Noor *et al.*, 2017; Dessale, 2019).

Wealth is key to technology adoption in agriculture. Farmers who have larger financial resources of their own are likely to adopt innovations earlier (Yigezu, El-shater, Mugeru, Aw-Hassan, Piggini, Haddad, Khalil, and Loss *et al.*, 2018). Farmers' annual turnover are a good proxy for wealth. It is often farmers with larger annual turnover that are more likely to adopt relatively new innovations. Wealthier farmers may be the first to try new technology because they are able to take risks, they have better access to extension information and their own cash resources to experiment with a new technique (Kahan, 2013).

Availability of labour influence the farmer in whether to adopt or no adopt new agricultural technology. It is assumed that large families provide the labour required for improved maize production practices (Abebaw and Belay, 2001). Farmers with more employees are likely to adopt new technology. If one has more labour they can divide and allow workers to explore other things (Food and Agriculture Organization, 2017). The high number of employees allow employers freedom for division of labour.

Years of experience play a huge role in new agricultural technology adoption decisions. Experience may positively relate to technology adoption by increasing a decision maker's ability to assess whether a new technology will be profitable (Khanna, 2017). Experience in a particular farming system makes the farmer more knowledgeable (Toffolini, Jeuffroy, Misschler, Pernel, and Prost, *et al.*, 2017).

Risks associated with the adoption of agricultural technology are the main factors that influence adoption decisions. The uncertainty associated with the adoption of any kind of agricultural technology has two features: firstly, the perceived riskiness of future farm yield after adoption and secondly, the production or price uncertainty related to farming itself (Koundouri, Nauges, and Tzouvelekase *et al.*, 2016).

2.8 Technology Adoption Impediments in Developing Countries

Technology adoption is viewed as an important tool for improving agricultural productivity in poor countries (Corral, Giné, Mahajan, and Seira *et al.*, 2017). Agricultural technologies have achieved enormous yield gains as well as lower costs for large-scale farmers in developed countries. However,

technology adoption in developing and countries remain relatively low (Bergoeing *et al.*, 2010). There are a number of barriers to agricultural technology adoption in LDCs which include financial constraints, lack of information and inadequate infrastructure. While farmers in developed countries have benefited from technological innovations, the peasant farmers in poor areas are yet to benefit adequately, due to the high cost of adoption (Eneji, Weiping, and Ushie *et al.*, 2012). Information barriers can be significant in preventing the adoption of profitable technology. They argue that, the existence and persistence of information constraints depend on farmers' ability to learn about the use of and the returns to new technologies through learning-by-doing or through learning-from-others. The majority of farmers are illiterate in Mozambique making it hard for them to learn about the use of new technology. Poor rural infrastructure has been identified as one of the major impediments to agricultural development in Bangladesh (Ahmed and Eklund, 2019).

2.9 Traditional Agriculture

Traditional agriculture is a type of farming that uses techniques developed over decades or centuries to ensure good, sustainable yield over time in a specific area. Traditional farming is most commonly in LDCs and developing countries. The majority of people in rural areas of LDCs use traditional knowledge, resources and household labour to carry out farming which takes place in homestead or home garden (Mapfumo, 2005 as cited by Khapayi and Celliers, 2016). In traditional farming, use of resources is directed by inputs, process and output (Sheahan and Barret, 2017). It about a farmer planting a seed (inputs), irrigating it (process) and sowing it when it ripens (output). Traditional farming has a number of advantages, which include creating higher natural levels of resistance to pest, it supports healthier soil and supports pollinators, and there are no worries about generic modified foods. Tradition farming uses natural resources and eliminates the use of synthetic products, creates health soil to produce health plants that are good for health (Siddique, Hamid, Tariq, and Gul *et al.*, 2014). However, traditional farming is time consuming, labour intensive and it allows wastage.

2.9.1 Traditional Agriculture Practices

Traditional agriculture features practices such as tillage, intercropping, crop rotation, traditional planting methods and local seed systems (Singh and Singh 2017). The majority of traditional farmers in developing countries use indigenous tillage systems. These systems are low cost, locally and culturally adapted technologies based on indigenous knowledge and reflect considerable knowledge of sustainable agriculture (Singh and Singh 2017). Most tillage operations are performed manually using a hoe or animal

drawn plough. Tillage activities remain labour intensive since farmers use manual farming implements (Awada, Lindwall, and Sonntag *et al.*, 2014).

Intercropping is widely practiced in Africa, it is cultivation of two or more crops on the same piece of land (Bybee-Finley and Ryan, 2018). For example; in South Africa, KwaZulu-Natal, smallholder farmers intercrop maize with beans or potatoes or pumpkins (Makhabela, 2006). Intercropping is regarded as a crop intensifying strategy aimed at minimising crop failure, stabilising yields, diversity and soil nutrients fixation especially when crops intercropped include legumes (Kiwia, Kimani, Harawa, Jama, and Silesh *et al.*, 2019). Intercropping ensures food security and maximum utilisation of land. Farmers practice intercropping for various reasons such as increasing food security, increased yields, to get surplus for income generation and minimise risk of crop failure (Achterbosch, van Berkum, Asbreuk, and Oudendag *et al.*, 2014; Makate, Wang, Makate, and Mango *et al.*, 2016). However, Farmers in developing countries are criticising intercropping, arguing it an inefficient, primitive and unproductive system (Akande, Oluwatoyinbo, Kayode and Olowokere *et al.*, 2006).

Crop rotation involves alternating planting the crops spot. Smallholder farmers have exploited this system for centuries to stabilize and increase yields (Norsworthy, Ward, Shaw, Llewellyn, Nichols, Webster, Bradley, Frisvold, Powles, Burgos, Witt, and Barret *et al.*, 2012). The main advantage of crop rotation is that it maintains soil nutrients. Traditional farmers consider crop rotation for a number of benefits such as; maintaining soil fertility, weed suppression, yields stability, minimise risk, control pests, diseases and insects (Pound and Jonfa, 2005). Watson, Walker, and Stockdale *et al.*, (2008) found that in Tanzania farmers practice crop rotation to improve soils and that the system was less labour intensive. This planting technique is easily available and the farmer only needs to be vigilant as well as ready to practice this technique as she or he will be using a land that was used the previous season or year (Bybee-Finley and Ryan, 2018).

Traditional planting methods exhibit the practises followed in intercropping and crop rotations. Planting is one of the laborious activities in traditional agriculture since it is mainly manual. Although this method is seen as labour intensive due to the fact that planting is manual, farmers know the benefits associated with seed broadcasting. To reduce labour demand, farmers broadcast seeds before soils are turned over (Aune, Coulibaly, and Giller *et al.*, 2017). In cases where animal traction is used, when the ox-plough is busy turning the soil, women follow with hoes digging small holes to bury the seeds and use the hoe to cover such buried seeds (Alabi, 2015). In Ethiopia, an agronomist tried to persuade farmers to follow line

planting without success because farmers knew that when seeds were broadcast weeds are suppressed due to higher plant densities (Abouziena and Haggag, 2016).

Traditional farming systems are characterised by local seed systems that are vital for food production. According to McGuire and Sperling (2016), most of these local seed systems operate at community level and are said to be informal. These seeds are not often given as free gifts but rather serve to reinforce social ties (Adam, Badstue, and Sindi *et al.*, 2018). It is exchange of limited quantities of seeds between neighbours. In most traditional farming systems, it is a common practice that farmers produce their own seeds or ask from neighbours or other farmers and relatives (Coomes, McGGuire, Garine, Caillon, McKey, Demeulenaere, Jarvis, Aistara, Barnauda and Clouvel *et al.*, 2016; McGuire and Sperling, 2016).

Traditional farming practices are advantageous in a number of ways as they are environmentally friendly, cheap and allow farmers to produce health food. However, traditional agriculture is labour intensive and it does not allow farmers to grow their businesses. (Stewart, Pierzynski, Middendorf, and Prasad *et al.*, 2020) states that, there are concerns that production is low due to depleted and poor soils, poor soil fertility management, poor plant protection practices, and soil water conservation practices. Throughout the world water scarcity is a challenge and since the majority of agricultural production is mainly rain-fed farmers need to know how to manage water (Kaihura and Stocking 2003; Modi, 2003 as cited by Mabhaudhia, Modi, and Beletse *et al.*, 2014). Currently global agriculture faces several critical issues in terms of food security, climate change, ecosystem degradation, biodiversity loss and various effects on ecosystem services (Padmavathy and Poyyamoli, 2011). Due to challenges of traditional farming farmers are encouraged practice modern agriculture that is more dependent on technology adoption. Technical change in the form of adoption of improved agricultural production technologies has been reported to have positive impacts on agricultural productivity growth in the developing world (Biru, Zeller, and Loos *et al.*, 2020).

2.10 Advantages and Disadvantages of Technology Adoption

2.10.1 Advantages of Technology Adoption

Technology adoption has a number of advantages (Iravani, Akbari, and Zohoori *et al.*, 2017; Kshirsagar, Pandey and Bellon, 2002 as cited by Jones, Shrinivas, and Bezner-Kerr *et al.*, 2014; Lencsés, Takács, and Takács-György *et al.*, 2014; Hornbeck, 2012). Some of the advantages of technology adoption that have been recorded are:

- Improves agricultural productivity.

- Create food security.
- Improved yield resulting in lowering the price of food staples.
- More accurate application of material, which will minimize waste of material.
- Reduce labour costs and save time.
- Profit margins become a bit higher and subsequently wages.
- It helps in marketing the business better.
- Play a big role in water security by providing data and information to monitor and improve water harvesting, supply, use, recycling and reuse across the farm, industry and domestic sectors.
- Improves efficiency by providing farmers with valuable data that allows them informed decisions about labour, market, and production.

2.10.2 Disadvantages of Technology Adoption

According to (Hornbeck, 2012; Kshirsagar *et al.*, 2002 as cited by Jones *et al.*, 2014; Jouanjean, Tucker and te Velde *et al.*, 2014). Adoption of the new agricultural technologies has a lot of disadvantages which include:

- Agricultural technologies have resulted in environmental degradation-Jouanjean *et al.*, (2014) argue that, the excessive use of the chemicals by the help of machines reduces the fertility of the land. They further argue that, lack of practical knowledge the farmers cannot handle the machines properly, while the cost of the maintenance is very high, and overuse of machines may lead to environmental damage
- Worsen absolute poverty and reduces the amount of steady employment. Dunman (1975); Mottaleb (2018) states that, the increasing use of the threshing machine made things worse for workers as it reduced the amount of steady employment in winter. For example, what will happen to landless farm workers if farmers decide to create robots that pick only ripe blackberries and ones that will interact with an autistic child? This will lead to retrenchment and further inequality (Gallardo and Sauer, 2018).

- Technology is expensive- Technology is usually more expensive than the technology it aims to sub, because it accounts for the environmental costs which have externalized in many conventional production processes (Iravani *et al.*, 2017). The costs of implementing are high and the cost of maintenance is very high.
- Widens the gap between big commercial farmers (haves) and small commercial farmers (have not). The small commercial farmers tend to have limited financial sources and cannot afford the new expensive machines hindering them to compete in the same market with big commercial farmers that have means and resources to invest in technology (Herens, Gabrielli, Peters, Brouwers, and Bosch *et al.*, 2018).

Technology adoption has both advantages and disadvantages. Some people view technology adoption as having a negative effect some view it as having a positive effect depending on their perceptions. Naturally, how people view technology is contradictory. Technology adoption provides farmers opportunities for earning profits that are not possible if they stick to traditional methods of farming globally. Eneji, *et al.*, (2012) argue that, although scientific and technological innovation benefits the society at large, the peasant farmers in poor areas are yet to benefit adequately, due to the high cost of adoption. According to (Mirza, Richter, van Nes, and Scheffer, *et al.*, 2019) agricultural technologies practices have resulted in environmental degradation and increased income inequality, inequitable asset distribution, and worsened absolute poverty. They further argue that, lack of practical knowledge the farmers cannot handle the machines properly, while the cost of the maintenance is very high, and overuse of machines may lead to environmental damage.

Chemical fertilizer and other modern agricultural practices introduced high-yield crop varieties to developing countries (Sebby, 2010). Environmentalists believe that agricultural technologies will have a negative impact in underdeveloped and developing countries, as they will give rise to inequality and unemployment. Jouanjean, *et al.*, (2014) argue that, the excessive use of the chemicals by the help of machines reduces the fertility of the land. Singh and Ashraf (2012) maintains that, agricultural technologies are sustainable.

Sustainability in agricultural means meeting our own needs without compromising the ability of future generations to meet their own needs (United Nations General, 1987 as Cited by Blowers, Boersema, and Martin, 2012). Sustainable development is defined as, the integration of economic, technological, social

and cultural development harmonised with the need to protect and improve the environment, which allows present and future generations to satisfy their needs and improve the quality of life (Spijkers 2018). The concept of sustainable agriculture as the primary food production activity involves harmonisation between economic (high productivity), social (improvement in living conditions) and environmental (preservation of the natural milieu) aspects of sustainability (Sulewski, Kloczko-Gajewska, and Sroka, *et al.*, 2018). Sustainability emphasizes, intergenerational equity, ecological sustainability, fair distribution of wealth, equity and justice and equal access to resources (Painter-Morland, Demuijnck, and Ornati *et al.*, 2017).

The new agricultural technology adoption has the ability to create new jobs as robots and machines need people to operate them. If Port Shepstone farmers adopt new agricultural technology that might open opportunities for unemployed engineers, biologist and technicians. New technologies may possible improve seeds, fertilizers, pest management practices and irrigation system resulting in high production. Transforming traditional agriculture is based on the idea that farmers in traditional agriculture are rational and efficient given their current resources and technologies (Adebayo and Oladele, 2012). Adoption of innovations could allow farmers to compete at world level. If Port Shepstone farmers adopt new technologies, there is a belief that productivity will increase and that will not only benefit the farmer but society at large. However, for new agricultural technology adoption to benefits the society at large it needs to be more inclusive, supporting the equitable reduction of poverty and hunger, and balanced with preserving existing high-value ecosystems (World Economic Forum 2013).

2.11 Theoretical Framework

2.11.1 Introduction

There are a number of theories pertaining to agricultural technology adoption but for the purpose of this study, the research will focus on technology adoption theories. The main aim of this study was to record Ugu farmers' views regarding the adoption of new agricultural technology. Therefore, it will review Theory of Diffusion of Innovations (DOI) (Rogers, 1995), Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991), Technology Acceptance Model (TAM) (Davis, 1989), Technology Acceptance Model 2 (TAM2) (Venkatesh and Davis, 2000), Technology Acceptance Model 3 (TAM3) (Venkatesh and Bala, 2008) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis and Davis *et al.*, 2003). These theories will assist in understanding how and why certain innovations are accepted or rejected. Rogers' diffusion of innovations theory, technology acceptance theories and factors considered to influence innovation

adoption are viewed as theories appropriate for investigating farmers' perceptions and attitudes to technology adoption in the Ugu District of KwaZulu-Natal, South Africa.

2.11.2 Diffusion of Innovations

The adoption process is inseparable from the diffusion process. Diffusion describes the adoption process across a population over time. Adoption commonly refers to the integration of new technology into existing practice; usually preceded by a period of trying and some degree of adaptation (Loevinsohn, Sumberg, Diagne, and Whitfield *et al.*, 2013). Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system (Roger, 2003). DOI is a research model that describes how, why and at what rate a new idea or innovation spreads through the social structure. DOI depends on four fundamental elements namely; innovation, communication channels, time, and social system. Based on this theory, this study sought to establish how an idea or product gains momentum and diffuses (or spreads) through a specific population or social system over time.

2.11.2.1 Four Main Elements in the Diffusion of Innovations

2.11.2.1.1 Innovation

Innovation is an idea, practice or project that is perceived as new by an individual (Rogers, 2003). Innovation newness depends on an individual's perception. For example, if a farmer views a tractor that was invented ten years ago as new then its innovation for him or her. The newness of innovation is associated with the innovation-decision making process, which includes knowledge, persuasion, and decision. The characteristics of innovation have a huge influence on how rapidly a new idea adopted. According to Rogers (2003) as cited by Alshamails, Papagiannidis and Li *et al.*, (2013), there are four main characteristics of an innovation include; complexity, compatibility, observability, and trialability. Complexity is about how easy it is for a farmer to understand and gain access to the innovation. Compatibility is the perceived usefulness of innovation to the farmer. Observability is about the farmer seeing and hearing about innovation from mass media or community leaders. If other farmers observe neighbouring farmers adopting the idea and speak highly of an innovation that would encourage the farmer to also adopt. Trialability is about the farmer wanting to implement the new idea in his or her business after seeing other farmers going through the same experience on television and hoping for similar results.

2.11.2.1.2 Communication

Communication is a two-way process of creating and transferring information through verbal and nonverbal means to reach a mutual understanding (Prabavathi and Nagasubramani, 2018). Every communication involves a source, message, and a recipient. Communication helps in creating awareness about an innovation and also increase its appeal (Walter, 2015). Considering the most effective methods of communication for a particular community – whether it is radio, community meetings, word of mouth, or a combination of the three it is vital to ensure the message reaches the correct audience. The message is transferred from the source to the receiver through mass media or interpersonal communication channels. Mass media channels are a one-way communication channels from the source to the receiver and they include a mass medium such as; television, radio, newspaper or magazines (Kotle and Armstrong, 2019). On the other hand, interpersonal channels involve two-way communication between two or more individuals (Men and Tsai, 2012).

Interpersonal channels play a big role in creating or changing strong attitudes held by an individual. Interpersonal channels are considered the most effective methods of communication for a particular community because they have a characteristic of homophily. Rogers (2003) describes homophily as the degree to which two or more individuals who interact share certain attributes, such as beliefs, socioeconomic status, age, level of education and the likes. However, the adoption of an idea needs some degree of heterophily. Heterophily is defined as the degree to which two or more individuals who interact do not exactly share the same attributes (Rogers, 2010).

2.11.2.1.3 Time

In behavioural research time is crucial. The innovation-diffusion process, adopter categorization, and the rate of adoption all include a time dimension (Alshamaila, Papagiannidis and Stamati *et al.*, 2013). Time is crucial in the diffusion of innovation model as it tests how technology diffuses over time at an individual and societal level.

2.11.2.1.4 Social System

The social system is the last element in the diffusion process. Since the diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. Rogers (2003: 23) defined the social system as, “a set of interrelated units engaged in joint problem solving to accomplish a common goal”. How community members interrelate affect the adoption of a new idea. For example, in communities where farmers have meetings or gatherings where they come together to openly discuss and

exchange information about innovations, they are likely to integrate technology in their business. In community meetings, opinion leaders are usually the main speakers.

2.11.2.2 The Innovation-Decision Process

A process where individuals are actively seeking and processing information with an aim to reduce uncertainty about the advantages and disadvantages of innovation is called the innovation-decision process (Sahin, 2006 as cited by Becker and Park, 2011) The adoption decision process is a process that occurs in five phases, namely; knowledge, persuasion, decision, implementation, and confirmation.

- 1) Knowledge about innovation is the first stage of innovation-decision process. At this stage an individual becomes aware of the innovation. The individual is exposed to innovation through various media channels but is not yet keen to find more information about the innovation.
- 2) Persuasion, in this stage the individual is interested in the innovation and actively seeking information from different sources about the innovation.
- 3) Decision to adopt the innovation or not, the individual compares the advantages and disadvantages of using innovation and evaluate the attributes of the innovation. Rogers (2010) maintains that this is the most difficult stage which acquires empirical evidence. There is formation of attitudes regarding the innovation and based on that attitude the individual decides to adopt or reject the innovation.
- 4) Implementation of the innovation, the individual employs the innovation.
- 5) Confirmation, the individual seeks reinforcement of his or her decision to continue using the innovation.

2.11.2.3 Types of Innovation Decisions

Innovation decisions are determined by two factors, namely; freedom to decide as an individual and having other people making decisions for everyone (Vagnani and Volpe, 2017). Three types of innovation decisions, and they include; Optional Innovation-Decision (OID), which is made freely and voluntarily by an individual, Collective Innovation-Decision (CID), which is a decision taken by all participants collectively and Authority Innovation-Decision (AID), which is a decision made by an opinion leader for the entire social system (Dietrich, 2010).

2.11.2.4 Adopter Categories

People do not adopt technology simultaneously. At the outset, only a few people are willing to try innovation and the percentage of adoption is low but as time goes on more people learn about the innovation and more people start to practice it (Diederer, van Meijl, Wolters, and Bijak *et al.*, 2003). Eventually, the whole community adopts the new idea and the fewer that have not adopted feel left out. Five classes of adopters include; innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003 as cited by Talke and Heidenreich, 2014). Innovators are people who are interested in new ideas, willing to take risks, have financial resources that allow them to do try and error (Cooper, 2010). They want to try innovation first. These would be the first farmers in their market to use a certain innovation. Early adopters are people with higher social status like innovators, well-educated and represent opinion leaders. These are people who need no convincing to adopt new technology, as they are already aware of the need for change. These are those farmers who embrace change and are among the first quarter to adopt the innovation. Early majority are not amongst the first people to adopt the innovation, they believe seeing is believing. However, they adopt innovation as the average person. These are farmers who would adopt an innovation after the first quarter of potential users (Vagnani and Volpe, 2017). The majority of farmers belong in this group. Late majority are people that are not open to change and will only adopt an innovation after it has been tried by the majority. These are farmers who would wait for other farmers to adopt innovation and see if it is successful or not and then adopt it. Laggards are very conservative people and they prefer to stick to traditional methods of doing things. If they adopt, they will be the last group adopt. These are farmers who would not introduce any kind of new technology or be the last group to adopt. This group consist of conservatism and illiterate individuals (AlGhamdi, 2012).

While a diffusion of innovation perspective focuses on perceived characteristics of an innovation a technology acceptance perspective focuses on behavioural attitudes towards a technology. The focal construct of the technology acceptance model are the perceived ease of use and perceived usefulness of a technology (He, Chen, and Kitkuakul *et al.*, 2018).

2.12 Technology Acceptance Theories

Adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation (Straub, 2009 as cited by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur, *et al.*, and 2012). Ertmer *et al.*, (2012) asserts that adoption is not only the choice to accept an innovation but also the extent to which that innovation is integrated into the appropriate context.

Agricultural technology acceptance theories are concerned with explaining adoption behaviour, exhibiting users' acceptance of information technologies, determinants of technology adoption, and neighbours' experience (Di Pietro and Pantano, 2012).

2.12.1 Theory of Reasoned Action

TRA (Figure 2.1) was developed by Fishbein and Ajzen (1975) and it is drawn from social psychology discipline. TRA aims to explain the relationship between attitudes and behaviours within human action. It is one of the most popular used theories and it states that beliefs influence attitude, which lead to intentions, and finally adoption. A farmer's decision to adopt a new innovation is based on the outcomes the farmer expects will come as a result of adopting the new innovation. TRA presents two fundamental independent concepts. The first concept is attitude towards behaviour and second concept is subjective norm, which are tied to behavioural and normative beliefs. Fishbein and Ajzen (1975) as cited by Head and Noar (2014) defined attitude towards a behaviour as an individual's positive and negative feelings about implementation the innovation. Subjective norm is an individual's opinion that majority people who are his or her influencers think he or she should or should not adopt the innovation in question (Alqasa, Mohd Isa, Othman, and Zolait *et al.*, 2014). TRA is based on individuals' attitude towards an innovation and is determined by their most significant beliefs and concerns of adopting the new technology. This theory can be used to predict how farmers will behave based on their pre-existing attitudes and behavioural intentions. TRA has been demonstrated and tested successfully for experimental support in predicting adoption in several disciplines such as, marketing and sociology (Lai, 2017). However, TRA fails to predict the adoption of individuals with low volitional control in mandatory and non-mandatory situation (Hameed, 2017). Therefore, it "provides an opportunity of expansion of its theoretical structure to incorporate beliefs affecting varying degree of volitional control of an individual" (Patel, 2007:417).

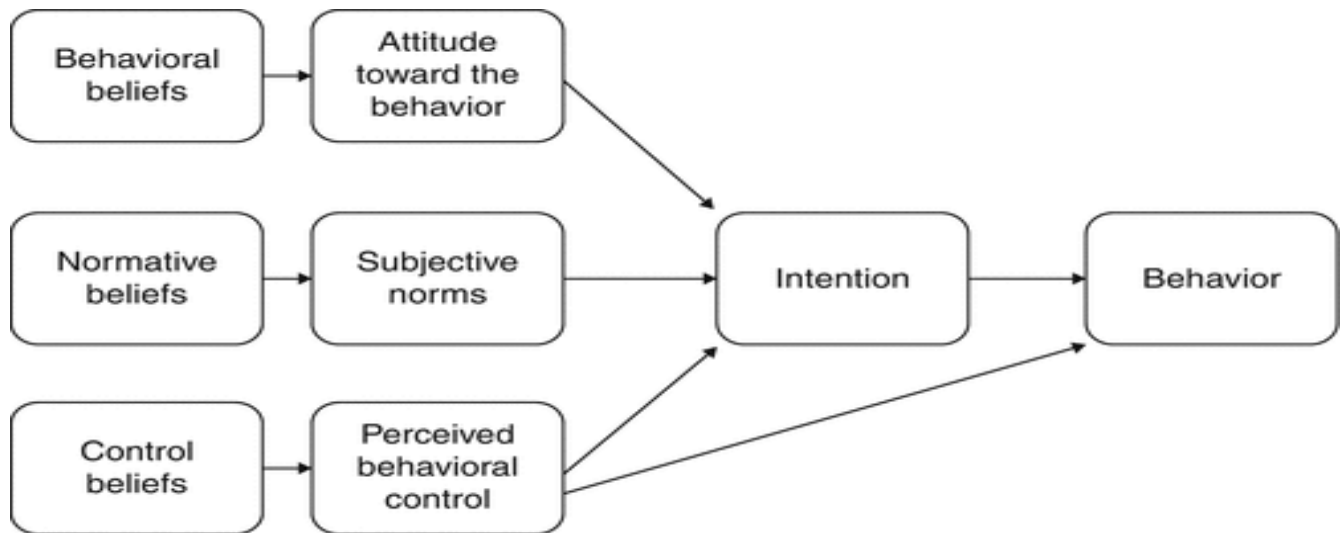


Figure 2.1 Theory of Reasoned Action – TRA (Fishbein & Ajzen, 1975)

2.12.2 Theory of Planned Behaviour

TPB (Figure 2.2) was utilised in this study because it is a general theory of every kind of social behaviour. According to Ajzen, (2011); Jung, Shim, Jin and Khang *et al.*, (2016), a positive attitude towards a given behaviour influences a person to perform a behaviour. The attitude towards behaviour, the subjective norm, and the perceived behavioural control are three theoretical concepts that influence the intention to perform a given behaviour. These concepts are formed by three different kinds of beliefs, namely consequence beliefs, normative beliefs and control beliefs (Adebayo and Oladele, 2012). Consequence beliefs influence the attitudes towards the behaviour. These attitudes are subjective evaluations of the consequences of performing the given behaviour. Normative beliefs cause subjective norms concerning the given behaviour. The subjective norm displays the perceived social pressure to perform the behaviour. Control beliefs form the perceived behavioural control. Perceived behavioural control contains the subjective assessment of a person’s ability to control the behaviour in question (Adebayo and Oladele, 2012).

Using TPB this study points out how internal factors, especially the attitude, play the most important role when farmers are faced with a decision to adopt or not to adopt a technology and. TPB assumes that consumers make decisions by calculating the costs and benefits of different courses of action and choosing the option that maximises their expected net benefits. “The more favourable the attitude toward a given behaviour and the subjective norm, and the greater the perceived behavioural control, the stronger should

be the person's intention to perform the behaviour in question. Once an intention is formed, people are expected to carry out their intentions when the opportunity arises" (Adebayo and Oladele, 2012:63-64).

TPB is underpinned by the Subjective Expected Utility theory (SEU). SEU main assumption is that people behave rationally. Therefore, after performing a behaviour people can revise and change their beliefs, because personal experience is seen as one of the important factors for changing attitudes. When beliefs are changed, a change in attitude, subjective norm, and perceived behavioural control will also follow. TPB assumes that rational behaviour is the result of processes of cognitive deliberation. It was used in this research because it is concern primarily with behaviours that are goal-directed and steered by conscious self-regulatory processes

TPB suggests that the adoption of new technology depends on the attitude and the knowledge that a farmer possess about a particular innovation. According to Taylor (2011), the more favourable the attitude toward a given behaviour and the subjective norm and the greater the perceived behavioural control, the stronger should be the person's intention to perform the behaviour in question. This suggests that a positive attitude of farmers towards innovation influences their decisions and will enhance the chances of adoption. After adoption, if the farmers recognize a better or poorer results, based on their experience the farmers can revise and change their beliefs about the impact of new agricultural technology.

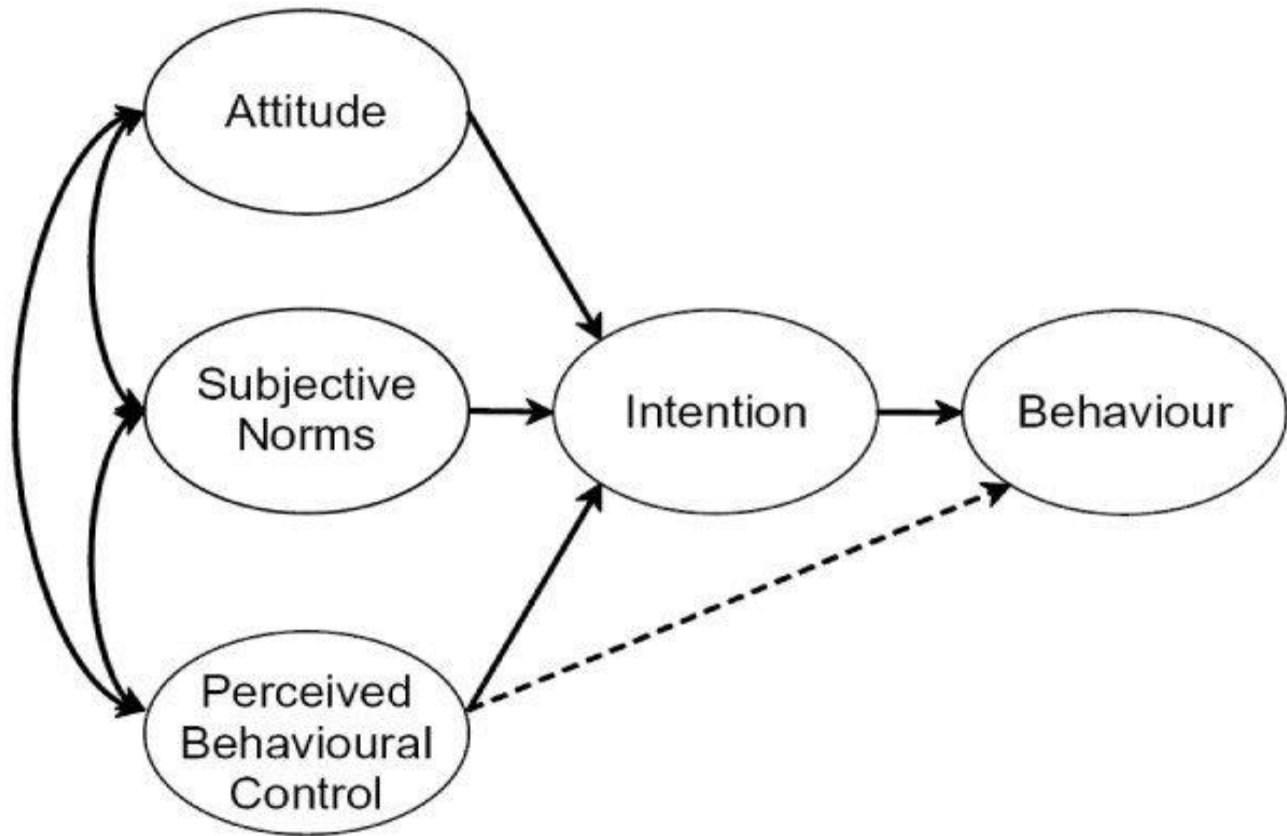


Figure 2.2 Theory of Planned Behaviour (Ajzen, 1991)

2.12.3 Technology Acceptance Model

TAM (Figure 2.3) was specifically designed to exhibiting users' acceptance of information technologies. In 1989 Davis used TAM to explain factors that influence computer acceptance goal as well as to explain computer usage behaviour. TAM) is the most influential model when investigating the adoption of new technology from an individual perspective that why it was adopted in this study. This model is commonly employed for describing an individual's acceptance of information systems (Davis et al., 1989). This study used TAM to assist the researcher identify reasons why a certain technology or system might be acceptable or unacceptable. Using TAM, the factors that influence farm's decisions to accept new agricultural technologies were estimated. In TAM, the two major factors influencing user's perception on adoption of new technology are; Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (He *et al.*, 2018). PU and PEOU influence the perceptions determining the adoption of technology and are suggestive of user intentions to develop new skills. The extent of the acquisition of new skills can be affected significantly by both extrinsic and intrinsic motivations (Dipboye, 2018). "Extrinsic motivation refers to the performance of an activity because it is perceived to be helpful in achieving special outcomes that are

different from the activity itself.” (Davis, 1989:320). In contrast, intrinsic motivation refers to the performance of a task for no apparent reinforcement other than the procedure of performing the activity per se.

2.12.3.1 Perceived Usefulness

Perceived Usefulness (PU) is defined as; the extent to which the user truly believes that adoption of the technology will enhance his performance in the industry context (Yen, Wu, Cheng and Huang *et al*, 2013). If a farmer believes adopting new agricultural technology will help him or her grow the business, produce more products and earn high profits he or she is most likely to adopt the technology. PU is concerned with end results, for example, the farmer might want to know if adopting technology will allow him or her to have a high return on investments. It looks at how the adoption of a particular agricultural technology helps the user in carrying out tasks. PU is also believed to have a direct effect on the users’ intention to use the technology (Davis, 1989 as cited by Teo, 2011). It is a fundamental factor for technology adoption that why it was viewed in this study as one of the factors influencing adoption.

2.12.3.2 Perceived Ease of Use

“Perceived Ease of Use signifies the degree to which an individual accepts that using certain technology would be effortless and hassle free” Zhu, Linb and Hsu (2012: 968). Perceived Ease-Of-Use (PEOU) – is the degree to which a person believes that using a particular system would be free from effort (He *et al*, 2018). It is a degree to which a farmer expects the new technology to be uncomplicated and have no disturbances in carrying out tasks. Simplicity makes the technology more acceptable to farmers. No-one farmer wants to spend days or weeks teaching workers how to operate a machine, that would be a waste of time and time is money. Bagozzi (2007) argued that TAM has gained popularity due to it being so easy to use yet, simplicity might be its biggest weakness. If something is simple and easy to use others can copy it easily and the farmer will have no competitive advantage of adopting the new technology. Nonetheless, Venkatesh and Davis in 2000 developed TAM2 as an extension of the TAM due to the limitations of the TAM in terms of explanatory power.

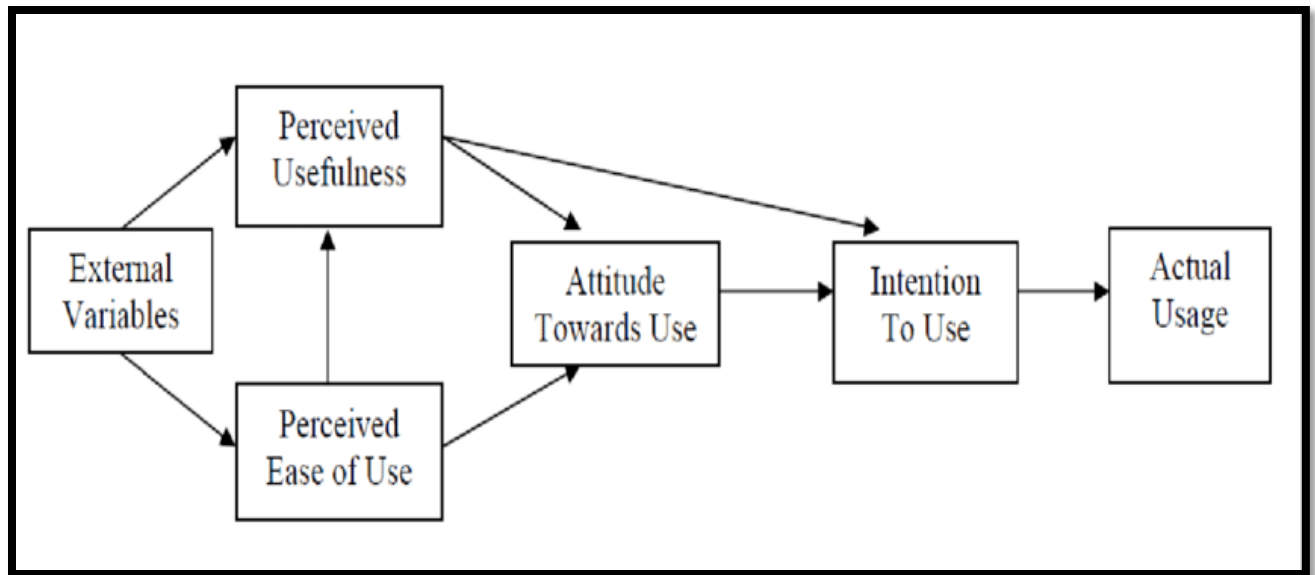


Figure 2.3 Technology Acceptance Model (TAM) (Davis, Bogozzi and Warshaw, 1989)

2.12.4 Technology Acceptance Model 2

TAM2's objective was to preserve the original TAM ideas. Venkatesh and Davis (2000) developed TAM2, an extension of the TAM due to the limitations of the TAM in terms of explanatory power. Venkatesh and Davis (2000) proposed the TAM 2 (Figure 2.4) with an aim to provide additional elucidations why users found a certain system useful at three points in one period: pre-execution, a month post-execution and three-month post-execution. TAM2 hypothesises that users' perceptions regarding the usefulness of the system are formed based on the users' mental evaluation of equivalents between vital goals at work and the significances of performing job tasks using the system (Lai, 2017). TAM was adopted in this study to understand how farmers' perceptions regarding the usefulness of the new agricultural technology might influence his or her decision to adopt or reject the new technology.

The TAM has been generally criticised by a number of researchers for various reasons. According to Priyanka and Kumar (2013: 147), "theory include questionable heuristic value, limited explanatory and predictive power, triviality, and lack of any practical value". While Benbasat and Barki (2007) as cited by Venkatesh, Thong, and Xu *et al.*, (2012) argued that TAM was failing to accommodate and adapt to the recurrently changing IT settings and this has led to theoretical chaos and confusion. Examining the adoption of technology from an individual perspective is inadequate because environment, exposure,

society and economic status in the vicinity where technology is shown to individual can collectively affect the adoption and use (Bagozzi, 2007).

However, TAM had received much support from (Yang, 2005; Lai and Zainal, 2015), based on perceptions of the technology's usefulness and convenience on adoption intentions. Lee and Jun (2007) as cited by Lai (2018), argued that TAM must be able to analyse factors influencing adoption intentions past perceptions of convenience and usefulness. TAM3 which will be discussed in detail below presented a complete nomological network of the determinants of users' Information Technology System adoption (Venkatesh and Bala, 2008).

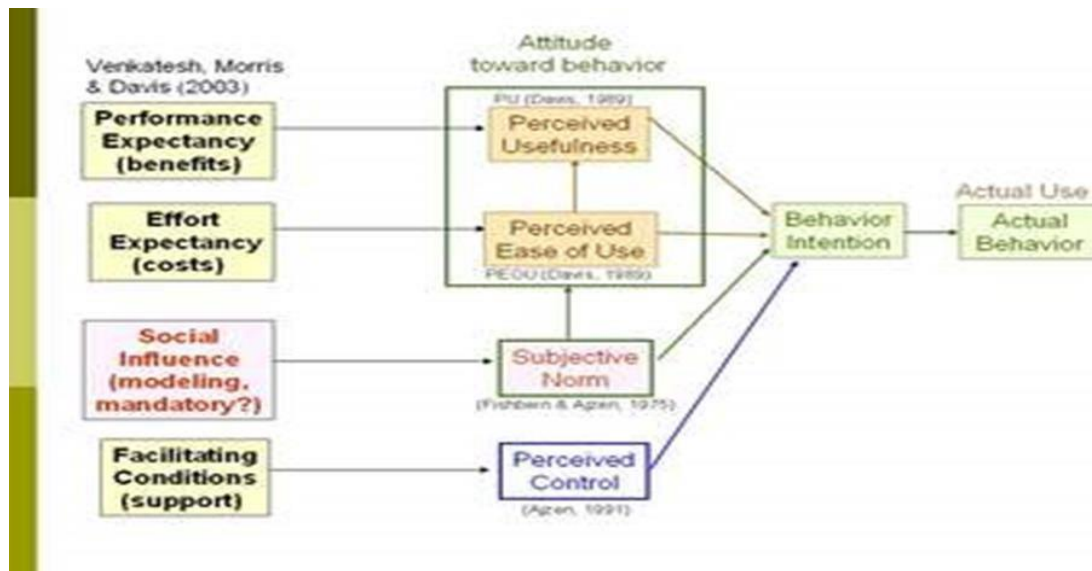


Figure 2.4 Technology Acceptance Model (TAM 2) (Venkatesh and Davis, 2003)

2.12.5 Technology Acceptance Model 3

As TAM2 solitary focused on the key factors of TAM's PU and usage intention concepts, Venkatesh and Bala (2008) as cited by Lai (2017) propose TAM3 (Figure 2.5), which added the determinants of TAM's PEOU, and usage intention constructs for heftiness. Using TAM3, Venkatesh and Bala (2008), depicted a thorough nomological network of the factors that influence users to adopt the information of technology system. Venkatesh and Bala (2008) developed TAM3 as an integrated model of technology acceptance by combining TAM2 and determinants of perceived ease of use model. Venkatesh and Bala in TAM3

development argued that adopter characteristics, innovation characteristics, firm characteristics, and environment characteristics are four determinants of perceived usefulness and perceived ease of use.

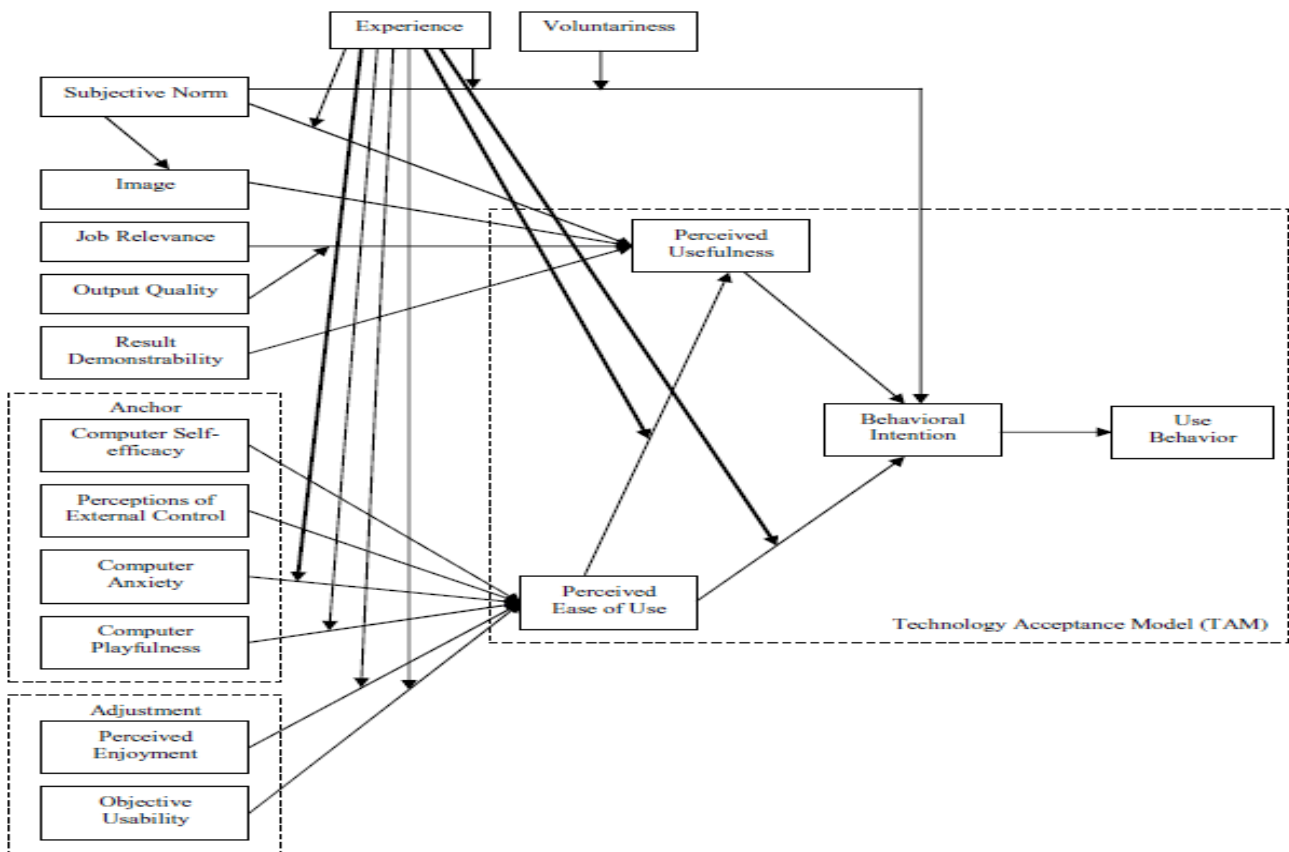


Figure 2.5 Technology Acceptance Model 3 (TAM3) (Venkatesh and Bala, 2008)

2.12.5.1 Adopter Characteristics

Individual characteristics are individual uniqueness or trait-based characteristics that influence a person to adopt or reject change. Wood and Swait (2002) suggests that, there may be personality traits that predispose individuals to adopt innovations and or adopt them more quickly than others. Adopter characteristics that affect the purchase of new technology include adopter class, risk disposition, geodemographic, the economic value needed and Word-of-Mouth (WOM) (Sharma, Kumar and Cosguner, *et al*, 2019). Adopters differ in their risk disposition; some are more risk oriented whereas some are conservative. Farmers who are risk oriented may adopt new technology first than conservative farmers who might adopt at a later stage or never. Adopters differ greatly concerning geodemographic variables such as age, gender, income, and education. Economic value directly affects the decision-making process

because if the farmer believes that technology adoption will positively affect income that will influence adoption decision (Di Pietro and Pantano, 2012). WOM from previous adopters influence the purchases of an innovation.

2.12.5.2 Innovation Characteristics

Innovation characteristics are distinctive to a particular innovation, how easy an innovation is to use, how the use of an innovation is compatible with the lifestyle of an individual (Lantos, 2011). The innovation characteristics include relative advantage, relative cost price, perceived usefulness, perceived ease of use and network externality (Shane, 2008). According to Moghavvemi, Mohd Salleh, Zhao, and Mattila *et al.*, (2012), relative advantage is used to assess the perception of benefits associated with adopting new technologies and the advantages that it carries to conquer a competing or preceding idea. In TAM, perceived usefulness and ease of use are two dominant factors influencing the adoption of technological innovations (He *et al.*, 2018). Network externality, the assets of an innovation and its usefulness to an adopter accelerates with the number of adopters, for example, telephones, and videogames also influences the innovation's sales (Shankar and Bayus, 2003).

2.12.5.3 Firm Characteristics

The firm characteristics suggests that farms who own big farms with good reputation are most likely to adopt innovations faster than farmers who own relatively small farms (Akudugu, Guo, and Dadzie *et al.*, 2012). The size and reputation of the firm influence its adoption. Large firms can induce trial by deploying superior resources. According to Atkin, Chaudhry, Chaudry, Khandelwal, and Verhoogen *et al.*, (2017) large firms with large market shares are more likely to adopt new technology because they have a greater ability to appropriate the profits from the adoption. Farmers from developed countries have invested in new agricultural technology and found it profitable to adopt new technology. New agricultural technology is expensive and often requires the agricultural entrepreneur to spend money upfront to improve facilities. The costs of innovations make it hard for small farmers to adopt innovations.

2.12.5.4 Environment Characteristics

The environment characteristics that drive new agricultural technology trial and repeat purchases include infrastructure, availability and demand for agricultural product and market conditions. Environmental factors contribute toward the purchase of a new product (Hartmann and Apaolaza-Ibáñez, 2012). Presence of the right technological and economic infrastructures is important for the adoption of innovation by farmers. The availability and demand for related products such as complements and accessories also

determine the rate and level of a new produce (Matsa, 2011). According to Shane (2008), how competitors react to the introduction of the innovation is likely to influence the innovation purchase adoption rate. For example, a farmer is more likely to adopt the new agricultural technology if neighbouring farmers are also adopting the new technology.

2.12.6 Unified Theory of Acceptance and Use of Technology

Venkatesh *et al* (2003) formed Unified Theory of Acceptance and Use of Technology (UTAUT) using the previous models. The UTAUT (Figure 2.6) incorporates four key predictors of users' behavioural intention and there are performance expectancy, effort expectancy, and social influence (Tran, Zhao, Diop and Song, *et al*, 2019). These predictors are facilitation conditions as well as four key moderators like gender, age, voluntariness and experience. All these predictors are associated with farmers' perception on technology. Based on this theory, this study sought to establish the behavioural intention to adopt new technology from the perspective of farmers by applying the extended UTAUT.

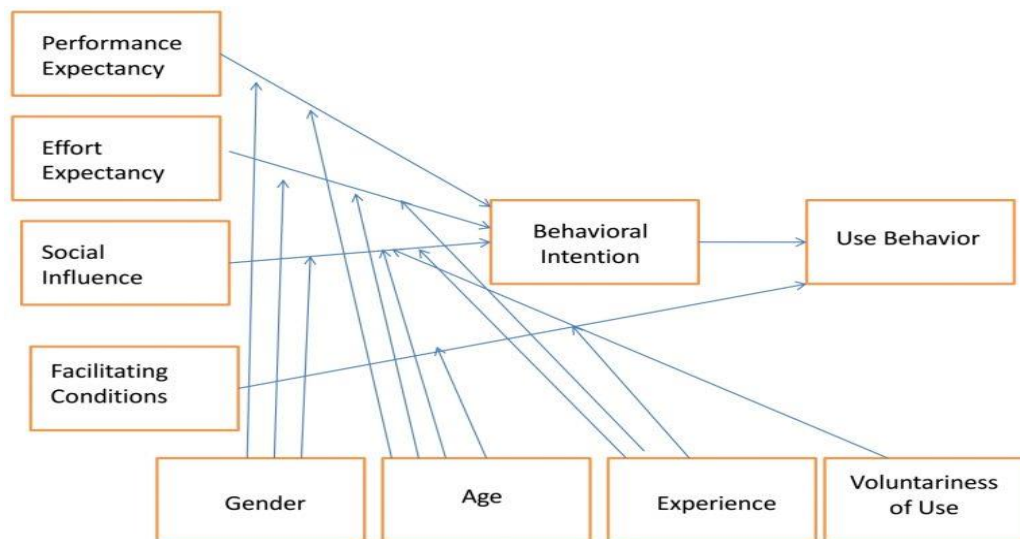


Figure 2.6 Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.*, 2003)

2.12.7 Social Influence

Yi, Jackson, Park, and Probst *et al.*, (2006) state that human and social factors could play a role in the adoption of technology using the TPB. Venkatesh and Davis (2000) argue that the norm was likely to have a significant influence on behavioural intention to use in a mandatory environment, whilst the effect could be insignificant in a voluntary environment. If a farmer knows other farmers who use technology or he

grew up in a community that used technology, he is more likely to adopt technology in his or her business than someone who grew up with limited access to technology. Davis, Bagozzi and Warshaw (1989) as cited by Lai (2017) argued that social norms scales had a very poor psychometric standpoint, and might not exert any influence on consumers' behaviour intention, especially when the information system application is a single platform.

2.12.8 Perception of External Control

Nanthida (2011) argues that external control is a function of available knowledge, ease of use of relevant resources, dexterity in the use of new skills and modern technology, and proficiency that is required in carrying out a particular task. Moreau, Lehmann, and Markman *et al.*, (2001) analyse prior product knowledge and its influence on consumers' perceptions of both continuous and discontinuous innovations. For example, if farmer has the right resources and has been taught or is knowledgeable on how to operate a machine that will influence his or her judgments on adoption intentions because of their level of control in carrying out certain tasks.

2.13 Conclusion

This chapter defined agriculture, discussed the importance of agriculture in economic development, agriculture entrepreneurship, traditional agriculture, advantages and disadvantages of new agricultural technology adoption. Taking advantages of technology adoption into consideration, the new agricultural technology has the potential to improve economic development of LDCs. Technology adoption theories are very important when talking about technology adoption in any context. They have proven to be very effective in understanding the reasons and factors influencing adoption. The TAM, TRA, TPB, TAM2, TAM3 and UTAUT have been used over the years by various researchers to explain the adoption of technology systems. Using these theories, the factors that influence farm' decisions to adopt modern agricultural can be estimated. These technology theories point out facts from different dimensions that influence a farmer's decision to adopt or not to adopt an innovation. TAM and TPB were selected to underpin this study because there are in line with aim of this study which was to record Ugu farmers' views regarding the adoption of new agricultural technology. TAM has been elaborated by researchers and progressed gradual over time to resolve its shortcoming. It has incorporating other theoretical models or introducing new external variables, and being applied to different environments, systems, tasks, and subjects. TAM attempts to provide logical explanations to help researchers and practitioners distinguish the reasons for acceptance or rejection of a particular innovation by famers and come up with appropriate

processes through explanation besides providing prognostication. Over the years, TAM deals with farmers' acceptance of technology. TAM has been tested extensively with different samples in different situations and many extensions to the TAM have been proposed and tested (Lai and Zainal, 2015; Lai, 2016) and proved to be valid and reliable model explaining factors influencing adoption.

TPB gave a fuller explanation on how positive attitude towards a given behaviour influences a person to perform the behaviour. The next chapter will discuss research methodology, data collection and analysis methods.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

According to Rajasekar, Philominathan, and Chinnathambi *et al.*, (2013), research is a logical and systematic search for new and useful information on a particular topic. Methodology refers to the way of searching or solving the research problem (Industrial Research Institute, 2010). Therefore, research methodology refers to investigating a given problem methodically and find out the outcome to reach a conclusion. Streubert and Carpenter (2011) stipulated that research methodology provide methods, techniques, and procedures to be used in the process of research design. Hence, it is crucial for the researcher to be clear about what she or he wants to research and how that must be researched when conducting any study. The previous chapter reviewed the literature about agriculture, new agricultural technology and technology adoption theory. This chapter discusses the research methodology, research design, sampling techniques and data collection methods. Data quality control and data analysis methods are discussed as well as different strategies that were used to enhance trustworthiness of the study.

3.2 Research Approach

De Vos *et al.* (2011) stipulate that there are three types of research approaches namely; qualitative, quantitative and mix methods. According to Harwell (2011), qualitative research methods provide an understanding of thoughts and experiences of participants. Therefore, the qualitative research method is based on opinions and perceptions. Contrary, quantitative research deals with statistical analysis and numerical data to provide quantitative information (Nyakala, 2012). Quantitative research is utilized to quantify the problem by creating numerical data that can be changed into useable statistics. Creswell (2009) describes a mixed method as an approach in which the researcher collects and analyze data using both quantitative and qualitative data in a single study. The goal of mixed research methods is to draw strong points from these approaches and minimize their weaknesses without replacing either the quantitative or qualitative (Green., Duan, Gibbons, Haogwood, Palinkas, and Wisdom *et al.*, 2015).

Qualitative research is focused on trying to represent consumers and their world as accurately as possible and in a way that helps decision-makers in policymaking (Pellissier, 2007). Qualitative research is an inquiry process of understanding which is based on distinct methodological traditions of inquiry that explore social problems; qualitative studies are usually conducted in a natural setting where detailed information is gathered directly from the participants (Silverman, 2010; Creswell, 2013). This study

adopted a qualitative research approach because the researcher wanted to investigate farmers' views on new technology adoption and interpret occurrences in terms that reflect the farmer. According to Jamshed (2014), using mainly qualitative research method one can collect relevant data using interviews. Qualitative research provides a more holistic view of farmers' opinions, perspectives, and attitudes regarding new technology adoption.

In this research, qualitative research methods were applied as they are appropriate and relevant to the study undertaken. In this study, interviews served as a fundamental tool in carefully collecting the data and proved to be efficient and significant in the data collection process. According to Nkantini (2005), qualitative research is not about numbers but about generating in-depth rich verbal data. Through the use of qualitative methods, the researcher was able to include different types of questions about the experiences, behaviour, opinions, attitudes, and feelings of the participants that were essential. Moreover, Hammarberg, Kirkman, and de Lacey *et al.*, (2016) maintains that in research that is designed to provide an in-depth description of a setting or phenomenon, qualitative methods are mostly used. This study provides an in-depth description of the phenomenon of technology adoption through the exploration of farmers' views.

3.3 Research Design

Research design is a strategy for a study that specifies research methods and procedures for collection, measurement, and analysis of data (Sileyew, 2019). Maboe (2009) as cited by Moloko and Chikwekwete (2019) described research design as the overall plan, where the respondents and the means of data collection of the study are described. There are three types of common research designs, namely; descriptive, exploratory and casual study. Descriptive studies are frequently intended to gather information that depicts the attributes of people, occurrences or circumstances as its objective is to describe (Sekaran and Bougie, 2013). An exploratory study is conducted when more or less facts are recognised but more evidence is needed to develop a feasible theoretical framework (Sekaran and Bougie, 2016).

This study applied descriptive research design. The goal of descriptive research is to describe a phenomenon and its characteristics (Nassaj, 2015). The purpose of conducting descriptive research is to get a deeper understanding of new technology adoption. The study aimed to discover the reality. In descriptive research 'What is going on?' and 'How is it going?' are two questions of major importance (Language Teaching Research, 2015). The purpose of selecting descriptive research was to get an accurate portrayal of farmers' perceptions of new technology adoption. This study aligned with descriptive research

to gain a deeper understanding of new technology adoption. The aim of the research was to explore Farmers' perceptions and attitudes to technology adoption in UDM.

Interviews were used to explore the views, experiences, beliefs and motivations of individual participants. Through using the descriptive paradigm, the researcher was able to gain insight into what is going on and how is it going? One major disadvantage of this sampling method is that generalizability is questionable.

Figure 3.1 Steps in the Research Process (Sreejesh, Mohapatra and Anusree 2014)



3.4 Research Objectives

In this evolving world, it is important for agricultural entrepreneurs to incorporate technologies into their businesses. The increase in demand for consumer goods stimulates technological innovation because technologies in agriculture make it quicker and cheaper to produce consumer goods (Schwab, 2016). The FIR is looming and it promises high profits for relatively cheap labour in a short time.

The objectives of this study are:

- 1) To explore farmers' views on new technology adoption.
- 2) To examine the factors that influence a farmer to adopt new technology.
- 3) To determine if there is any form of external assistance that farmers are getting towards technology adoption.

3.5 Research Questions

In order to achieve the objectives of this study, the researcher attempted to discuss and address the following questions:

- 1) What are the farmers' views on new technology adoption?
- 2) What are factors that influence farmers to adopt new technology?
- 3) What form of external assistance are the farmers getting towards technology adoption?

3.6 Study Site

The study site is the physical place where the study is to be conducted to collect the desired data (Simons 2009). This research was geographically based at Port Shepstone under UDM. Port Shepstone is situated on the south coast of KwaZulu-Natal under UDM. The UDM municipality is predominantly rural, with traditional authorities having significant control in rural communities, particularly. While Tribal land is used for subsistence farming of maize growing, amadumbe, sweet potatoes and beans where families grow for consumption. Small-scale and big commercial farmers play a huge role in economic development in rural areas in UDM (Ugu District Municipality, 2017).

3.7 Population and Target Population

Population refers to all individuals or group of people and objects that are the units of interest of a researcher (Burns and Grove, 2011). Population refers to the entire group of people, events or things that interest the researcher wishes to investigate (Sekaran, 2016). Usually, the individuals and objects within the population have common characteristics (Polit and Beck, 2012). Burns and Grove (2011) defined a target population as, the collection of units or group of people and objects with certain characteristics of interest for the researcher. The target population for this study are agricultural entrepreneurs and farm workers in KwaZulu-Natal.

3.8 Sampling Technique

Probability and non-probability sampling are two types of sampling methods. Probability sampling is a method in which every individual in a population gets an equal opportunity to be part of a sample. Conversely, a type of sampling where each member does not have a known non-zero chance of being included is called non-probability (Blumberg *et al.*, 2008). Different types of non-probability sampling include, convenience sampling, purposive sampling, quota sample, snowball sampling, systematic

sampling and double sampling (Haque and Craig, 2010). Convenience and purposive sampling techniques were two types of non-probability sampling methods employed in this study.

In convenience sampling (also known as Accidental Sampling) targeted population must be accessible, geographically immediate and be willing to participate (Etikan, Musa, and Alkassim, *et al.*, 2016). Convenience sampling involves choosing the nearest individuals to serve as participants (Cohen *et al.*, 2011). Through using convenient sampling, the researcher was able to find farmers nearby where the researcher resides; in that way, logistic problems were avoided and traveling costs were saved.

Purposive sampling is about selecting individuals based on their possession of certain criteria and characteristics suitable for research questions (McMillan, 2010). The participants were commercial farmers with operational farms ranging from inexperienced to experienced. The commercial farmers were a mixture big and small and involved in crop or poultry farming. The reason for selecting commercial farmers only was to ensure that the participants view their farms as business. It was vital for the researcher to have participants with operational farms. Purposive sampling involves selecting participants who understand the phenomenon being studied (Creswell, 2014). This ensured that participants that were selected were knowledgeable and were familiar with the farming business hence they were able to generate relevant and rich data. In Purposive sampling the researcher selects respondents to be sampled based on personal knowledge, professional judgment or experience (Cooper and Schindler, 2008). The researcher consciously interviewed only those who are already practicing farming. “Sometimes, purposive sampling is the only meaningful way to investigate” (Sekarma and Bougie, 2013:254). The reason for selecting these types of sampling methods is that, according to Cohen *et al.*, (2011), purposive sampling and convenience sampling are used together regularly in order to access knowledgeable people who have in-depth knowledge about particular topics through their experiences. Using convenience and purposive sampling proved to be time-saving, convenient and economical.

3.9 [Sample Size](#)

The process of choosing the appropriate individuals, items, or events as representatives for the entire population is known as sampling (Sekaran and Bougie, 2016). The participants in this study were seven commercial farmers. According to Guest, Bunce, and Johnson *et al.* (2006), guidelines for determining non-probability sample sizes are virtually non-existent. Sample size in qualitative research is determined by saturation O'Reilly and Parker (2013). The reason for stopping on the seventh agricultural entrepreneur is that the researcher felt that the saturation state was achieved. Saturation means that no additional data

to the one already collected would add any value to the study (Glaser and Strauss, 1967). The researcher felt that the eight participants will add no value to the study, he or she may repeat what has been said. Participants were starting to repeat what has been said already. As the saturation state was reached, the researcher stopped collecting data. According to Onwuegbuzie and Leech (2007), small samples sizes of often ten or less participants, are common in qualitative descriptive phenomenological studies.

3.9.1 Criteria for Selecting Respondents

The researcher thought it was appropriate that respondents must display certain attributes to be able to participate in this research. The respondents were:

- Currently involved in agricultural activities in UDM, South Coast of KwaZulu-Natal,
- Willing to take part in the research.

3.10 Data Collection Method

Data can be obtained from primary or secondary sources. According to Sekaran and Bougie (2013), primary data is the original information obtained first-hand by the researcher on the variables of interest for the specific purpose of the study. Sources of primary data include interviews, questionnaires, focus groups and panels (Denscombe, 2010). On the contrary, secondary data is information that has been collected previously for purposes other than the problem at hand. Primary data for this research was collected using individual face-to-face interviews. This research method was selected with the purpose of enhancing the trustworthiness of the study and easy data analysis

3.10.1 Data Collection Tools

This study used interview data collection method. Individual face-to-face semi-structured interviews were conducted with seven farmers. In the individual face-to-face interviews, the participants answered semi-structured questions. According to Jamshed 2014 the advantage of this interview technique is that it provides a scope for probing issues and leading into an in-depth discussion about matters pertaining to the study at hand. The interviews were conducted in English and isiZulu as participants were multiracial and multicultural.

3.10.2 Semi-Structured Interviews

The self-administered interview questions for this study included three sections, highlighted below:

Section A – Biographic data.

Section B – What are the farmers’ views on new technology adoption?

Section C – What are the factors that influence farmers to adopt technology?

Sections D- What form of external assistance are the farmers getting towards technology adoption.

Participants were selected based on their knowledge and experience in agricultural activities. Cohen *et al.*, (2011) states that an interview is the involvement of ideas between the two or more people on a topic with the aim of producing knowledge. Through the use of interviews, the researcher was able to ask participants about their experiences, knowledge, attitudes, and beliefs about new agricultural technology adoption. The first section of questions intended to obtain background information and characteristics of the participants. The purpose of section B was to find farmers’ perceptions on new technology adoption. The aim of section C was to ascertain factors that influence farmers’ decisions on new technology adoption. The last section, section D intended to discover if government assist farmers on new agricultural technology adoption. Before the commencement of interviews, the researcher explained the purpose of research and the role of the participants, as well as how the research would be conducted to ensure the rights of the participants were not violated. The participants were told that participation was voluntary time so that they will not feel obligated to participate if they did not want to participate. According to Creswell, Plano, and Clark *et al.*, (2011), in qualitative research, using semi-structured interview the researcher is able to see the world through the eyes of the participants.

The researcher administered semi-structured interview questions with an aim to allow participants to be expressive while probing to gather more in-depth data. During an interview, the researcher took notes and audio-taped the interview session. The researcher was also able to see nonverbal behaviours, such as hesitations or smiles that indicated how the respondents felt about the issues (Silverman, 2010). Participants were asked for permission to tape-record the interview for transcription after the data collection process was completed. The participants adhered to the use of audio-tape at the beginning for the entire interview to be ethical or to meet the ethical standard. The interview session with each participant took between fifteen and thirty minutes. The date and venue were agreed upon with the participant to limit disruptions and cancellations.

3.11 Data Analysis

Data analysis is crucial part of the study because it is where the data generated from various methods are studied so that conclusions can be drawn about drawbacks and prospects regarding the topic at hand (Newton, 2010). Marshall and Rossman (2014) maintains that this stage is the most difficult, complex, ambiguous, creative and enjoyable phase in the process of qualitative data analysis. Qualitative data analysis involves efforts to understand the phenomenon under study, integrate information and explain relationships, theories about how and why the relationships appear as they do, and reconnect the new data with the present data (Sutton and Austine, 2016; Vaismoradi, Jones, Turunen, and Snelgrove *et al.*, 2016).

Data was analysed using a thematic analysis method. This method involves grouping of data into themes to identify common patterns or recurrent themes from transcribed data (Nishishiba, Jones, and Kraner *et al.*, 2014). Thematic analysis was presumed suitable for analysis of data collected in this study because the technique concisely organises data collected and then describes the data sets in detail. Thematic analysis method organizes a group of repeating ideas to enable the researcher to answer the study question (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, and Kyngäs, *et al.*, 2014). Recurring themes, patterns, or concepts were identified when interview recordings were interpreted.

To analyse data, the researcher ensured that the data collected was appropriate by dividing the interview questions into four groups, and then check if all questions had no errors on them. In line with the process of thematic data analysis, the researcher audio-recorded the interview sessions. After completing the interviews, the researcher proceeded to listen to the recordings and assess each respondent's data in conjunction with the research questions in order to commence with the categorizing and thematic process. The first step in the qualitative data analysis process is coding which involved breaking down, examining, comparing, and categorizing the data (Elliot, 2018). Firstly, each interview was transcribed verbatim. Secondly, the researcher transcribed the information into a printable version. Each transcript was read several times to ensure a thorough understanding of the content. The researcher employed content analysis technique to analyse data that was collected from the interviews. This permitted the researcher to identify a series of patterns that included views of farmers on technology adoption, the influence of these views on innovation adoption, as well as where they emanated from. After identifying these initial patterns, a search for connections across categories. This technique enabled the researcher to identified main-themes and sub-themes. Using questions as themes helped the researcher merge categories in a more understandable manner to the reader. Quotations from completed interviews are used as evidence in support of the

findings. Discussions were linked to the adoption theory and literature review with an aim to intensifying accuracy and trustworthiness of the data analysis process.

Pseudonym names were used in the presentation of findings to protect the identity of the district, the farmers and their farms. No editing of grammatical errors in participant interviews was undertaken, to ensure the participants' original statements was not compromised.

3.12 Inductive and Deductive Approach

Qualitative content analysis can be used in either an inductive or a deductive way as both inductive and deductive approaches have similar content analysis processes which involve three main phases: preparation, organization, and reporting of results (Elo *et al.*, 2014). Inductive reasoning was considered a feasible choice because kind of data needed along with objectives of study. This study is qualitative therefore inductive approach was deemed highly appropriate to be use in order to give a description to the study that aimed to record participants' views regarding the adoption of new agricultural technology, and in order to understand factors that influence participant to adopt or reject an innovation.. The deductive methodology was not chosen because this study is not quantitative, was not high structured and did not use scientific principles.

3.13 Data Quality Control

Researchers are often conflicted about the use of reliability and validity in qualitative research (Leung, 2015). The use of reliability and validity are common in quantitative research and now it is reconsidered in the qualitative research paradigm. The most widely used criteria for evaluating qualitative content analysis is trustworthiness. The aim of trustworthiness in a qualitative inquiry is to support the argument that the inquiry's findings are "worth paying attention to" (Guba and Lincoln 1994; Elo *et al.*, 2014).

3.13.1 Validity and Reliability

According to Heale and Twycross, (2015) validity is based on how accurately the concept is measured in a quantitative study. Validity is the degree to which an instrument measures what it intended or supposed to measure (Sekaran and Bougie, 2016). On the hand, reliability pertains to the capacity of the measuring instruments to produce consistent results if tested multiple times (Zikmund, Babin, Carr, and Griffin *et al.*, 2013). Reliability is about how consistency is the measure (Heale and Twycross, 2015). According to Sekaran and Bougie (2016) reliability of measure indicates the extent to which it is without bias and henceforth ensures consistent instrument (internal consistency). The interview questions were not bias, leading, ambiguous or double barren and this increased the chances of both validity and reliability.

Although it can be difficult to measure reliability and validity in qualitative research since the intention of this research was not to generalise the results to a larger population but the findings can be applicable to another context. In an attempt to determine the degree to which the findings of this inquiry can apply or transfer beyond the bounds of the project and to ensure that the research findings represented a trustworthy conceptual interpretation of the data all trustworthiness issues were taken into consideration (Lincoln and Guba, 2013; Christiansen *et al.*, 2010).

3.13.2 Trustworthiness Issues

In any qualitative research, credibility, transferability, dependability, and confirmability are four issues of trustworthiness that demand attention (Krefting, 1990; Christiansen *et al.*, 2010).

3.13.2.1 Credibility

The credibility involves establishing that the results of qualitative research are credible or believable from the perspective of the participant in the research. The main purpose of qualitative research is to describe or understand the phenomena of interest from the participant's view. From this perspective, the purpose of qualitative research is to describe or understand the phenomena of interest from the participant's view. Thus, it is necessary for the researcher to request participants to read the transcripts and comment on the interpretation of their views on the research question. The credibility of the study was reflected in following ways in the study; firstly, the researcher ensured that there was credibility in the study taken through the data collections tool, which was semi-structured face-to-face interviews.

Secondly, participants' words were transcribed as they were spoken. Thirdly, comparison of data: all data collected were compared to check for validity. Lastly, the participants were given chance to check for accuracy and see if the researcher did not manipulate the research by adding or omitting anything to their responses. The research and participant had to run through some answers that the researcher was noting down.

3.13.2.2 Dependability

Macmillan and Schumacher (2010) define dependability as the criterion that is concerned with consistency; the extent to which the study could be simulated in a similar context; or with similar participants which may produce similar results. To address the issues of dependability in this study, the researcher provided an adequate audit trail in order to explain how the researcher collected data, how the researcher analysed data and the research procedures that the researcher followed in conducting the research study.

3.13.2.3 Conformability

According to McMillan and Schumacher (2010), conformability of the findings is attained through data collected in objectivity throughout the study by examining if the findings of the study could be confirmed by another study. The researcher addressed the issue of confirmability in this study by ensuring there was sufficient evidence to back data interpretations and no unsubstantiated claims were made, but analysed data as produced by the participants. The researcher will hand over the audio recordings together with the research.

3.13.2.4 Transferability

Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings. Qualitative researcher can enhance transferability by thoroughly describing the research context and the assumptions that were central to the research (Moon, 2016). The person who wishes to transfer the results to a different context is then responsible for judging the receptivity of the transfer. To enhance transferability in this study, the researcher used the literature that was reviewed in this study and the theoretical framework to recontextualise data analysis and interpretations of the findings (Moore, 2012; Grant and Osanloo, 2014). The researcher made ensured participants' response were interpreted objectively. The researcher provided step by step details of data analysis that were made, in order to provide a rationale for the methods conducted. This allowed for the portrayal of accurate information gather from participants (Marshall and Rossman, 2014).

3.14 Ethical Considerations

Ethics is the set of moral principles by the individual or a group of people that provides rules and expectations about the rightest manner towards respondents, employers, other researchers and experiential subjects (Kahari, 2010). The researcher followed the ethical requirements set out by the University of KwaZulu-Natal. The researcher requested written permission to conduct the research from DARD. Permission to conduct research was secured from DARD in Port Shepstone and was attached to the application for ethical clearance. Ethical clearance was obtained from the registrar at the UKZN to collect data. After permission was granted and ethical clearance was obtained, the researcher telephonically contacted participants. Participants in this study were informed from onset that participation is voluntary and they were issued a consent form containing details about the study with the option of participating or withdrawing at any stage of the research (Christiansen *et al.*, 2010). The findings of the research will not be used for any other purpose, other than for the masters' dissertation.

3.15 Conclusion

This chapter discussed methodology, research design and research approach. The aim of the study, research questions and objectives of the study were also discussed. The study location and target populace, sampling procedure, information gathering techniques, and information quality control were highlighted. Purposive and convenient research approaches were adopted. Lastly, it discussed how qualitative data was collected using face-to face interviews and analysed using thematic analysis method.

CHAPTER FOUR

RESEARCH FINDINGS

4.1 Introduction

This chapter presents research findings based upon the methodology applied to gather data which was discussed on the previous chapter. Data will be analysed in relation to the three research objectives which are; to explore farmers' views on new technology adoption, examine the factors that influence a farmer to adopt new technology and determine if there is any form of external assistance that farmers getting towards technology adoption. The findings of the research are arranged in a logical sequence to enable the researcher to neutrally and objectively interpret participants' views and experiences. Semi-structured interviews data collection method moulded by research questions was used to collect data.

4.2 Demographics of the Participants

Under this section, background information of the research participants is discussed. An overview of the attributes of participants will be provided on table 4.1 below:

No	Participants Name	Gender	Age	Marital Status	Highest Qualification	Annual Turnover	Number of employees	Number of Years operating the farm
1.	A1.	Male	56	M	Cedara Diploma	7 000 000	35-67	56
2.	A2	Male	45	M	Bachelor of Agricultural Management	7-8 000 000	58	23
3.	A 3.	Female	55	M	Masters in Community nursing	N/A	18	19
4.	A4.	Male	45	S	B Com Economics and Business Economics	600 000	25	29
5.	A 5.	Male	35	M	Masters of Science	300-500 000	200+	13
6.	A 6.	Female	46	M	Primary	3 000 000	28	15
7.	A7.	Male	27	S	Honours degree in Tourism	75 000	5	2

Table 4.1 Biographic Data

***Names of farmers are pseudonyms**

4.2.1 Section A: Biographical and Demographic Details

4.2.1.1 Gender of Respondents

- **Purpose of the Question**

The aim of the first interview question of the questionnaire was to establish gender equality in farmers.

- **Results Acquired**

According to the above table, it is mostly male than female farmers who participated in this study. The respondents consists of five male famers (71%) and two female farmers (29%) respondents from seven respondents.

4.2.1.2 Age of Respondents

- **Purpose of the question**

The purpose of question two was to determine the age group of all the respondents who participated in this study.

- **Results Acquired**

A total of three (43%) respondents belong to the age group of 41-50, the other two (29%) respondents are between the ages of 51-60, one (14%) respondent was between the ages of 31-40, and the other one (14%) respondent was between the ages of 21-30. The results show that there is a wide variety in them of age groups.

4.2.1.3 Marital status of Respondents

- **Purpose of the Question**

Question three of the questionnaire aimed to determine marital status of the respondents of this study since it might affect decision making, income and gender roles.

- **Results Acquired**

According to the above table, five (71%) of the respondents are married and two (29%) of the respondents are single.

4.2.1.4 Highest qualification of Respondents

- **Purpose of the Question**

Question four of the questionnaire aimed to establish if respondents have any formal qualifications or training in the agricultural sector. This question evaluated if farmers had knowledge and skills relating to the agricultural sector.

- **Results Acquired**

Table 4.1 illustrate that the majority, four (57%) of the respondents have formal higher education related to agriculture, two (29%) of the respondents have higher education not related to agriculture and only one (14%) respondent indicated to have no formal education.

4.2.1.4 Annual turnover of Respondents

- **Purpose of the Question**

The aim of question five in section A of the questionnaire was to determine the respondents' annual turnover. The findings on annual turnover are vital because it provided insight into the characteristics of the overall business. The researcher wanted to establish if the farmers have financial resource or money to invest in technology.

- **Results Acquired**

One (14.2%) participant indicated he makes between 71000- 80 000, the other (14.2%) participant indicated he makes between (300001- 500000), one other (14.2%) participant indicated he make between (500001- 600 000), another one (14.2%) participant indicated he makes between (2000001- 3000000), the other two (29%) participants indicated they make between (7000001- 8 000 000), and the other one (14.2%) participant preferred not to say.

4.2.1.5 Number of employees

- **Purpose of the Question**

Question six of the questionnaire aimed to investigate the role of agriculture in employment and economic development of rural areas. This question aimed to establish the manpower each participant has in his or her business. Farmers indicated that they have few permanent staff and lot of contractual or seasonal workers.

- **Results Acquired**

The table 4.1 indicate that one (14%) respondent had between 0-10 workers, the other one (14%) respondent had between 11-20, the other two (29%) respondents had between 21-30, the other two (29%) respondents had between of 31-70 workers and one (14%) respondent indicated had between 2001-300 employees.

4.2.1.6 Number of years operating the farm

- **Purpose of the Question**

The aim of question seven in section A of the questionnaire was to demonstrate experience of the respondents in the agricultural sector. This question was about finding out if the famer is experienced or a beginner in the agricultural.

- **Results Acquired**

Table 4.1 indicates that two (29%) respondents had between twenty and thirty (21-30) years of operating the farm, the other three (43%) respondents had between ten and twenty (11-20) years of experience, the other one (14%) respondent had between fifty and sixty (51-60) years of experience, this is because he grew-up in the farm, the last (14%) respondent had between zero and ten (0-10) years of experience.

PRESENTATION OF RESULTS

This segment will present findings of the study. The researcher will reflect on the thematic analysis that was done to get insights from data collected through semi-structured interviews.

4.3. Section B: What are farmers' views on new technology adoption?

4.3.1 What are your views on new agricultural technology?

- **Purpose of the Question**

Question one of section B in the questionnaire aimed to investigate respondents' general views on new agricultural technology.

- **Results Acquired**

Themes	Frequency	Participants
New technology is necessary	7	A1, A2,A3,A4,A5,A6,A7
New technology is not necessary	0	

Table 4.2 What are your views on new agricultural technology?

The presented data depicted considerable variation of farmer's views in relation to new agricultural technology. Farmers view new agricultural technology as necessary and important because of different reasons such as; improving productivity, business growth, and increasing profits. Farmers argued that the new technology is important and helpful.

Themes Frequency

All seven participants indicated that they view new agricultural technology as necessary.

Participant one mentioned that:

A1: *"One has to stay with the new agricultural technology; one has to learn it otherwise will stay behind."*

A4: *"New agricultural technology is necessary to improve productivity, increase profits and improve long term sustainable job enterprise."*

A6: *"It a good and helpful to farmers."*

A7: *"It is very important for business growth. If you are not using the new technology, you will not manage to make profits in this business."*

4.3.2 Do you prefer to stick to traditional methods of farming or do you like moving with time? Please explain.

- **Purpose of the question**

The purpose of question two in section B was to determine the respondent's personal preferences when it comes to technology adoption.

- **Results Acquired**

Themes	Frequency	Participants
I prefer stick to traditional methods of farming	1	A6
I like to moving with time	6	A1,A2,A3,A4,A5, ,A7

Table 4.3 Do you prefer to stick to traditional methods of farming or do you like moving with time? Please explain.

From the data collected it is evident that farmers love moving with times and adopt the new technology. Most participants of this study indicated that although they like moving with times and adopt the new agricultural technology financial constraints are hindering their progress in adopting and implementing the new agricultural technology. Participants indicated that circumstances force them to stick to traditional methods of farming.

Themes Frequency

Participants mentioned that:

A2: *“I like to move with the time and adopt technology but I think at the moment we haven’t adopted too much new technology but I think we may but the cost of implementing it is very expensive.”*

A3: *“I like to move with the time. In order to survive in this industry in pleasant times one has to move with the time. We are moving with times because we are no longer using manual to for our chickens and pigs.”*

A5: *“Move with technology particularly in very commercial agriculture that we are but I think there are also some traditional technology which should not be forgotten. 90% of farmers move with time.”*

A7: *“Moving with times is helpful as you know there are social networks that help you to connect with people. It very helpful not only the machines but also as the marketing strategy.”*

4.3.3 Does your farm have or use new agricultural technology? Why?

- **Purpose of the Question**

The aim of the question three in section B of the questionnaire was to establish if participants of this study already have or are already using new agricultural and the reason for their choices.

- **Results Acquired**

Themes	Frequency	Participants
Yes! my farm use new agricultural technology	4	A1,A2, ,A5, A7
No! my does not use new agricultural technology	2	A4,A6
Partly, my farm use new agricultural technology	1	A3

Table 4.4 Does your farm have or use new agricultural technology? Why?

The participants of this study express that their businesses have adopted and are using new agricultural technology. They have adopted new agricultural in their business for a number of reasons such as; improve productivity and business growth. These findings revealed that some farmers adopted the new agricultural in their business because they believe it saves them time and money while allowing them to produce more. However; some are still using traditional methods of farming while others are using or mixture of the new and old methods of farming.

Themes Frequency

Participants mentioned that:

A2: *“Yes! We are using new technology to try and improve productivity but not much computer technology.”*

A7: *“For my business to grow, there are machines I use for baby chicken to grow and feed.”*

One participant indicated that their business has and use new agricultural technology partly.

A3: *“Partly, because it easy and effective.”*

Two participants indicated that they do not have or use new agricultural technology in his farm because the cost of purchasing and implementing.

A4: *“No! Because of the costs of purchasing and implementing it.”*

A6: *“They use the new agricultural technology in macadamia and sugar cane but in forests we are still using the old methods.”*

4.3.4 Do you perceive new agricultural technology to be a useful tool in performing your Activities? Yes or No? And why?

- **Purpose of the Question**

The purpose of question four of section B of the questionnaire was to determine farmers’ perceptions on new agricultural technology usefulness in performing their agricultural activities.

- **Results Acquired**

Themes	Frequency	Participants
Yes! I perceive new agricultural technology to be a useful tool in performing my activities	6	A1,A2, A4,A5, A6,A7
No! I do not perceive new agricultural technology to be a useful tool in performing my activities	0	
Yes and no	1	A3

Table 4.5 Do you perceive new agricultural technology to be a useful tool in performing your activities? Yes or No? And why?

These findings revealed that most farmers perceive the new agricultural technology as a useful tool in performing their agricultural activities. Participants in this study mentioned that they perceive new agricultural technology to be a useful tool in performing their activities because it saves them time, allows them to be efficient and manage data among other things.

Participants mentioned that:

A2: *“Yes, absolutely! We do, it helps us to be more efficient, it helps us to have information to make farming and production decisions.”*

A5: *“Yes, of course yes! We use the machine to sort the nut more efficiently. We look at it every day all the time, data management, data interpretation, waste management, there is technology all the time every day we keep looking.”*

A6: *“Yes! It help when aerial irrigating pest and on ploughing. The new tractors can plough and remove soil particles from the weed and that saves time because it would have taken a lot of time if it was done manual by humans.”*

A7: *“Yes! I am able to go to sell and activities continue in my absent because of this technology that is why I am saying those who have it must continue using it.”*

Participants three said:

A3: *“Yes and no. Yes because it easy to work with but because it expensive to install, we are small at times we use the old (traditional) methods.”*

4.3.5 In your opinion should Ugu district farmers adopt new agricultural technology? Why?

- **Purpose of the Question**

Question five of section B aimed at finding farmers' personal opinions about Ugu district farmers adopting new agricultural technology.

- **Results Acquired**

Themes	Frequency	Participants
Yes! Ugu district farmers should adopt new agricultural technology	7	A1,A2,A3,A4,A5,A6,A7
No! Ugu district farmers should not adopt new agricultural technology	0	

Table 4.6 In your opinion should Ugu district farmers adopt new agricultural technology? Why?

Farmers expressed that UDM farmers should adopt the new agricultural technology for financial and production reasons.

Participants mentioned that:

A1: *"Yes, everybody should adopt the newer technology otherwise you will be left behind."*

A3: *"Our neighbouring farmers are big and they are using it the new technology."*

A4: *"Definitely those who can afford it should adopt it, to reduce costs, improve productivity and to increase profits."*

A5: *"Commercial farmers absolutely, substantial farmers if they can afford it absolutely but it doesn't make sense those farmers who are too small because the costs of that technology are too high to be worth a while for the farm."*

A6: *"Yes, we can make a lot more and profit margins can be clear in this agricultural industry."*

A2 *"Neighbouring farmers are adopting new agricultural technology and we will see from them if it works or not."*

4.4 Section C: What are factors that influence a farmer to adopt new technology?

4.4.1 How familiar are you with new agricultural technology developments? Please explain.

- **Purpose of the Question**

Question one in section C of the questionnaire aimed to determine if farmers were familiar with new agricultural technology developments. This question aimed to discover farmers' awareness about new agricultural technology developments.

- **Results Acquired**

Themes	Frequency	Participants
I am Familiar with new agricultural technology developments	4	A2, A3,A5,A7
I am not Familiar	3	A1, A4, A6

Table 4.7 Hoe familiar are you with new agricultural technology developments? Please explain.

Four participants indicated that they are aware of new agricultural technology developments relevant to their business. The other three participants indicated that they are not familiar with the new innovations. Most participants mentioned that they try to keep up to date and research about new innovations.

Participants mentioned that:

A3: *"I am aware of my own units like in the chickens, pigs and sugar cane."*

A5: *"Very familiar it my job."*

A7: *"I am familiar but there is still a lot to learn. We have been told we need to go to workshops and observe because we are still young in this business."*

A1: *"I am not quite up-to-date with all that, I try to find what relevant for me."*

A6: *"I am focused on traditional methods and have limited knowledge about the new agricultural technology due to the fact it expensive and the mind is used to the old technology."*

4.4.2. Are neighbouring farmers adopting new agricultural technology (from small to large)? And why?

- **Purpose of the Question**

The purpose of question two in section C was to determine whether or not neighbouring farmers are adopting new agricultural technology. The aim of this question was to determine farmers' awareness of their social context.

- **Results Acquired**

Themes	Frequency	Participants
Yes! Neighbouring farmers are adopting new agricultural technology	7	A1,A2,A3,A4,A5,A6,A7
No! Neighbouring farmers are not adopting new agricultural technology	0	

Table 4.8 Are neighbouring farmers adopting new agricultural technology (From small to large)? And why?

Participants mentioned that neighbouring farmers are adopting the new technology but it is the large commercial farmers who are adopting new technology more than small-scale commercial farmers.

Participants mentioned that:

A1: *"Everybody is adopting the newer technology in agriculture."*

A3: *"Yes big ones. It's not worth it too expensive for smaller farmers."*

A4: *"The ultimate goal of farmers is to have a profitable and sustainable enterprise by adopting these measurements you are achieving both goals."*

A5: *"10-15% of our farmers are adopting the technologies that are being advised to adopt. Not as high as you would like. They adopt because the cost is cheap and profits are very high. They adopt because it is fashionable."*

A7: *"Big commercial farmers yes. We always use what we can afford."*

4.4.3 What do you think are advantages of adopting new agricultural technology?

- **Purpose of the Question**

The aim of the question three in section C of the questionnaire was to investigate whether respondents of this research view technology adoption as advantageous. This question probed individuals' views, attitude and beliefs towards the new technology. The outcome of this question can determine the likelihood of a farmer to adopt the new technology because of perceived advantages.

- **Results Acquired**

Themes	Frequency of responses	Participants
Improve productivity	7	A1, A2, A3, A4, A5 A6, A7
Improve profits	7	A1, A2, A3, A4, A5 A6, A7
Minimise wastage	4	A1,A4,A5, A6,A7
Optimisation of yield	3	A1,A2,A5

Table 4.9 What do you think are advantages of adopting the new agricultural technology?

Farmers indicated that adopting the new technology is advantageous in a number of ways such as; improving profit margins, improving efficiency, improving productivity and minimising wastage.

Participants mentioned that:

A2: *“More efficient production which will lead to more profits and to optimise yield obviously we have to feed a growing population.”*

A4: *“More accurate application of material, less waste of material and reduce labour costs.”*

A5: *“Improving yield, improving performance, improving efficiency.”*

A6: *“Improve productivity, save time and profit margins become a bit higher.”*

A7: *“There are a lot of advantages, when you look at marketing, you are using technology but when looking as agriculture alone it helps you do things fast.”*

4.4. 4 What do you think are disadvantages of adopting new agricultural technology?

- **Purpose of the Question**

The purpose of question four in section C of the questionnaire was to determine perceived disadvantages and challenges that farmers can experience when adopting new agricultural. This question was established to probe farmers' concerns about new technology adoption. The perceived disadvantages can lead to rejection of new agricultural innovations.

- **Results Acquired**

Themes	Frequency of Responses	Participants
Costs	5	A1, A2, A3, A4, A6.
skilled labours	3	A3, A4, A6, A7
Fashion.	1	A5
Job loss	1	A2

Table 4.10 [What do you think are disadvantages of adopting new agricultural technology?](#)

Farmers argued that adopting technology also come with disadvantages. The main disadvantage of new agricultural technology is the costs. Participants mentioned that adopting the new technology

Participants mentioned that:

A1: *"It expensive to get or start off, once it gets going it pays itself off."*

A6: *"It expensive to buy and skilled workers who can operate it do not come cheap."*

Participants revealed that it will require skilled labour.

Participants mentioned that:

A3: *"We need more skilled labour. We will need to train workers"*

Participants indicated jobs can be lost as one machine can do a job done by five people.

A2: *"The potential to lose jobs, the cost."*

A4: *"It will not necessary lead to job lost as we will be producing more. Workers will have do to other things"*

4.4.5 Do you think adopting technology would have an impact in your business or production? How?

- **Purpose of the Question**

Question five in section C of the questionnaire aimed at investigating farmers' perceived impact of adopting the new agricultural innovations.

- **Results Obtained**

Themes	Frequency	Participants
Improve productivity	5	A2, A3, A4, A5,A6, A7
Improve profit margin	3	A1,A4,A6
Help with decision making	2	A2, A5
It helps minimise wastage	3	A1,A4,A5

Table 4.11 Do you think adopting technology would have an impact in your business or production? How?

The presented data shows that farmers believe adopting new agricultural technology will have a positive impact on their businesses.

Participants mentioned that it might limit wastage. :

A1: *"It will save you money."*

A4: *"It will ensure workers apply the correct amount of chemicals and limit wastage."*

Participants mentioned that it might improve productivity.

A2: *"Yes, definitely improve output in production of crops, ability to optimise yield. It can help you decide where to plant certain crops."*

A6: *"Improve productivity, job done in short time and profit margins would be a bit higher than they are now."*

Participants mentioned that it can help in business growth.

A7: *"It would have a positive impact and the business can grow to the level you wish for as mine is focusing on growing chicken if adopt technology I will be able to slaughter them like Riversmead and Rainbow and produce eggs."*

Participants mentioned that adopting technology could result in improved productivity, save them time and money.

4.5 Section D: Is there any form of external assistance that farmers are getting towards technology adoption?

4.5.1 Does government assist farmers on new agricultural technology adoption? Please explain.

- **Purpose of the Question**

The first question in the last section of the questionnaire aimed to discover if there is any form of external assistance farmers are getting from the government.

- **Results Acquired**

Themes	Frequency	Participants
Yes! Government assist farmers on new agricultural technology adoption	2	A4, A7
No! Government assist farmers on new agricultural technology adoption	5	A1,A2,A3,A5,A6

Table 4. 12 Does government assist farmers on new agricultural technology adoption? Please explain.

The presented data shows considerable that farmers from their experience are concerned with government lack of assistance. Majority of participants plainly indicated that government does not assist farmers on new agricultural technology adoption.

Participants mentioned that:

A1: *'No! The only thing we have SASRI.'*

A2: *'Not that I am aware of. We do not have much interaction with department of agriculture. I think they only focus more on small growers. From commercial farmer's point of view, we do not get much assistance and I think there should be more money available for research and development area even for commercial farmers because at the end of the day everyone will benefit from it.'*

Farmers indicated that it not clears who gets the funding and corruption is major problem.

A5: *"The government has failed the all the farmers particularly the rural farmers and subsistence farmers. The problem is they talk about, tell everybody and write on paper that there are going to do it. But when*

it comes to the poor farmer on the ground they go there and say they need money, they have never been trained properly, often there are being bribed.”

A6: *“No. We do send proposals and I have sent a number of them but I have not been lucky although I am a black women and government says they are uplifting women because we were oppressed.”*

Participants mentioned that government assist:

A4: *“Government does have plans in place like subsidies and grant funding to assist farmers but however there are difficult to access for a variety of reasons and I am talking from personal experience, when you approach them, the budget is already finished.”*

A7: *“Yes government does have workshops a lot of them. But with money no. Big commercial farmers and white farmers benefit a lot from these workshops because they have money to invest in what was presented”*

4.5.2. Are there any workshops where farmers are shown or taught about new agricultural technology? Please explain.

- **Purpose of the Question**

The purpose of question two in section D of the questionnaire aimed to probe if there was any place where they meet and are taught, show or exposed to new agricultural technology.

- **Results Acquired**

Themes	Frequency	Participants
Yes! There are workshops where farmers are shown or taught about new agricultural technology	7	A1,A2,A3,A4,A5,A6,A7
No! There are no workshops where farmers are shown or taught about new agricultural technology	0	

Table 4.13 Are there any workshops where farmers are shown or taught about new agricultural technology? Please explain.

Participants acknowledged that there are workshops that are organised mostly by private companies’ where farmers are shown or taught about new agricultural technology. Participants indicated that these workshops are more of sales presentation.

Participants mentioned that:

A1: *'Yes, we have workshops.'*

A3: *"Yes, there are workshops where we buy food and medication."*

A4: *"Attend workshops from the private companies that produce the product."*

A6: *"Yes there are workshop buy independent company who show us new technologies, how it works and what will be the benefit if farmers buy the new technology."*

A7: *"Yes a lot. Ugu district municipality invite us to workshops. Workshops is what the government is good at but not financial support. We learn a lot of things and you get to think if I had money I was going to implement."*

Famers indicated that they get external assistance from private companies which organise workshops to teach and show them the new agricultural technology. These companies own or produce this new technology.

4.6 Conclusion

This chapter presented the researcher findings using thematic analysis and interpretation of the empirical results. The findings were essential in answering the three critical questions of the study as mentioned in the first chapter and as also highlighted in this chapter. The data generated provided participants' views, thoughts and perceptions about new agricultural technology. The next chapter will focus on the discussion of the research results in conjunction with the research objectives.

CHAPTER 5

RESEARCH DISCUSSION

5.1 Introduction

The previous chapter presented findings of the study. This chapter will discuss and summarise the key research findings of this study in line with the research objectives and literature review.

5.2 Biographic Data

Gender had a significant impact on participants' perceptions and attitudes to technology adoption. Women indicated low level of awareness about new agricultural innovations, somewhat negative attitude and low levels of technology adoption in their farms compared to men, but there were only two women. It has been argued by some authors that women are generally discriminated against in terms of access to external inputs and information (The Research and Data section of UN Women, 2014). This suggests that male farmers are more aware about new agricultural innovations and are more likely to adopt improved technology than females.

Age had no correlation with farmers' perceptions and attitudes to technology adoption. Both young and old farmers indicated to be aware of the benefits of technologies, flexible and less sceptical about new technology adoption. A farmer's age may influence adoption decisions in different ways for example; a younger farmer due to his or her education and exposure to technology might be more likely to adopt innovations early in his life cycle whereas an older farmer might be more likely to adopt technology because of experience and financial resources (Rathey, *et al.*, 2011).

Marital status had no effect on farmers' perceptions and attitudes to technology adoption in this study. Married participants and single participants shared same perceptions and attitudes about new technology adoption advantages, disadvantages, anticipated impact, views and level of awareness.

Years of experience indicated to have no impact on farmers' views, perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal. Years of experience are irrelevant because younger farmers may have greater flexibility in accepting new ideas and in dealing with risks (Kalaitzandonakes, *et al.*, 2018). However, well-experienced and well resources older farmer might be willing trying new technology (Rathey, *et al.*, 2011).

Data signified that farmers with higher level of education related to agriculture had positive perceptions and attitudes to new innovations adoption. Farmers that are more educated are typically assumed better able to process information and search for appropriate technologies to alleviate their production constraints (Khapayi and Celliers, 2016). The belief is that education gives farmers the ability to perceive, interpret and respond to new information much faster than their counterparts without education. Therefore, level of education had a significant impact on farmers' perceptions and attitudes about technology adoption in the Ugu district of KwaZulu-Natal because they are knowledgeable about production practices.

Annual turnover is a factor on farmer's views, perceptions and attitudes to new agricultural technology adoption. Wealthy farmers that have larger annual turnover and lot of employees had positive perceptions and attitudes to new innovations are more likely to adopt since the adoption can generate economies of scale. Wealthier farmers are more able to take risks or have better access to extension information or to credit, or they may be able to use their own cash resources to experiment with a new technique (Rapsomanikis, 2015). Technology adoption is expensive, for example; tractors or other machinery requires a large initial investment (Yigezu *et al.*, 2018).

Farmers with lot of employees had a positive perceptions and attitudes to adopt the new agricultural technology. This is the case with indivisible technology in particular; such adoption of new varieties requires more labour inputs (Bandiera and Rasul, 2006; Food and Agriculture Organization, 2017). Farmers with more labour can do job rotations and division. However, it is difficult to ascertain why farmers with are significantly more likely to adopt technology on their farms.

In addition to socio-economic factors determining adoption, farmers' perception of the modern technology also has significant influence on adoption decisions (Ntshangase *et al.*, 2018; Ullah *et al.*, 2018)

5.3.1 RESEARCH OBJECTIVE 1: To explore farmers' views on new technology adoption

Findings of the data collected from the participants' shows different views from farmers on the new agricultural technology adoption. Findings revealed that farmers view new technology adoption as necessary and important for business growth. According to farmers, moving with times and adopting the new technology can have positive impact on their businesses and production. They pointed out that technology adoption contributes to increase in yield which is directly linked to profits.

The findings emanated from the farmer's interviews highlighted that farmers believe adopting the new agricultural technology could increase productivity, increase profits, save time, reduce waste, help with

data management and help in making informed decisions. This concurs with literature that speed and range of technological change holds promise for accelerating inclusive agriculture and rural development, leading to more rapid structural transformation from agriculture to high productivity manufacturing and other sectors (Barrett *et al.*, 2017). Technical change in the form of adoption of improved agricultural production technologies has been reported to have positive impacts on agricultural productivity growth in the developing world (Mwangi and Kariuk, 2015). Improved technology adoption for agricultural transformation and poverty reduction is critical in modern day agriculture (James and Awan, 2019). However, participants raised concerns that technology adoption is too expensive and it might not be worth a while for smallholder commercial farmers. Finding reveal that financial constrains was hindering farmers from fully adopting technology. Access to credit figures prominently among the often cited reasons why technology fails to diffuse (Mwangi and Kariuki, 2015; Lalani, Dorward, Holloway, and Wauters *et al.*, 2016). The lack of sufficient accumulated savings by small commercial farmers may prevent them from having the necessary capital for investing in new technologies (Manganhele, 2010).

Finding revealed that participants believe UDM farmers should adopt new agricultural technology to ensure that they are profitability. Participant argued that large commercial farmers are the ones who should lead the way in new technology because they have financial resources that allow them to do try and error. The smallholder commercial farmers will observe from the big commercial farmers if the innovation works or not, if it works then they will adopt it.

The findings revealed that farmers perceive adoption of new agricultural technology as necessary. They believe adopting new technology might allow them to be more competitive. The findings revealed that farmers perceive new agricultural technology to be a useful tool in performing their activities because it saves them time, allows them to be efficient and manage data. This concurs with the body of literature. According to Technology Acceptance Model (TAM), two major factors influencing adoption of technology is perceived usefulness and ease of use (Davis, 1989). Agricultural entrepreneurs may adopt the new agricultural technology because they perceive it to be useful in their businesses and had positive attitudes to new innovation adoption. Farmers' perceptions and attitudes to modern technology also has significant influence on adoption decisions (Yu, *et al.*, 2018).

Overall, the findings showed that farmers view technology adoption as necessary for businesses growth and increasing production. However, farmers had partly implemented the new agriculture technology due to high costs, perceived usefulness, size of their business and type of products they produce.

5.3.2 RESEARCH OBJECTIVE 2: To examine what factors that influence a farmer to adopt technology

The research findings presented in this study revealed that farmers are aware of the new technological developments relevant to their businesses. The findings showed that large commercial farms are adopting new technology more than smallholder commercial farms. Reason being, large commercial farms have financial resources and skilled workers who are knowledgeable about the new agricultural technology. Chew, Loo, Bohari, Hamid, Sukri, and Kusumarwadan *et al.*, (2017) argue that firms that are large or have large market shares are more likely to undertake innovation, because benefits of new technology adoption is higher for larger firms and because of the availability of funds. Financial resources, and size of the business are among the main factors that influence adoption of new technology. According to Shane (2008), the firm characteristics suggests that, farmers who own big farms with good reputation are most likely to adopt a new technology than farmers who own relatively small farms.

Farmers indicated that advantages of adopting new agricultural technology includes optimisation of yield, improving performance, improving efficiency, saving time, and improving profit margins. This concurs literature. New agricultural technology has a direct influence on changing the lives of the poor, by improving agricultural productivity, raising incomes of farm households, creating employment for landless labourers and subsequently wages and lowering the price of food staples while creating food security (Irz *et al.*, 2001; Abdu-Raheem sand Worth, 2011).

However, farmers acknowledged that adopting the new agricultural technology has also disadvantages such as, loss of jobs. This concurs literature. Mottaleb (2018) state that, the increasing use of the threshing machine-made things worse for workers as it reduced the amount of stead employment in winter. For example, what will happen to landless farm workers if farmers decide to create robots that pick only ripe blackberries and ones that will interact with an autistic child? However, farmers also revealed that adopting of new agricultural technology might also open opportunities for skilled labours and current employees might also get an opportunity to be trained for certain skills. One participant mentioned that, buying a technology or product that is not correct for one's farm and they do not how to use it because they are following fashion is a disadvantage of new agricultural technology adoption. Jouanjean, *et al.*, (2014) argued that, lack of practical knowledge the farmers cannot handle the machines properly, while the cost of the maintenance is very high, and overuse of machines may lead to environmental damage. Nonetheless, farmers believe advantages of adopting the new agricultural technology outweigh the disadvantages.

Overall, the findings show that farmers perceive technology adoption as advantageous. Farmers believe that adopting technology can have a positive impact on their businesses. Moreover, findings reveal that farmers believe that adopting the new agricultural technology may allow them to produce more, hence profit margins will increase.

5.2.3 RESEARCH OBJECTIVE 3: To determine if there is any form of external assistance that farmers getting towards technology adoption.

The findings emanated from the farmer's interviews highlighted problems with the government, DARD and farmers. There is lack of communication and no relationship. Participants believe that government does not assist farmers on new agricultural technology adoption. Farmers complained about lack of government assistance, especially financial assistance. They argued that government has good policies but fails to implement. Smallholder commercial farmers indicated that most often than not they need financial assistance to buy the new technology but every time they apply for assistance the budget is always finished. They mentioned that corruption might be an issue in DARD since it is not clear who get the money or financial assistance from the department. Farmers indicated that assistance from government or DARD is necessary for smallholder commercial farmers or rural farmers to adopt new technology.

Participants acknowledged that there are workshops that are organised mostly by private companies' where farmers are shown or taught about the new agricultural technology. According to Ntshangase, *et al.*, (2018), increased household exposure to innovations through several visits by extension personnel, and via information distribution as well as technical support to farmers, greatly increase farmers' awareness of available technologies and their potential benefits. Awareness plays a big role innovation adoption. However, participants indicated that these workshops are more of sales presentation because companies own or produce these innovations they are showing them.

5.4 Conclusion

This chapter discussed the key findings on farmers' perceptions and attitudes to technology adoption in the Ugu District of KwaZulu-Natal, South Africa. Participants indicated that, socio-economic issues and perceived usefulness of an innovation are some of the factors influencing their decisions to adopt or not to adopt new agricultural technology. Conceptual and theoretical frameworks were linked to data in the present study. The last chapter will focus on the summary of the study and recommendations for future research.

CHAPTER SIX

RECOMMENDATIONS

6.1 Introduction

The previous chapter discussed the central findings of the study that were intended to answer the key research objectives. This chapter will present the recommendations and limitations of this empirical study. The implications for further research will also be discussed. Lastly, this closing chapter will reveal whether data collected shed light on the research problem, and most importantly answered the critical research questions as presented in chapter one.

6.2 Recommendations

This section focuses on recommendations based on key research findings which were presented using three critical questions that have been explored in this research study. With regard to key research findings which emerged from this study concerning farmers' perceptions and attitudes to technology adoption in the Ugu District of Kwazulu-Natal, South Africa. The following recommendations are made:

6.2.1 Demographics of the Research Participants

Socio-economic factors influencing farmers' perceptions and attitudes to technology adoption in the Ugu district of KwaZulu-Natal, South Africa are; gender, level of education, number of employees and wealth. Female farmers must be educated and encouraged to adopt new technology in their businesses because the two female farmers who were part of this study indicated low level of new agricultural technology awareness and adoption in their businesses. Farmers that are well informed about the new agricultural technology were the ones who indicated to have adopted the new agricultural technology in their businesses and how it is helping them save time, improve yield and profit margins. Smallholder commercial farmers indicated that financial constraints hinder them from adopting the new technology. Collaboration between male and female farmers as well as farmers and DARD is encouraged to develop female farmers and small commercial rural farmers.

6.2.2 What are the farmers' views on new technology adoption?

Regarding findings on critical question one, the study indicated that understanding farmers' perceptions and attitudes to technology adoption is necessary because their perceptions and attitudes influence their decision-making process regarding technology adoption. Farmers indicated that they have and are using

technology in their businesses. Participants argued that farmers in UDM should adopt technology in their businesses because that may be beneficial to them as technology adoption in other countries such as; Bangladesh and United States of America has led to increase in production and profit margins. It is recommended that farmers are taught or made aware of new innovation relating to their businesses. Workshops are recommended. Farmers also mentioned that if they can have cash injection they can also adopt the new technology. Financial aid in form of tax-free loans is recommended.

6.2.3 What are factors that influence farmers to adopt technology?

Participants mentioned that large commercial farmers are already adopting the new technology therefore; it is recommended that large commercial farmers adopt at least one farmer and teach them about the new technology they are using. The large commercial farmers can assist smallholder commercial farmers maybe not financial but by sharing knowledge and allowing them to come and observe how they do things in their businesses. This could be like a big brother, big sister setting (where the knowledgeable other teaches or mentors the one who still needs more knowledge). Large commercial farmers are perceived as opinion leaders when it comes to technology adoption so allowing them to have contact with smallholder commercial farmers maybe valuable to small farmers, especially if they will have a chance to visit the farms and see for themselves what technology are these large commercial farmers adoption and why.

To close the gap between big commercial farmers and small commercial farmers there is also a need to encourage partnerships between farmers to allow the sharing of skills and knowledge about the new agricultural technology.

Farmers indicated information about the new agricultural technology is not already available to them, they have to search for it or get it from private companies who are selling the innovations. The researcher recommends increase in the availability of information sources in public and private institutions. Farmers should be encouraged to participate or join associations and cooperatives to gain experience and engagements with other farmers not only in South Africa but in other parts of the world, there are numerous world organisation and association for farmers. The private and public sector should ensure the availability and affordability of the new technologies. An intensive campaign about the FIR and how it might affect farmers in South Africa is recommended to raise awareness. Most people spend most of their time on their cell phones and the internet serves as a powerful medium of communication with the farmers about new developments, an App about new agricultural innovations is recommended.

Farmers indicated that there is lack of technological personnel in the agricultural sector. A training programme to ensure the availability of complementary skills is recommended, it could be incentivised. Partnerships between farms and universities and high school that offer agricultural programs is recommended because students have knowledge by no practical experience and farmers need knowledgeable people, it will be a win-win situation.

6.2.4 What form of external assistance are the farmers getting towards technology adoption?

Given the concerns that have been raised by the participants in this study, it is important for the department of agriculture to work closely with farmers. It is imperative that communication channels between the department of agriculture and farmers should be strengthened. It is also recommended that DARD works on addressing the mistrust, constant communication is needed.

The findings indicated that some participants believe that the DARD is not doing enough to encourage technology adoption in UDM. DARD and farmers should invest in Research and Development (R&D) on the new agricultural technology and give farmers free access to research findings, so they can be up-to-date about new innovations in the agricultural sector. Knowledge about innovation helps the farmers' innovation decision process and can shape farmers' perceptions and attitudes about technology adoption.

Most farmers have identified lack of funds as a common barrier to technology adoption. Financial aid or cash injections such as subsidies and grant funding are recommend for both large and small commercial farmers.

Farmers complained that they do not know who get the funding and even if they have all the necessary documents they do not get the financial they have applied for. Red tape reduction is recommended. Government should get rid of the unnecessary restrictions that prevent farmers from accessing government grants because government does have plans in place like subsidies and grant funding to assist farmers but farmers find it difficult to access the for a variety of reasons.

Policies that facilitate adoption of innovation should be implemented because DARD already has them in their annual reports. It is necessary for DARD to provide farmers with policy documents which will guide them on how they implement new agricultural technology.

The rationale for these interventions is that adoption of new agricultural technology by UDM farmers is low. Farmers a play an important role in economic development, food security and reduction of unemployment. Hence, it is vital that farmers have necessary knowledge, skills or abilities to make

judgements about the desirability and feasibility new agricultural technology adoption. This will help farmers on their decision to adopt or reject an innovation. The knowledge can positively or negatively shape farmers' perceptions and attitudes to technology adoption. Ongoing evaluation on policies and intervention strategies should be conducted to determine their impact on new technology adoption in farming.

6.3 Implication for Further Research

This section discusses the implications that can be adopted for further research presented below. This study was conducted in Port Shepstone with less than ten farmers. Surely, these are not the only farmers under UDM who have perceptions and attitudes towards agricultural technology adoption. It would be remarkable to see how large commercial farmers in the same districts view new agricultural technology adoption. A comparative study can also be done to cover both the developers and farmers point of view since this study covers only farmers' views on new agricultural technology adoption. It would be interesting to observe the results from policymakers and funders which is DARD.

6.4 Limitations of the Study

According to Sidhu (2003); Nelson (2017), when conducting empirical research often not everything goes according to the original plan. This suggests that every research had its own limitations. Like most research, this one had its limitations, which included participants being reluctant to reveal their annual turnover and what their business specialised in. Most farmers produce more than one product and it seemed like they favoured one over the other and preferred to speak about the one they like. However, from the beginning of the study, the researcher had vividly explained all the information will be used for research purposes only. Due to the time constrain the study was conducted over a short period for such a phenomenon and this could have impacted the results of the data collected.

Despite the limitations noted above, this study could act as a catalyst or starting point for more research by fellow researchers, the DARD in different provinces and other stakeholders. The study provided valuable information about the research topic which policymakers and farmers can look into when making decisions about technology adoption.

6.5 Conclusion

This study was conducted with the three objectives of the study; firstly, to explore farmers' views on new technology adoption, to examine what factors that influence a farmer to adopt technology and to determine if there is any form of external assistance that farmers getting towards technology adoption.

The study took on a qualitative case study design using the semi-structured interviews and used to collect data. Farmers indicated that moving with times and adopting new agricultural technology is beneficial. Overall, the findings show that farmers perceive new agricultural technology as advantageous and might have a positive impact on their businesses as can lead to improved profit margin, improved yield, increase in return on investment and reduction of wastage. However, technology adoption is not all advantageous as it could lead to job loss and increased gap of inequality between smallholders and big commercial farmers. Therefore; new agricultural technology adoption needs to benefits the society at large and be more inclusive. It must support the equitable reduction of poverty and hunger and be balanced with preserving existing high-value ecosystems (World Economic Forum 2013).

Yet, new agricultural adoption in UDM remains low due to financial constraints, size of the business and lack of support and assistance. It is clear that technology is not promoted enough and there is a lack of technological personnel in the agricultural sector. Moreover, the study also revealed some traditional methods of farming are essential and can not do away with them.

In conclusion, the researcher believes that the research questions have been answered and, in the process, the aim of the study realised, although the discovery of the study is the tip of the iceberg of the phenomenon.

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APPENDICES

APPENDIX A: Ethical clearance: University of KwaZulu-Natal



14 February 2020

Miss Nomvikelelo Kawula (210508270)
School of Management, IT and Governance
Pietermaritzburg Campus

Dear Ms Kawula,
Protocol reference number: HSSREC/00000222/2019
Project title: Farmers' Perceptions and Attitudes to Technology Adoption in the Ugu District of KwaZulu-Natal, South Africa

Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on 14 February 2020 has now been approved as follows:

- Change in title

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

Best wishes for the successful completion of your research protocol.

Yours faithfully

Dr Shamila Naidoo (Chair)

/ss

Humanities & Social Sciences Research Ethics Committee
Dr Shamila Naidoo (Chair)
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Website: <http://research.ukzn.ac.za/Research-Ethics/>

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

APPENDIX B: Ethical Clearance: Department of Agriculture & Rural Development



agriculture
& rural development

Department:
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

KZN Department of Agriculture & Rural Development
Private Bag X885, Port Shepstone,

Enquiries: N. Bulana

Tel: 039-682 2045

Toll-Free: 0800 000 996

Email: n.bulana@kzndard.gov.za

Website: www.kzndard.gov.za

Dear Miss N. Kawula

PERMISSION TO CONDUCT RESEARCH IN THE KZN DARD –UGU DISTRICT

Your application to conduct research entitled " **IMPACT OF TECHNOLOGY ADOPTION BY UGU AGRICULTURAL FARMERS**" in the KwaZulu Natal Department of Agriculture and Rural Development under Ugu District has been approved. The condition of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. A copy of this letter is submitted to farmers where the intended research and interviews are to be conducted.
3. The researcher must ensure that business proceedings are not interrupted.
4. Please note that farmers are under no obligation to participate or assist you in your investigation.
5. Farmers are not identifiable in any way from the results of the research.
6. The period of investigation is limited to the period from 21 June 2019 to 30 September 2019.
7. Upon completion a brief summary of the findings, recommendations or a full report/ dissertation/thesis must be submitted to the office of the District Director-Ugu District.
8. Please note that your research and interviews will be limited to farmers in Department of Agriculture and Rural Development under Ugu District.


MATHO GWALA
M.P. Gwala
District Director-Ugu District
Date: 20 June 2019

TOGETHER WE HAVE MADE KZN A BETTER PROVINCE TO LIVE IN

APPENDIX C: Research Interview Schedule

Research Interview Schedule Participant

No:

SECTION A: Biographical and demographic details

1. Gender
2. Age group-
3. Marital status
4. Highest qualification
5. Annual turnover
6. Number of years operating the farm

Pseudonym: **Date of Interview:**

Section B: What are the farmers' views on new technology adoption?

1. What are your views on new agricultural technology?
2. Do you prefer to stick to traditional methods of farming or do you like moving with time? Please explain.
3. Does your farm have or use new agricultural technology? Why]
4. Do you perceive new agricultural technology to be a useful tool in performing your activities? Yes or No. And why?
5. In your opinion should Ugu district farmers adopt new agricultural technology? Why?

Section C: What are the factors that influence a farmer to adopt technology?

1. How familiar are you with new agricultural technology developments? Please explain
2. Are neighbouring farmers adopting new agricultural technology (from small to large)? And why?
3. What do you think are advantages of adopting new agricultural technology?
4. What do you think are disadvantages of adopting new agricultural technology?
5. Do you think adopting technology would have an impact in your business or production? How?

Section D: Is there any form of external assistance that farmers are getting towards technology adoption?

1. Does government assist farmers on new agricultural technology adoption? Please explain.
2. Are there any workshops where farmers are shown or taught about new agricultural technology?

Thank You for your participation!

Uhlelo Lwenhlolokhono Yocwaningo Umbambiqhaza

Inombolo:

ISIGAMU A: Imininingwano ngendabuko nenkambo yempilo yomuntu

1. Ubulili bakho.
2. Iminyaka yakho yobudala.
3. Ngabe uganile noma uganiwe?
4. Iziphi iziqu onazo eziphezulu?
5. Ngabe wenza imali engakanani ngonyaka?
6. Unezisebenzi ezingaphi?
7. Unesikhathi esingakanani uphethe leli pulazi?

Igama lokuzakhale:

Usuku lwenhlolokhono:

ISIGAMU B: Ngabe ithini imibono yabalimi ngokuqoka ubuchwepheshe obusha bezolimo?

1. Ububona kanjani ubuchwepheshe obusha bezolimo?
2. Ngame uncamele ukugxila ezindleleni ezindala zezolima noma uthanda ukuhambisana nesikhathi? Chaza kabanzi.
3. Ngabe ipulazi lakho linabo noma liyabusebenzisa yini ubuchwepheshe obusha bezolimo? Ngobani?
4. Ngabe ubuchwepheshe obusha bezolimo ububona njengethulizi eliwusizo ekwenzeni imisebenzi yakho? Yebo noma Cha? Ngobani?

5. Ngokubona kwakho, ngabe kumele abalimi besifunda Ugu baqoke ubuchwepheshe obusha bezolimo? Ngobani?

Section C: Ngabe iziphi izinto ezinomthelela ekutheni abalimi baqoke ubuchwepeshwe obusha bezolimo?

1. Unolwazi olungakani ngobuchwepheshe obusha bezolimo? Chaza kabanzi.
2. Ngabe abalimi abangomakhelwa bayabusebenzisa ubuchwepheshe obusha bezolimo (kusuka kwabancane kuya kwabakhulu)? Ngobani?
- ☐ ☐ Ucabanga ukuthi yini ubuhle bokusebenzisa ubuchwepheshe obusha bezolimo?
4. Ucabanga ukuthi yini ububi bokusebenzisa ubuchwepheshe obusha bezolimo?
5. Ucabanga ukuthi ukusebenzisa ubuchwepheshe obusha bezolimo bungaba namthelela muni ebhizinisini lakho noma kwimikhiqizo? Kanjani?

Section D: Ngabe lukhona usizo abalimi abalutholayo oluvela ngaphandle eligqugquzela ukusetshenziswa kobuchwepheshe obusha bezolimo?

1. Ngabe uhulumeni uyabasiza abalimi ekuqokeni ubuchwepheshe obusha bezolimo? Chaza kabanzi.
2. Ngabe ikhona imihlangano yokucobelelana lapho abalimi bekhonjiswa noma befundiswa ngobuchwepheshe obusha bezolimo? Chaza kabanzi.

Siyabonga ngokubamba kwakho iqhaza!

APPENDIX D: Letter to Department of Agriculture

School of Management, IT and Governance
Corner Golf & Ridge Roads
Scottsville,
3201

Dear Sir/Madam

Permission to conduct research/ Gatekeeper

My Name is Nomvikelelo Kawula. I am a Masters student in the School of Management, Information Technology and Governance at the University of KwaZulu-Natal. I am seeking Department of Agriculture & Rural Development's permission to conduct a research project entitled: **Impact of Technology Adoption by Ugu Agricultural Farmers.**

The aim of this study is to explore the impact of technology adoption by Ugu agricultural farmers. I am seeking the department's permission to conduct the study with farmers in your area. In this study farmers will be interviewed and be audio taped. I wish to ensure you that conducting this research will not interfere with the business proceedings, as the interviews will be scheduled accordingly. The names of farmers or participants will not be disclosed as to protect their identities and for ethical reasons. Participation is voluntary and participants will be free to withdraw from the research anytime. No payment will be made for this study. The data recording and transcript will be locked in a safe place. The information collected will only be used for the research purposes only.

Should you require further information please use the above contact details.

Yours faithfully.

Nomvikelelo Kawula (Miss)

APPENDIX E: Consent Form

CONSENT TO PARTICIPATE

I _____ have been informed about the study entitled **Impact of Technology Adoption by Ugu Agricultural Farmers** by Nomvikelelo Kawula.

I understand the purpose and procedures of the study. I have been given an opportunity to ask questions about the study and have had answers to my satisfaction. I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions or concerns or queries related to the study I understand that I may contact the researcher at: 0789188278.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Additional consent,

I hereby provide consent to:

Audio-record my interview

YES / NO

Date

Signature of Participant

IMVUME YOKUBAMBA IQHAZA

Mina _____ ngazisiwe ngocwaningo olusihloko sithi **Impact of Technology Adoption by Ugu Agricultural Farmers** olwenziwa nguNomvikelelo Kawula.

Ngiyayiqonda inhloso nenkambiso yalolucwaningo, Ngilinikeziwe ithuba lokubuza imibuzo ngalolucwaninga ngathola izimpendulo ezigculisayo. Ngiyavuma ukuthi ukubamba kwami iqhaza kulolucwaningo kuyintando yami futhi ngingahoxa noma ingasiphi isikhathi ngaphandle ngokuphazameseka kwemikomele engifanele.

Uma ngineminye imibuzo ukukhathazeka noma izikhalo ngalolucwaningi ngiyaqonda ukuthi ngingaxhumana nomcwaningi ku-0789188278 .

Uma nginemibuzo noma ukukhathazeka ngamalungelo ami ngengombambiqhaza noma nginokukhathazeka ngenxeye ethile yololucwaningo noma umcwaningi ngingaxhumana ne:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Isivumelwano esingeziwe,

Ngiyavumelana nokuthi:

Uqopha inhlolekhono yami

YEBO/CHA

Ukusayina kombambiqhaza

Usuku